Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead

FINAL HABITAT EXPANSION PLAN

November 2010

Prepared by:
California Department of Water Resources
and Pacific Gas and Electric Company

Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead

Final Habitat Expansion Plan

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Executive Summary

Effective November 20, 2007, Pacific Gas and Electric Company (PG&E) and the California Department of Water Resources (DWR) entered into the Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead (HEA) with the following parties: American Rivers; Arthur Baggett, Jr.[1]; California Department of Fish and Game (DFG); U.S. Department of Agriculture Forest Service; National Marine Fisheries Service (NMFS); U.S. Fish and Wildlife Service (USFWS); and State Water Contractors, Inc. DWR and PG&E (Licensees) formed a Steering Committee to implement the HEA in accordance with its terms and conditions.

The HEA provides a framework for the Licensees to jointly identify, evaluate, and select the most promising and cost-effective action(s) to expand spawning, rearing, and adult holding habitat for spring-run Chinook salmon and steelhead in the Sacramento River Basin. Habitat expansion is to be accomplished through enhancements to existing accessible habitat, improving access to habitat, or other habitat expansion action(s) and is intended to mitigate for any presently unmitigated impacts due to the blockage of passage of all fish species caused by the Feather River Hydroelectric Projects.

The HEA was negotiated to provide an alternative to NMFS exercising its Section 18 authority under the Federal Power Act to require a trap-and-transport (NMFS' preferred terminology for trap-and-haul) program for fish passage past Oroville Dam in the new Federal Energy Regulatory Commission licenses for DWR's Oroville Facilities Project and PG&E's Upper North Fork Feather River and Poe Hydroelectric Projects, all of which are located in the Feather River watershed. NMFS would have otherwise required a trap-and-transport program on the Feather River, which generated concern because of its high estimated cost and low potential for success.

On November 20, 2009, the Licensees submitted the Draft Habitat Expansion Plan (HEP) for review and comment by the HEA signatories and directly affected third parties (other stakeholders), as required by Section 4.1.3 of the HEA. The Draft HEP recommended either of two groups of actions, the Lower Yuba River Actions or the Three-Creek Actions. Many of the comments received on the Draft HEP supported either or both of the groups of recommended actions.

[1] Mr. Baggett, a member of the California State Water Resources Control Board (State Water Board), signed the HEA as a recommendation to the State Water Board. Neither he nor the State Water Board is a Party to the HEA. Mr. Baggett will not be participating in the State Water Board's consideration of any petition for water quality certification for any Habitat Expansion Plan pursuant to Section 401 of the federal Clean Water Act.

However, significant comments were made regarding the interpretation and application of the HEA terms and conditions. NMFS commented that the Draft HEP was deficient and recommended that the Licensees request an extension of 6 months to complete the Final HEP. An extension was requested and granted for the purposes of (1) responding to the comments on the Draft HEP, most significantly to address questions regarding the estimates of the contributions of the recommended actions to the HET and the eligibility of some of the actions; (2) further developing the actions presented in the Draft HEP; and (3) re-evaluating potential actions in the Upper Yuba River based on new information provided by NMFS.

ES1 HEA Goals

The overall goal of the HEA is to expand habitat with the physical characteristics necessary to support spawning, rearing, and adult holding of spring-run Chinook salmon and steelhead in the Sacramento River Basin as a contribution to the conservation and recovery of these species (Section 2.1 of the HEA, "Goal of Agreement").

The specific goal of the HEA is to expand spawning, rearing, and adult holding habitat sufficiently to accommodate an estimated net increase of 2,000–3,000 spring-run Chinook salmon for spawning in the Sacramento River Basin, as compared to the habitat available under any relevant existing requirements or commitments (Section 2.2 of the HEA, "Habitat Expansion Threshold") (i.e., "actions expected to occur in a timeframe comparable to implementation of habitat expansion action[s] under this Agreement" [Section 3.2 of the HEA]). This specific goal is referred to as the *Habitat Expansion Threshold* or *HET*.

ES2 HEA Criteria

The HEA identifies several sets of criteria for identifying, evaluating, recommending, and approving habitat expansion actions, including:

- Evaluation Criteria (Section 4.1.1 of the HEA),
- Selection Criteria (Section 4.1.2 of the HEA), and
- NMFS Approval Criteria (Section 4.2.3 of the HEA).

The Licensees developed working definitions for the various HEA criteria to facilitate utilization of these criteria for selecting actions to be included in the HEP. Criteria definitions drew on the concepts described in the HEA, current scientific literature, recovery plans, and other sources. The Licensees requested feedback on the working definitions from NMFS, the HEA signatories, and other interested stakeholders to support the application of the criteria in a consistent and transparent manner. Chapter 2 of this plan describes the approach used by the Licensees in applying the Evaluation and Selection Criteria to the potential habitat expansion actions and in selecting the recommended actions.

ES3 Contribution to the HET

The Licensees developed a qualitative approach that used empirical data and the professional judgment of the Steering Committee and other experts to estimate the contribution of the recommended actions to the HET. The procedure to estimate contribution to the HET is based on existing scientific knowledge and provides a conservative estimate of habitat potential associated with the recommended actions. While developing this methodology, the Licensees took into account comments received through consultation with NMFS, other HEA signatories, and an independent expert (Dr. Gregory B. Pasternack).

Estimating contribution to the HET involved two steps. First, the *quantity* of habitat for spawning by spring-run Chinook salmon was estimated based on the extent of habitat expansion and estimates of Chinook salmon spawning densities in the Yuba River. Second, the *quality* of the expanded habitat for spring-run Chinook salmon was evaluated. In this step, the estimated quantity of expanded habitat was reduced to reflect existing habitat limitations across life stages of spring-run Chinook salmon not addressed by the recommended actions. This adjustment resulted in a more conservative estimate of contribution to the HET. Appendix N in the Final HEP contains a detailed description of the procedure and its results.

As stated in Section 6.1 of the HEA, the Licensees are obligated to provide habitat but are not obligated to guarantee or verify fish production or habitat utilization. The estimated contribution of the recommended actions to the HET represents an index of the increase in quality and quantity of habitat for spring-run Chinook salmon. The Licensees assumed that actions benefiting spring-run Chinook salmon would also benefit steelhead, and no explicit evaluation of the actions was made with regard to their benefits for steelhead. Actual contribution to the HET resulting from the actions could differ due to a variety of factors beyond the influence of the HEA.

ES4 Recommended Actions

The recommended actions consist of the following three components, collectively referred to as the Lower Yuba River Actions:

- expansion of spawning habitat at Sinoro Bar in the Englebright Dam Reach above the Deer Creek confluence;
- expansion of spawning habitat at Narrows Gateway in the Narrows Reach below the Deer Creek confluence; and

- the option of planning for and installing a seasonally operated segregation weir on the Yuba River below the outlet of the Narrows Pool to segregate spring-run and fall-run Chinook salmon, if deemed necessary by the resource agencies (NMFS, USFWS, and DFG).

The recommended actions have been modified since the Draft HEP based on comments and additional information. The Licensees removed the Three-Creek Actions from consideration in the Final HEP based on anticipated full or partial funding from other sources. Should the status of anticipated funding change before approval of the Final HEP by NMFS, the Licensees may reconsider recommending these actions for implementation under the HEA.

The Licensees re-evaluated potential actions in the Upper Yuba River based on additional information provided by NMFS. The Licensees determined that these actions present technical, legal, social, and logistical hurdles that preclude their completion in a timely manner. Therefore, the Licensees could not recommend the Upper Yuba River Actions for consideration under the HEA at this time.

The Lower Yuba River Actions achieve the goals of the HEA by expanding habitat in the Yuba River below Englebright Dam to support spawning, rearing, and adult holding of spring-run Chinook salmon and steelhead. This group of actions is estimated to expand the habitat sufficiently to exceed the HET. The actions rate favorably on a number of HEA criteria, including supporting segregation between fall-run and spring-run Chinook salmon and having a high potential to establish another independent, self-sustaining population of spring-run Chinook salmon in the Sacramento River Basin.

The Lower Yuba River Actions would significantly contribute to the ongoing efforts of the Licensees, resource agencies, non-governmental organizations, and landowners to create an area that could be managed for spring-run Chinook salmon in the upper portion of the Lower Yuba River—from Englebright Dam down to the outlet of Narrows Pool, a distance of approximately 2 miles. The recommended actions have a high degree of local and political support and, as a whole, no known opposition.

The Licensees concluded that expansion of habitat as defined in the HEA was best achieved through reliance on natural hydrologic-geomorphic processes whenever possible and that these natural processes were the most likely means to achieve needed habitat quantity and quality that could be sustained over time. The HEA was drafted as an alternative to a trap-and-transport program on the Feather River. Trap and transport is based entirely on artificial means to circumvent migrational barriers and is not ecologically sustainable without significant human intervention. A significant investment of time and funds to cover development, capital, operation and maintenance costs would be required for a successful program.

The recommended actions in the Lower Yuba River benefit to a large degree from hydrologic-geomorphic processes that are largely naturally occurring to provide long-term stability of features conducive to spring-run Chinook salmon and steelhead. The Lower Yuba River Actions also offer benefits that can be sustained in the face of climate change, given the water management regime in effect in the Lower Yuba River.

Table ES-1 summarizes the attributes assigned to the Lower Yuba River Actions by the Licensees, as well as an evaluation of these actions based on applying the NMFS Approval Criteria specified in the HEA. Approval of the Final HEP will be determined by NMFS, after input from the HEA signatories and other stakeholders, using the NMFS Approval Criteria.

Table ES-1. Application of NMFS Approval Criteria to Lower Yuba River Habitat Expansion Actions (Lower Yuba River Actions)

Action Attributes	Lower Yuba River Actions
Estimated contribution to the Habitat Expansion Threshold[a]	4,182 adult spring-run Chinook salmon[b]
Estimated cost	~$23.4 million[c]
NMFS Approval Criteria Evaluation[d]	
Estimated to meet the Habitat Expansion Threshold?	Yes
Assures necessary testing, operations, and maintenance?	Yes
Supports establishing geographically separate self-sustaining population?[e]	Yes
Supports segregating spring-run from fall-run?[e, f]	Yes
Eligible?	Yes
Expected to be implemented in a reasonable period of time?	Yes

Note: The Lower Yuba River Habitat Expansion Actions (Lower Yuba River Actions) consist of expanding spawning habitat at Sinoro Bar and Narrows Gateway in the Lower Yuba River and the option of planning for and installing a seasonally operated segregation weir on the Yuba River below the outlet of the Narrows Pool, if deemed necessary by the resource agencies (National Marine Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Game).

[a] This value reflects the potential number of adult fish that can be supported by habitat expansion. Actual results of the actions could differ due to a variety of factors both inside and outside the Yuba River.

[b] This estimated contribution to the Habitat Expansion Threshold (HET) was calculated using the methodology described in Appendix N of the Final HEP, which yielded a specific number. The estimated contribution of the recommended actions to the HET represents an index of the increase in quality and quantity of habitat for spring-run Chinook salmon. The calculation is not meant to imply a degree of precision.

[c] A 20-percent contingency was added to the estimate due to uncertainties in available cost information.

[d] Evaluation applies to the group of three actions, not necessarily each of the individual actions.

[e] Criterion not required for approval.

[f] Segregation may occur naturally or, if deemed necessary by the resource agencies, with installation of an optional segregation weir.

ES4.1 Eligibility

The HEA allows for a variety of actions to be considered eligible for inclusion in the HEP. Actions identified in other venues, including unfunded actions, are acceptable for consideration, provided that implementation results in a net expansion of habitat over any Existing Requirements and Commitments. Existing Requirements and Commitments are defined in Section 3.2 of the HEA and may include, but are not limited to, legal or regulatory requirements subject to a binding order, action by an agency or court, relicensing proceedings, or existing final biological opinions.

The issue of eligibility for the spawning habitat expansion action at Sinoro Bar, as presented in the Draft HEP, was raised relative to a gravel augmentation program required of the U.S. Army Corps of Engineers (Corps). On November 21, 2007, NMFS issued the *Biological Opinion for the U.S. Army Corps of Engineers' Operation of Englebright and Daguerre Point Dams on the Yuba River, California* (2007 BiOp) to address the effects of operations on spring-run Chinook salmon (and other species). In the 2007 BiOp, NMFS issued an incidental take statement with a number of Reasonable and Prudent Measures, including the following:

1. *The Corps shall develop and implement a long-term gravel augmentation program to restore quality spawning habitat below Englebright Dam.*

   A) *The Corps shall utilize the information obtained from the pilot gravel injection project to develop and commence implementation of a long-term gravel augmentation program within three years of the issuance of this biological opinion.*

The large-scale spawning habitat expansion actions proposed as part of the Lower Yuba River Actions are distinct and separate from the gravel augmentation program required of the Corps by the NMFS 2007 BiOp. The two sets of actions are complementary. Each set of actions would independently provide expanded spawning habitat, and the Corps program could help to sustain the HEP actions over time through periodic introduction of gravel to Sinoro Bar and Narrows Gateway. Thus, the spawning habitat expansion actions proposed below Englebright Dam in the Final HEP are eligible under the terms and conditions of the HEA.

ES5 Outreach

Stakeholder input and public support are critical to successful implementation of the actions proposed under the HEP. Throughout development of the Draft HEP and the Final HEP, the Licensees have worked closely with the signatories to the HEA and sought input from local stakeholders to recommend actions that could be approved for implementation under the HEA. Appendix C of the Final HEP details the various outreach activities conducted over the past 3 years. The

Licensees plan to continue outreach efforts until a Final HEP is approved for implementation, and then to work with the appropriate stakeholders in order to affect the success of the HEP.

ES6 Summary

In summary, the Lower Yuba River Actions represent an excellent opportunity to meet the goals, terms, and conditions of the HEA. They provide a significant, timely, and much needed contribution to the conservation and recovery of spring-run Chinook salmon with ancillary benefits to steelhead. Upon approval, the Licensees are confident that, with the support of the HEA signatories and other stakeholders, the Lower Yuba River Actions can be implemented within a reasonable time frame (i.e., within approximately 5 years), providing an almost immediate benefit to spring-run Chinook salmon.

Furthermore, the Lower Yuba River Actions recommended by the Licensees are fully compatible with an Upper Yuba River reintroduction program proposed by NMFS and could serve as a springboard from which to launch such actions in the future. The Lower Yuba River Actions represent a sizeable contribution to development of a Yuba River spring-run Chinook salmon population that is fully supportive of goals in the *Public Draft Recovery Plan for Central Valley Salmon and Steelhead* (NMFS 2009).

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Contents

Appendices

Tables

Page

Figures

Page

Acronyms and Abbreviations

2007 BiOp	*Biological Opinion for the U.S. Army Corps of Engineers' Operation of Englebright and Daguerre Point Dams on the Yuba River, California* (NMFS 2007)
AFRP	Anadromous Fish Restoration Program
AMP	adaptive management plan
Background Report	Background Report on the Status of Spring-Run Chinook Salmon and Central Valley Steelhead in the Sacramento River Basin (DWR 2009)
CalTrout	California Trout
Co-Manager Review Draft Recovery Plan	*Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead Co-Manager Review Draft*
Corps	U.S. Army Corps of Engineers
Delta	Sacramento River-San Joaquin River Delta
DEM	digital elevation model
DFG	California Department of Fish and Game
DPS	distinct population segment
DWR	California Department of Water Resources
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FERC	Federal Energy Regulatory Commission
Forest Service	U.S. Department of Agriculture Forest Service
FPA	Federal Power Act
FPC	Federal Power Commission
GAIP	Gravel/Cobble Augmentation Implementation Plan
GIS	geographic information system
HEA	Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead
HEP	Habitat Expansion Plan
HET	Habitat Expansion Threshold

LFRHIP	Lower Feather River Habitat Improvement Plan
Licensees	(California Department of Water Resources and Pacific Gas and Electric Company)
Lower Yuba River Actions	Lower Yuba River Habitat Expansion Actions
m	meters
m^2	square meters
m^3	cubic meters
MAF	million acre-feet
NGO	non-government organization
NMFS	National Marine Fisheries Service
O&M	operations and maintenance
Oroville Facilities	Oroville Facilities, FERC Project No. 2100
Oroville Settlement Agreement	Settlement Agreement for Licensing of the Oroville Facilities
PG&E	Pacific Gas and Electric Company
Poe	Poe Hydroelectric Project, FERC Project No. 2107
Public Draft Recovery Plan	*Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead* (NMFS 2009)
RM	river mile
RMT	Yuba Accord River Management Team
Rock Creek-Cresta	Rock Creek-Cresta Hydroelectric Project, FERC Project No. 1962
SAA	Streambed Alteration Agreement
State Water Board	State Water Resources Control Board
SWP	State Water Project
SYRCL	South Yuba River Citizens League
Three-Creek Actions	Battle Creek, Big Chico Creek, and Antelope Creek Habitat Expansion Actions
TRT	Technical Recovery Team
Upper North Fork Feather River	Upper North Fork Feather River Hydroelectric Project, FERC Project No. 2105
USFWS	U.S. Fish and Wildlife Service
VSP	Viable Salmonid Population
YCWA	Yuba County Water Agency
Yuba Accord	Lower Yuba River Accord

Acknowledgments

The Licensees are pleased to present this Final Habitat Expansion Plan (HEP) to the National Marine Fisheries Service (NMFS) for review and approval as required by the Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead (HEA). NMFS will solicit comments on this Final HEP prior to considering their approval.

Throughout this document, reference is made to the Steering Committee as defined by the HEA Coordination Agreement between the Licensees party to the HEA, the California Department of Water Resources (DWR) and Pacific Gas and Electric Company (PG&E). The Steering Committee consists of two representatives each from DWR and PG&E. The Steering Committee members are:

- Liv K. Imset, Senior License Coordinator, PG&E, Power Generation
- Chris Wilkinson, Chief, Ecological Studies Branch, DWR, Division of Environmental Services
- Paul Kubicek, Senior Consulting Scientist – Aquatic Biologist, PG&E, Land & Environmental Management
- Heidi Rooks, Chief, Office of Environmental Compliance, DWR, Division of Environmental Services (through April 2010)

For the purposes of the HEA, the Steering Committee represents the views of the Licensees.

The Steering Committee solicited and received input from many additional DWR and PG&E employees during the process, including, but not limited to, Gene Geary (Senior Aquatic Biologist, PG&E), Curtis Steitz (Senior Aquatic Biologist, PG&E), and Tom Studley (Senior Consulting Scientist – Aquatic Biologist, PG&E). Their input was critical to the success of this effort.

The Steering Committee also retained a consultant, ICF International, to aid in the implementation activities and development of the Final HEP. Key members of the ICF International team included:

- Colleen Lingappaiah, Project Manager – Water Resources, ICF International
- Chip McConnaha, Ph.D., Senior Fisheries Ecologist, ICF International
- Joan Lynn, Technical Editor, egret, inc. for ICF International

These individuals participated in most of the Steering Committee meetings and were instrumental in completing the Final HEP. They also received input and support from many of their employees, including Marin Greenwood, Ph.D. (Certified Fisheries Professional, ICF International), Bill Mitchell (Senior Fisheries Biologist, ICF International), and Jeff Peters (Geomorphologist/ Restoration Specialist, ICF International).

The Steering Committee also formed a core Technical Team of professional biologists including the following individuals:

- Paul Kubicek
- Chris Wilkinson
- Chip McConnaha
- Steve Brumbaugh, Environmental Scientist, Habitat Restoration Section, Department of Water Resources, Division of Environmental Services
- Erin Chappell, Environmental Scientist, Habitat Restoration Section, Department of Water Resources, Division of Environmental Services (through November 2009)

The Steering Committee Technical Team carried out the collection of potential actions to be considered, application of the HEA criteria, and development and application of the HET contribution procedure. The Technical Team also participated in most of the Steering Committee meetings and consulted with representatives of the signatories, stakeholder groups, and other technical professionals as available throughout the process.

The Licensees would like to express their appreciation to the HEA signatories, stakeholder groups, and other technical professionals who commented on the Draft HEP, as well as provided critical input used during the entire HEA process and development of the Final HEP. Many individuals stepped forward to participate in the HEA process and responded to requests for information. The Licensees look forward to continuing to work with these individuals and organizations to ultimately achieve a successful outcome of the HEA.

Lastly, the Steering Committee would like to thank the employees of the Fairfield-Suisun Sewer District who provided both hospitality and regular meeting space for the past 3 years.

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Chapter 1
Introduction

Effective November 20, 2007, Pacific Gas and Electric Company (PG&E) and the California Department of Water Resources (DWR) entered into the Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead (HEA) with the following parties: American Rivers, Arthur G. Baggett, Jr.[1]; California Department of Fish and Game (DFG); U.S. Department of Agriculture Forest Service (Forest Service); National Marine Fisheries Service (NMFS); U.S. Fish and Wildlife Service (USFWS); and State Water Contractors, Inc. A copy of the HEA is available on the HEA website: www.sac-basin-hea.com. DWR and PG&E (the Licensees) formed a Steering Committee, comprised of two representatives each, to execute the HEA in accordance with its terms and conditions.

The HEA allows DWR and PG&E 2 years to jointly identify, evaluate, and select the most promising and cost-effective action(s) to expand spawning, rearing, and adult holding habitat for spring-run Chinook salmon and steelhead in the Sacramento River Basin. These actions are proposed as an alternative to NMFS exercising its Section 18 authority under the Federal Power Act (FPA) to require a trap-and-transport (NMFS' preferred terminology for trap-and-haul) fish passage prescription over Oroville Dam in the new Federal Energy Regulatory Commission (FERC) licenses for DWR's Oroville Facilities Project and PG&E's Upper North Fork Feather River and Poe Hydroelectric Projects, all of which are located in the Feather River system and are referred to collectively as the Feather River Hydroelectric Projects. NMFS has reserved the right to exercise its Section 18 authority in the event that one or both of the Licensees withdraws from or materially breaches the HEA (FERC 2006).

This Final Habitat Expansion Plan (HEP) includes the following chapters:

- Chapter 1 provides background on the HEA and its goals.
- Chapter 2 describes how the HEA has been carried out to date and how the HEP was developed.
- Chapter 3 presents the Licensees' recommended actions in detail, including their objectives and benefits, estimated cost, proposed implementation schedule, and the implementation responsibilities of each Licensee.

[1] Mr. Baggett, a member of the California State Water Resources Control Board (State Water Board), signed the HEA as a recommendation to the State Water Board. Neither he nor the State Water Board is a Party to the HEA. Mr. Baggett will not be participating in the State Water Board's consideration of any petition for water quality certification for any Habitat Expansion Plan pursuant to Section 401 of the federal Clean Water Act.

- Chapter 4 discusses the rationale for selecting the HEP recommended actions, including their contribution to the Habitat Expansion Threshold (HET), and eligibility.
- Chapter 5 explains the remaining phases associated with the HEA.
- Chapter 6 identifies the sources cited in the document.

Various technical and informational appendices include, among others, a timeline for implementation of the HEA, a description of the outreach activities taken by the Licensees to keep the HEA signatories and directly affected and responsive third parties (herein referred to as *other stakeholders*) informed about the HEA process, an explanation of how potential habitat expansion actions were scored using the HEA criteria, and a discussion of the methodology used to estimate contribution of an action to the HET.

1.1 Background of the HEA

1.1.1 FERC Relicensing for Feather River Projects

1.1.1.1 DWR Relicensing

DWR constructed and operates the Oroville Facilities, FERC Project No. 2100 (Oroville Facilities), on the Lower Feather River. The Oroville Facilities were developed in 1967 as part of the California State Water Project (SWP), a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. Also in 1967, the Feather River Hatchery was opened as compensation for habitat loss in the reaches above Lake Oroville Dam (Sommer et al. 2001). The SWP makes deliveries of supplemental water to two-thirds of California’s population and over 750,000 acres of agricultural lands. Lake Oroville Dam is also operated to provide power generation, improve water quality in the Sacramento River-San Joaquin River Delta (Delta), manage Feather River floodwaters, provide recreation, and enhance habitat for fish and wildlife.

The Oroville Facilities are operated under a license originally issued by the Federal Power Commission (FPC [the FPC was succeeded by FERC]) on February 11, 1957, for a term of 50 years. Under the requirements of the FPA and FERC regulations, DWR filed a timely application for a new license on January 26, 2005. The original license expired on January 31, 2007; however, the Oroville Facilities have been operated since then under annual licenses pursuant to Section 15 of the FPA. The application for the new license is currently pending before FERC.

DWR is seeking a new license for the Oroville Facilities through the Alternative Licensing Procedure (DWR 2008), as outlined in the Federal Register (FERC 2005). As part of this process, the Settlement Agreement for Licensing of the Oroville Facilities (Oroville Settlement Agreement) was developed (DWR 2006). The Oroville Settlement Agreement describes a number of habitat restoration activities in the Lower Feather River. These activities, as part of a comprehensive Lower Feather River Habitat Improvement Plan (LFRHIP) (Article A101), include the following:

- **Gravel Supplementation and Improvement Program (Article A102).** This program requires that a gravel management plan be developed in consultation with the Ecological Committee, established under the LFRHIP, that may include gravel supplementation or riffle rehabilitation within the ordinary high water mark of the Lower Feather River.
- **Channel Improvement Program (Article A103).** This program requires the improvement of Moe's Ditch and Hatchery Ditch in the Low Flow Channel of the Lower Feather River, along with construction of no less than 2,460 feet of new side channel riffle/glide complexes.
- **Structural Habitat Supplementation and Improvement Program (Article A104).** This program is intended to provide additional rearing habitat within the Lower Feather River by addition of structural complexity. This may be done through the addition of large woody debris, boulders, and other objects. A minimum of two pieces per riffle will be included in the Low Flow Channel and High Flow Channel, from River Mile 54.2 to River Mile 67.2, making a total of 50–500 pieces.
- **Fish Weir Program (Article A105).** This program includes two phases. Phase 1 is the development of a monitoring weir just upstream of Thermalito Afterbay Outlet. Phase 2 involves construction of a segregation weir, equipped with an egg-taking station, if appropriate.
- **Riparian and Floodplain Improvement Program (Article A106).** This program requires development of a plan to enhance and reconnect floodplain habitats within the Oroville Wildlife Area. This plan must also address the effect of flood/pulse flows and will be re-evaluated within 15 years.
- **Feather River Fish Hatchery Improvement Program (Article A107).** This program sets specific targets for hatchery temperatures, requires development of a hatchery management program (including a Hatchery and Genetics Management Plan), potential installation of a water supply disinfection system, and annual hatchery operations and maintenance[2].
- **Instream Flow and Temperature Improvement for Anadromous Fish (Article A108).** This requirement includes higher minimum flows and lower temperatures than were being met previously in the Lower Feather River in accordance with the Agreement Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish and Wildlife (1983).

All timelines related to these programs begin once a new license is issued. For further information on these programs, refer to Appendix A of the Oroville Settlement Agreement (DWR 2006).

[2] The Draft Hatchery and Genetics Management Plan includes a proposed production goal of up to 3 million eggs, with a release of 2 million spring-run Chinook salmon smolts. The current production goal for steelhead is up to 1 million eggs, with a release of 400,000 yearlings (DWR 2007).

1.1.1.2 PG&E Relicensing

PG&E owns and operates the Poe Hydroelectric Project, FERC Project No. 2107 (Poe), on the North Fork Feather River under a license issued by the FPC on October 26, 1953, for a term of 50 years. Under the requirements of the FPA and FERC regulations, PG&E filed an application for a new license for Poe on October 2, 2001. This application is currently pending before FERC. The original license for Poe expired on September 30, 2003; since that time, the project has been operating under annual licenses pursuant to Section 15 of the FPA.

PG&E owns and operates the Upper North Fork Feather River Hydroelectric Project, FERC Project No. 2105 (Upper North Fork Feather River), under a license issued by the FPC on January 24, 1955, for a term of 50 years. Under the requirements of the FPA and FERC regulations, PG&E filed an application for a new license for the Upper North Fork Feather River on October 23, 2002. This application is currently pending before FERC. The original license for the Upper North Fork Feather River expired on October 31, 2004; since that time, the project has been operating under annual licenses pursuant to Section 15 of the FPA.

PG&E also owns and operates a third project on the North Fork Feather River, the Rock Creek-Cresta Hydroelectric Project, FERC Project No. 1962 (Rock Creek-Cresta), under a license issued by FERC on October 24, 2001, which expires on September 30, 2034.

1.1.2 HEA Negotiated as an Alternative to Prescribed Fish Passage

Section 18 of the FPA gives NMFS the authority to require fishways or fish passage. NMFS exercised this authority in the FERC relicensing proceedings for the Oroville Facilities and Upper North Fork Feather River for DWR and PG&E, respectively. NMFS stated that a trap-and-transport program for spring-run Chinook salmon in the Feather River system would meet its fish passage objectives. The trap-and-transport program would involve trapping adult fish below the Lake Oroville Dam, transporting them approximately 60 miles upstream by tanker truck, and placing them in the Upper North Fork Feather River. The program also would require collecting downstream migrants in the Upper North Fork Feather River and transporting them back downstream below Oroville Dam. NMFS has filed modified or amended modified prescriptions in the Oroville Facilities, Upper North Fork Feather River, and Poe licensing proceedings to reserve its authority to prescribe fishways as provided in the HEA.

The NMFS proposed trap-and-transport program on the Feather River generated concern because of its high estimated cost and low potential for success. Ultimately, DWR and PG&E, together with other participants in the relicensing proceedings, came together to discuss alternatives to trap and transport for expanding anadromous fish habitat. In proceedings separate from but related to the Oroville Settlement Agreement, DWR, PG&E, NMFS, USFWS, DFG, the Forest Service, American Rivers, Arthur Baggett, Jr. and the State Water Contractors negotiated the HEA to establish an approach for identifying, evaluating, selecting, and implementing the most promising and cost-effective action(s) to expand spawning, rearing, and adult holding habitat for spring-run Chinook salmon in the Sacramento River Basin (DWR 2007). This was an alternative to NMFS, other resource agencies, or other parties seeking fish passage on the Feather River or its tributaries in the relicensing of the Oroville Facilities, Poe, and Upper North Fork Feather River, or through amendment of the license for Rock Creek-Cresta[3].

As stated in Section 1.2 (a) of the HEA, the HEA fully mitigates for any presently unmitigated impacts on all fish species due to the blockage of fish passage caused by the Feather River Hydroelectric Projects. The HEA, however, is not intended to mitigate for *all* habitat losses in the Feather River watershed. Other mitigation measures to compensate for loss of habitat include those outlined in Appendix A of the Settlement Agreement for Licensing of Oroville Facilities (see above) and the continued operation of the Feather River Fish Hatchery.

Also stated in Section 1.2 (b) of the HEA, the HEA:

> "…resolves among the Parties during the term of this Agreement issues related to regulatory conditions for Fish Passage associated with or related to any of the Feather River Hydroelectric Projects in excess of the action(s) contemplated under this Agreement, including, but not limited to, issues (related to Fish Passage) arising under exercise of authority under the ESA (subject to Section 13 of this Agreement), California Endangered Species Act (subject to Section 13 of this Agreement), Sections 18, 4(e), 10(a), and 10(j) of the FPA, and Section 401 of the Clean Water Act, provided the Licensees are complying with their obligations under this Agreement."

1.2 Goal of the HEA

As stated in Section 2.1 of the HEA, "Goal of Agreement":

> The overall goal of this Agreement is to expand the amount of habitat with physical characteristics necessary to support spawning, rearing and adult holding of Spring-Run and Steelhead in the Sacramento River Basin as a contribution to the conservation and recovery of these species. The expansion shall be accomplished through enhancements to existing accessible habitat, improving access to habitat, or other action(s) and … is intended to fully mitigate for any presently unmitigated impacts due to the blockage of Fish Passage of all fish species caused by the Feather River Hydroelectric Projects.

[3] See Recital G of the HEA.

As stated in Section 2.2 of the HEA, “Habitat Expansion Threshold”:

> The specific goal of the Agreement is to expand spawning, rearing and adult holding habitat sufficiently to accommodate an estimated net increase of 2,000 to 3,000 Spring-Run for spawning (‘Habitat Expansion Threshold’) in the Sacramento River Basin, as compared to the habitat available under any relevant Existing Requirements or Commitments. The Habitat Expansion Threshold is focused on Spring-Run as the priority species, as expansion of habitat for Spring-Run typically accommodates Steelhead as well.

Existing requirements or commitments are defined in Section 3.2 of the HEA as “actions expected to occur in a timeframe comparable to implementation of habitat expansion action[s] under this Agreement.”

1.3 Potential Habitat Expansion Actions

Section 3.1 of the HEA, “Scope of Eligible Habitat Expansion Actions,” states that potential actions to expand spawning, rearing, and adult holding habitat for spring-run Chinook salmon and steelhead will be identified, evaluated, selected, and implemented according to Section 4 of the HEA, “Planning and Implementation of Habitat Expansion Action(s).” According to the HEA, habitat expansion actions may include, among other things:

- dam removals,
- dam re-operation,
- creation or enhancement of fishways,
- water temperature/flow improvements, or
- other physical habitat enhancements.

Habitat expansion actions should ensure future operation and maintenance if such operation and maintenance is needed after initial implementation. Habitat expansion actions also may include functional start-up testing, if needed, for technical validation of the action’s design (e.g., that a fish ladder operates as designed) but not long-term monitoring of species utilization or benefit.

Actions identified in other venues, including unfunded actions, are acceptable for consideration, provided that implementation of the HEA results in a net expansion of habitat over any existing requirements and commitments (as defined in Section 3.2 of the HEA), whether by the Licensees or others.

The Licensees identified, evaluated, and recommended potential habitat expansion actions using criteria identified in the HEA, including:

- seventeen non-prioritized Evaluation Criteria (Section 4.1.1 of the HEA) to screen potential habitat expansion actions and develop a preliminary list of viable actions, and

- four non-prioritized Selection Criteria (Section 4.1.2 of the HEA) to select recommended habitat expansion actions for implementation.

The approach taken by the Licensees to apply the Evaluation and Selection Criteria to the potential habitat expansion actions and select the recommended actions is described in Chapter 2, "Development of the Habitat Expansion Plan."

NMFS will consider six Approval Criteria (Section 4.2.3 of the HEA), along with comments from the HEA signatories and other stakeholders, and any other relevant information, when deciding whether to approve the recommendations made by the Licensees.

1.4 Timeline

This Final HEP is being submitted to NMFS for approval. The Licensees are also distributing the Final HEP to the HEA signatories, the State Water Board, and other stakeholders for their information. Before approving the Final HEP, NMFS will commence a 60-day consultation process with the HEA signatories, State Water Board, and other stakeholders.

The proposed approval and implementation schedule for the habitat expansion actions recommended by the Licensees is presented in Appendix A. The remaining phases associated with implementing the HEA are described further in Chapter 5.

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Chapter 2
Development of the Habitat Expansion Plan

This section provides an overview of the steps taken to develop the HEP according to the terms and conditions required by the HEA. It describes the development of potential habitat expansion actions, application of the HEA Evaluation and Selection Criteria to potential actions, actions recommended in the Draft HEP, and development of the Final HEP.

2.1 Developing Potential Habitat Expansion Actions

The first step in developing a list of habitat expansion actions that could potentially be considered for the HEP included compiling a comprehensive List of Potential Actions. The Steering Committee created three consecutive lists of actions during this process. These lists included the:

- Draft Working List of Potential Actions,
- Working List of Potential Actions, and
- Short List of Potential Actions.

The process for developing each list is described below.

2.1.1 Draft Working List of Potential Actions

The Steering Committee initially compiled a Draft Working List of Potential Actions to be considered for inclusion in the HEP (Appendix B1). This list was primarily developed from:

- the results of a separate PG&E/California Trout (CalTrout) effort to develop a list of prioritized actions that could contribute to recovery of Central Valley salmon and steelhead,
- recovery actions identified in the NMFS *Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead Co-Manager Review Draft* (Co-Manager Review Draft Recovery Plan), and

- input received from other parties to the HEA and stakeholder groups who submitted completed HEA questionnaires and contact information/comment sheets to the Steering Committee.

Other tools used during the development of the Draft Working List of Potential Actions include a geographic information system (GIS) database, which compiled data for various watersheds in the Upper Sacramento River Basin (e.g., dams and diversions, critical habitat, current distribution, etc.), and a report providing background information on the status of spring-run Chinook salmon and steelhead populations throughout watersheds in the Sacramento River Basin. These tools, which assisted the Steering Committee in the identification, evaluation, and selection of potential habitat expansion actions, are described in the following sections.

2.1.1.1 Prioritized Actions Contributing to Salmon and Steelhead Recovery

In late 2005, PG&E and CalTrout initiated the Prioritized Actions Contributing to Salmon and Steelhead Recovery Project that involved participation of a broad set of private and public stakeholders, including NMFS, USFWS, DFG, and the Association of California Water Agencies. The purpose of this collaborative effort was to develop a prioritized list of recovery opportunities for Central Valley salmon and steelhead listed under the federal Endangered Species Act (ESA) that is independent of, and complementary to, ongoing recovery efforts undertaken by federal and state agencies. More than 200 potential recovery actions were identified and evaluated as part of this process. In addition, a prioritization tool was developed and applied to many of the actions; NMFS has indicated interest in exploring the potential application of this prioritization tool in association with the Central Valley Salmon and Steelhead Recovery Plan. The Steering Committee used the list produced by the PG&E/CalTrout project as the starting point for developing a preliminary list of potential actions.

2.1.1.2 NMFS Co-Manager Review Draft Recovery Plan

NMFS is currently developing a recovery plan for listed Central Valley salmon and steelhead. NMFS has stated that implementation of the recovery plan for the Sacramento River winter-run Chinook salmon evolutionarily significant unit (ESU), Central Valley spring-run Chinook salmon ESU, and Central Valley steelhead distinct population segment (DPS) is vital to the continued persistence and recovery of these species. Recovery plans are developed to serve as a guideline for achieving ESA recovery goals by describing the steps that must be taken to achieve viable ESUs/DPSs.

NMFS issued the Co-Manager Review Draft Recovery Plan in May 2008. Although the plan was still in development, the Steering Committee obtained permission to use the Co-Manager Review Draft in order to identify additional recovery actions for spring-run Chinook salmon and steelhead. The Steering Committee integrated actions in the Co-Manager Review Draft Recovery Plan into the Draft Working List of Potential Actions (Appendix B1).

In October 2009, NMFS issued the *Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring- Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead* (Public Draft Recovery Plan). Actions recommended in the Draft HEP were referenced against that document.

2.1.1.3 Signatory and Stakeholder Input

As part of HEA outreach activities (described in Appendix C), the Steering Committee prepared a questionnaire to obtain information on potential habitat expansion actions from the signatories to the HEA and other stakeholders. The questionnaire was developed to solicit ideas for actions that could contribute to the expansion of anadromous fish habitat in the Sacramento River Basin and be considered for inclusion in the HEP. The type of information requested in the questionnaire assisted the Steering Committee in determining the potential of an action to meet the HEA criteria and includes:

- contact information for the action,
- description of the action,
- species-limiting factors,
- environmental objectives (i.e., how the action is intended to change the environment in order to achieve the biological objectives),
- biological objectives (i.e., the anticipated biological response from the action),
- cost,
- schedule,
- feasibility,
- project support, and
- supporting documents.

A series of meetings was held to explain the questionnaire to signatories and stakeholders (see Appendix C), and the questionnaire and comment form were posted on the HEA website along with detailed instructions on their completion and submittal. Questionnaires and comment forms completed by the HEA signatories were submitted to the Steering Committee by February 27, 2009. Questionnaires completed by other stakeholders were submitted to the Steering Committee by April 30, 2009. The Steering Committee received 22 completed questionnaires prior to issuance of the Draft HEP (Appendix D).

2.1.1.4 Additional Tools

GIS Database for Potential Actions

The Steering Committee requested DWR staff to develop a GIS database compiling appropriate data for various watersheds in the Upper Sacramento River Basin, to support the identification and evaluation of potential habitat expansion actions. The GIS database is focused on the following watersheds: Clear, Cow, Bear, Cottonwood, Beegum, Battle, Antelope, Thomes, Mill, Deer, Butte, Stoney, and Big Chico Creeks and the Sacramento, Feather, Yuba, and American Rivers. The database was developed for internal use to assist with selection of potential habitat expansion actions.

The types of data that were incorporated into the GIS database include base layer information (e.g., roads, towns, cities, public lands, and county boundaries); hydrologic features (e.g., rivers, streams, lakes, ponds, and reservoirs); watershed boundaries; digital elevation models (DEMs); 1:24K U.S. Geological Survey topographic maps; aerial photographs (NAIP); satellite imagery; land use data; current and historical distribution of anadromous fish; designated critical habitat for spring-run Chinook salmon and Central Valley steelhead; dams, water diversions, and other potential fish passage barriers (PAD); ongoing and completed watershed restoration projects; and other available data on salmonid habitat.

Background Report

The Steering Committee requested DWR staff to prepare a *Background Report on the Status of Spring-Run Chinook Salmon and Central Valley Steelhead in the Sacramento River Basin* (Background Report) (DWR 2009) (Appendix E). The purpose of this report was to provide background information on the status of spring-run Chinook salmon and Central Valley steelhead populations throughout watersheds in the Sacramento River Basin in order to support the Steering Committee in the identification, evaluation, and selection of potential habitat expansion actions.

The report included two main sections, addressing: (1) the general life history of spring-run Chinook salmon and steelhead in the Sacramento River Basin; and (2) the status of populations in individual tributaries of the Upper Sacramento River Basin.

The first part of the report covering general life history includes information about:

- basic life history characteristics of the species,
- their historical and current distribution, and
- results of the Population Viability Assessment completed in support of NMFS recovery planning for the species.

The second part of the report addresses the following tributary watersheds: Clear, Cow, Bear, Cottonwood, Beegum, Battle, Antelope, Thomes, Mill, Deer, Butte, Stoney, and Big Chico Creeks and the Yuba and American Rivers. Specific topics that are addressed for each tributary watershed include:

- an evaluation of available watershed assessment data, including potential spawning, summer holding, and rearing habitat, as well as known limiting factors for spring-run Chinook salmon and steelhead populations;
- historical and current adult monitoring activities;
- completed, ongoing, and other identified restoration activities;
- limitations for restoration; and
- potential benefits of restoration.

2.1.2 Working List of Potential Actions

As a result of the actions and resources described in the previous section, completed actions were removed from the Draft Working List of Potential Actions, and new actions were added to the list. Actions that were not viable[1] were removed from the list as well. The Steering Committee then grouped actions within watersheds where applicable.

The result of this approach was a Working List of Potential Actions (Appendix B2).

2.1.3 Short List of Potential Actions

The Steering Committee next identified those actions (single and grouped) from the Working List of Potential Actions with a high estimated contribution to the HET. Professional judgment was used to identify actions that would likely add habitat to support at least 500 spring-run Chinook salmon, as well as steelhead.

The result of this approach was a Short List of Potential Actions that included individual and grouped actions (Appendix B3).

[1] Actions that were not viable contained some significant feature that would prevent the action from being implemented under the terms of the HEA. For example, lack of support by a regulatory agency could prevent the action from obtaining permits that may be required before the action could be implemented.

2.2 Applying HEA Criteria to Potential Habitat Expansion Actions

The HEA identifies several criteria for identifying, evaluating, recommending, and approving potential habitat expansion actions, including:

- HEA Evaluation Criteria (Section 4.1.1 of the HEA),
- HEA Selection Criteria (Section 4.1.2 of the HEA), and
- NMFS Approval Criteria (Section 4.2.3 of the HEA).

The Steering Committee developed working definitions for the various HEA criteria (Appendix F) to facilitate applying these criteria for selecting actions to be included in the Draft HEP. The working definitions drew on the concepts captured in the HEA, current scientific literature, recovery plans, and other sources. The Steering Committee requested feedback on the working definitions from NMFS, the HEA signatories, and other stakeholders to further develop these definitions in order to consistently apply the criteria when identifying, evaluating, and recommending habitat expansion actions. Based on comments received, the Steering Committee revised the working definitions and presented them to the HEA signatories and other interested stakeholders at the August 12, 2009 informational meeting. No further comments were received on the revised definitions during preparation of the Draft HEP.[2] The working definitions provided transparency in the application of the criteria as written in the HEA.

The *Working Definitions of Evaluation, Selection, and Approval Criteria* are available on the HEA website and are presented in Section F.2 of Appendix F.

2.2.1 Applying HEA Evaluation Criteria

Section 4.1.1 of the HEA identifies that "the Licensees shall use the…non-exclusive and non-prioritized Evaluation Criteria to screen potential habitat expansion action(s) and develop a preliminary list of viable actions." Evaluation Criteria scores were applied to the actions in the Short List of Potential Actions to develop a Ranked Preliminary List of Viable Actions.

In general, a scale of 1 to 5 was used to score how each action met each of the 17 HEA Evaluation Criteria. No zero values were used in this scoring process. If an action fully met a criterion, it was given a score of 5. If an action failed to meet a criterion, it was given a score of 1. The intermediate degree to which actions did or did not meet a criterion determined a score of 2, 3, or 4. The detailed scoring rationale for each of the Evaluation Criteria is described in Appendix F.

[2] NMFS provided an additional comment to the Steering Committee regarding the working definitions (Evaluation Criterion [n]) in its comment letter on the Draft HEP. The Steering Committee incorporated this comment in the working definitions.

Scoring the Short List of Potential Actions by the HEA Evaluation Criteria resulted in the Ranked Preliminary List of Viable Actions found in Appendix B4.

2.2.2 Applying HEA Selection Criteria

Section 4.1.2 of the HEA explains that "[a]fter developing a preliminary list of viable habitat expansion action(s) using the Evaluation Criteria set forth in Section 4.1.1…, the Licensees shall use the…non-prioritized Selection Criteria to select recommended habitat expansion action(s) for implementation." After the HEA Evaluation Criteria were applied, the Ranked Preliminary List of Viable Actions was re-evaluated. Some actions were removed because the actions were (1) already completed; (2) addressed in other actions on the list; (3) not viable; or (4) not eligible under Section 3.2 of the HEA. Selection Criteria scores were applied to the remaining actions, resulting in the Ranked List of Viable Actions.

Consistent with the methodology used for the Evaluation Criteria, a scale of 1 to 5 was used to score how well each action met each of the Selection Criteria. No zero values were used in this scoring process. The detailed scoring rationale for each of the Selection Criteria is described in Appendix F.

The scores resulting from application of the four Selection Criteria were weighted using the Evaluation Criteria scores and then normalized in order to identify which actions best met these two elements of the HEA. Additional detail on the process and the results of scoring the Ranked List of Viable Actions by the Selection Criteria are found in Appendix F and Appendix B5, respectively.

2.3 Actions Recommended in the Draft HEP

The process described above resulted in two groups of habitat expansion and enhancement actions that were included as recommended actions in the Draft HEP: (1) the Lower Yuba River Habitat Expansion Actions (Lower Yuba River Actions); and (2) the Battle Creek, Big Chico Creek, and Antelope Creek Habitat Expansion Actions (Three-Creek Actions). The Draft HEP described each action, stated why each was being recommended, and discussed potential issues related to their review under the HEA.

As described previously, the Licensees evaluated a large number of potential actions for possible inclusion in the Draft HEP. The Licensees considered the recommended groups of actions to be the best combination of actions to put forward at the time to meet the HET and to ensure the success of the HEA in expanding habitat for spring-run Chinook salmon. On November 20, 2009, the Licensees submitted the Draft HEP for review and comment by the HEA signatories and other stakeholders, as required by Section 4.1.3 of the HEA.

2.4 Development of the Final HEP

2.4.1 Comments Received on the Draft HEP

Section 4.1.3 of the HEA provides a 90-day comment period on the Draft HEP for signatories to the HEA and directly affected third parties. The Licensees distributed the Draft HEP to the HEA signatories and a broad list of other parties, including other stakeholders and parties who had requested to review the plan or who had participated in developing the plan. In addition, the Draft HEP was posted to the HEA website.

Eighteen comment letters or emails were received. All of the HEA signatories, except for the Forest Service, submitted written comments on the Draft HEP. Comments also were received from a number of county and local agencies, public interest groups, non-government organizations (NGOs), and landowners. All of the comment letters received were posted to the HEA website. Each of the comment letters was categorized, and each comment was numbered and entered into a table (Appendix G) to facilitate responding to each comment received.

Many of the comments supported either or both of the actions recommended in the Draft HEP. However, significant comments were raised regarding the interpretation and application of the HEA terms and conditions. In its comment letter on the Draft HEP, NMFS recommended that the Licensees request an extension of 6 months to complete the Final HEP to allow NMFS to (1) confer with the Licensees and other parties regarding the NMFS opinion that the Draft HEP was deficient; and (2) introduce “new information and another alternative that NMFS believes will meet the requirements of the HEA” (see comment letter FED1 in Appendix G).

2.4.2 Six-Month Extension

Section 5 of the HEA allows for the Licensees or NMFS to request from each other an extension of time in order to achieve deadlines specified in the HEA and further states that the request should be granted if good cause exists. Although the Licensees did not agree with several comments and conclusions presented in comments from NMFS on the Draft HEP, the Licensees agreed that an extension of time was necessary to address the comments, review the new information on the NMFS proposed action, and work toward developing a Final HEP.

The Licensees met with NMFS staff on April 28, 2010, to discuss comments from NMFS on the Draft HEP and to discuss a strategy and goals for the proposed 6-month extension. On May 5, 2010, the principals from NMFS (regional director) and each of the Licensees (deputy director [DWR] and vice-president [PG&E]) met to further discuss the 6-month extension. During these meetings, the Licensees and NMFS agreed that the primary areas of significant concern identified in the NMFS comment letter were:

- eligibility of the actions recommended in the Draft HEP;
- the methodology used to estimate the contribution to the HET; and
- application of the HEA Evaluation and Selection Criteria, particularly with regard to the definitions, weighting, and scoring.

The Licensees and NMFS agreed that additional time was needed to address these and other concerns, further develop the recommended actions in response to comments received and new information obtained since the Draft HEP was issued, and evaluate new information on an Upper Yuba River action. To achieve these objectives, the Licensees and NMFS agreed to the following actions during the 6-month extension:

- The Licensees would notify the HEA signatories of the 6-month extension as required by the HEA.
- The Licensees would review with NMFS the methodology used by the Licensees to estimate contribution of an action to the HET.
- The Licensees would further develop the actions recommended in the Draft HEP—informed by comments received and by conferring with the HEA signatories, directly affected third parties, and other interested parties—and would incorporate additional information that had become available during the 6-month period.
- NMFS would clarify its proposed action in the Upper Yuba River watershed based on new and anticipated information being developed. The Licensees would then reevaluate the proposed Upper Yuba River action, in accordance with the terms and conditions of the HEA, and determine whether the action should be recommended in the Final HEP.
- The principals from NMFS and the Licensees would meet again to review the progress made on determining actions to be recommended in the Final HEP.
- The Licensees would prepare responses to comments received on the Draft HEP and prepare a Final HEP for anticipated submittal to NMFS by November 20, 2010.

On September 8, 2010, the principals from NMFS (regional director) and each of the Licensees (deputy director [DWR] and vice-president [PG&E]) met to discuss progress toward developing the Final HEP, including the topics listed above.

2.4.3 Activities during the 6-Month Extension

2.4.3.1 Communication with HEA Signatories

On May 18, 2010, the Licensees sent a formal request to NMFS for a 6-month extension on the deadline to submit a Final HEP. The request outlined the objectives described above. In a letter dated June 1, 2010, that cited good cause, NMFS approved the request for an extension and the plan to proceed with development of a Final HEP. The HEA signatories were sent copies of both letters, which also were posted on the HEA website, to inform them of the extension.

In May and June 2010, the Steering Committee held conference calls with representatives of each of the HEA signatories to inform them of the planned actions to be undertaken during the 6-month extension, update them on new information received since the Draft HEP was issued, and request any available updates. The Licensees also asked each of the HEA signatories whether there was interest in meeting with all stakeholders or whether they were sufficiently informed on the plan for the extension. None of the HEA signatories expressed interest in a group meeting.

2.4.3.2 Review of Methodology Used to Estimate Contribution to the HET

The Steering Committee met with NMFS staff on two occasions (May 12 and July 21, 2010) to clarify the methodology used by the Licensees in the Draft HEP to estimate contribution to the HET. During these meetings, the Steering Committee also discussed comments received on the Draft HEP and informed NMFS about the development of recommended actions for the Final HEP.

May 12, 2010 Meeting

The Steering Committee met with NMFS staff on May 12, 2010. The purpose of the meeting was to review the methodology used by the Licensees in the Draft HEP for estimating contribution to the HET, discuss subsequent refinements to the method, provide an update on the actions recommended in the Draft HEP, and discuss potential actions in the Upper Yuba River that could fulfill the requirements of the HEA.

Methodology of Estimating Contribution to the HET

At the meeting, the Steering Committee reviewed the rationale for the methodology used by the Licensees to estimate the contribution of an action to the HET, the structure of the method, the assumptions used, and the specific results. The Steering Committee also presented the results of an independent estimate of contribution to the HET conducted by Dr. Gregory B. Pasternack,[3] *Estimate of the Number of Spring-Run Chinook Salmon That Could Be Supported by Spawning Habitat Rehabilitation at Sinoro Bar on the Lower Yuba River*, dated July 2, 2010 (Appendix H). Dr. Pasternack used an independent methodology to determine spawner density in the Lower Yuba River. His report provides a description of the methodology used, the rationale for its use, and the specific results yielding a range of estimates based on different assumptions about the target area and the occurrence and behavior of spring-run Chinook salmon in the Central Valley. The Steering Committee also provided an update on the continued development of the actions recommended in the Draft HEP.

Upper Yuba River Actions

NMFS discussed potential actions for the reintroduction of spring-run Chinook salmon in the Upper Yuba River watershed. Discussions on the Upper Yuba River reintroduction plan included a review of the report, *Yuba River Fish Passage, Conceptual Engineering Project Options*, prepared for NMFS by MWH in February 2010. NMFS also previewed its draft HEA questionnaire that was later submitted to the Steering Committee on June 29, 2010 (Appendix I). The discussion and the questionnaire outlined plans for further studies, including habitat modeling using Stillwater's RIPPLE model, development of a reintroduction plan by R2 Resources, and ongoing work with the Yuba Salmon Forum. The Yuba Salmon Forum, originally known as the Yuba River Multi-Party Forum, is an effort by NMFS to pull together numerous stakeholders to identify, evaluate, and seek implementation of effective actions to achieve viable anadromous salmonid populations in the Upper Yuba River watershed.

At the end of the meeting, NMFS requested a follow-up meeting with additional NMFS technical staff. The identified objectives were for the Steering Committee to explain the methodology used to estimate the contribution to the HET to a larger group of NMFS technical staff and for Dr. Pasternack to personally present his independent estimates of potential spawning density at Sinoro Bar to NMFS staff.

July 21, 2010 Meeting

The Steering Committee met with NMFS technical staff on July 21, 2010. The purposes of the meeting were primarily to (1) review again the method used by the Licensees to estimate contribution to the HET with an extended audience from NFMS technical staff; (2) provide an opportunity for NMFS technical staff to question Dr. Pasternack on the results of his independent estimates of spawning density at Sinoro Bar; and (3) discuss potential actions in the Upper Yuba River that potentially could fulfill the requirements of the HEA. NMFS

[3] Gregory B. Pasternack, PhD, M.ASCE is a professor of watershed hydrology and geomorphology at the University of California, Davis. Dr. Pasternack has been involved with the Lower Yuba River for several years prior to the HEA; his expertise as a geomorphologist with specialized knowledge of the Lower Yuba River is broadly acknowledged. From 2003 to 2008, Dr. Pasternack was funded by the Anadromous Fish Restoration Program (AFRP) to study flow and habitat relationships, and how these relationships affect fish production processes in the stream.

had submitted an HEA questionnaire on June 29, 2010 (Appendix I), describing salmon reintroduction options in the Upper Yuba River watershed.

Methodology of Estimating Contribution to the HET

As requested by NMFS, the Steering Committee asked Dr. Pasternack to present the results of his July 2010 report estimating the number of spring-run Chinook salmon that could be supported by expansion of spawning habitat at Sinoro Bar. This presentation allowed NMFS technical staff to query Dr. Pasternack not only on his report but also on the extent of his knowledge related to the Lower Yuba River obtained through work with the resource agencies and other stakeholders, both academically and professionally. Extensive discussion on the Lower Yuba River and the potential HEA actions followed. The group discussed the availability of spawning, rearing, and holding habitats; limiting factors; and the definition of spring-run versus fall-run Chinook salmon.

The Steering Committee followed Dr. Pasternack's presentation with a presentation on the methodology it used to estimate contribution to the HET; the structure of the method, including the assumptions used; and the specific results.

The Steering Committee noted the comments and questions received at the meeting, which were later considered in development of the Final HEP. During the meeting, NMFS asked its staff to provide written comments on both the methodology used by the Licensees to estimate contribution to the HET and the estimates of potential Chinook salmon spawning at Sinoro Bar in Dr. Pasternack's report. The Steering Committee requested that NMFS send its comments (if any) to the Steering Committee; no comments were received.

Upper Yuba River Actions

Following the presentations by Dr. Pasternack and the Steering Committee, NMFS gave a presentation on their ongoing efforts to reintroduce anadromous salmonids in the upper Yuba River watershed. The discussion detailed plans for further studies, including habitat modeling by Stillwatwer Sciences using its RIPPLE model and development of a reintroduction plan by R2 Resources consultants. Stillwater Sciences also gave a presentation on the model, its application to the Upper Yuba River watershed, and ongoing data collection.

The group discussed the various scenarios and components presented in the HEA questionnaire on the Upper Yuba River Actions, the possibility of doing a pilot or experimental project under the HEA, the timeframe for completion of NMFS ongoing studies, the potential use of Feather River Hatchery fish for the initial phase of the reintroduction, and the significant number of river miles available as possible anadromous fish habitat in the Upper Yuba River watershed.

2.4.3.3 Further Development of Recommended Actions

One of the objectives of the 6-month extension was to give the Licensees the opportunity to respond to comments received on the Draft HEP and to evaluate new information in order to further develop the actions recommended in the Draft HEP. The following sections provide a follow-up on the status of the Three-Creek Actions and development of the Upper and Lower Yuba River Actions.

Removal of Three-Creek Actions

The Licensees removed the Three-Creek Actions from consideration in the Final HEP because the individual actions have been fully or partially funded by other sources, or funding appears to be imminent. The funding status for each action is described below.

- **Battle Creek Actions.** DFG has identified full funding for the Battle Creek Actions (i.e., Phase 2 of the Battle Creek Salmon and Steelhead Restoration Project). Funding is currently being secured. (Berry pers. comm.)
- **Antelope Creek Action.** As documented during a teleconference with DFG (Bratcher pers. comm.), the AFRP will provide full funding for Paynes Crossing in Fiscal Year 2010-2011. The Antelope Creek Action will be implemented by DFG in summer 2011.
- **Big Chico Creek Action.** Partial funding for restoration of the Iron Canyon fish ladder has been obtained (Strachan pers. comm.). Providing funding for the remainder of this project would not result in a significant contribution to the HET; thus, the Licensees eliminated this action from consideration.

Should the status of anticipated funding change before approval of the Final HEP by NMFS, the Licensees may reconsider recommending these actions for implementation under the HEA.

Yuba River Actions

Two broad action areas in the Yuba River remained under consideration: the Lower Yuba River and the Upper Yuba River, separated by Englebright Dam at approximately river mile[4] (RM) 23 (Figure 2-1). The Upper Yuba River includes the South, Middle, and North forks of the Yuba River and associated dams and reservoirs. Englebright Dam blocks passage of anadromous fish into the Upper Yuba River. The Lower Yuba River extends downstream from Englebright Dam to the confluence with the Feather River. The Lower Yuba River is divided by Daguerre Point Dam at approximately RM 11. Daguerre Point Dam has passage facilities for anadromous fish.

[4] River miles are based on measurement following the valley centerline rather than the stream thalweg.

While the Yuba River has great potential to expand habitat for spring-run Chinook salmon and steelhead, it also presents great challenges. Historically, the Yuba River was a major producer of Chinook salmon (Yoshiyama et al. 1998). The current capability of the Yuba River to support spring-run Chinook salmon has been greatly diminished by the ravages of past mining activity, ongoing agriculture, and the effects of construction and operation of dams throughout the system (NMFS 2009). Englebright Dam, constructed in 1941, forms a complete barrier to passage of anadromous fish and eliminated 76 percent of Chinook salmon habitat in the Yuba River drainage (Pasternack et al. 2010). Addressing the full range of needs in the Yuba River system is far beyond the scope of the HEA. To be effective, the HEA must concentrate on a portion of the watershed where actions are most likely to provide timely and effective benefits to spring-run Chinook salmon and steelhead.

The following sections describe the refinement of the Lower Yuba River Actions based on comments received and new information obtained since the Draft HEP was issued, and the re-evaluation of potential actions in the Upper Yuba River.

Lower Yuba River

Refinement of Lower Yuba River Actions

Major activities related to the Lower Yuba River Actions that were undertaken by the Licensees since the Draft HEP was issued focused on:

- re-evaluating and refining the estimated contribution to the HET;
- determining the conditions under which use of a segregation weir may be appropriate;
- obtaining more detailed information on the activities planned by the U.S. Army Corps of Engineers (Corps) at both Englebright and Daguerre Point Dams that potentially could affect eligibility of the recommended actions; and
- continued communication with stakeholders, including potentially affected landowners.

During the 6-month extension, the Licensees also implemented the following activities, primarily related to outreach, and gathering and reviewing new technical information in support of the Lower Yuba River Actions that was not available during preparation of the Draft HEP:

- Commissioned the report by Dr. Pasternack, *Estimate of the Number of Spring-Run Chinook Salmon That Could Be Supported by Spawning Habitat Rehabilitation at Sinoro Bar on the Lower Yuba River* (Pasternack 2010a) (Appendix H) to provide an independent estimate of the number of spring-run Chinook salmon that could be supported by spawning habitat in the Sinoro Bar area below Englebright Dam.
- Developed a draft concept for an adaptive management plan (AMP) in response to comments received from DFG and other HEA signatories on the optional segregation weir component of the Lower Yuba River Actions. The Steering Committee met with DFG on July 16 and September 27, 2010, to

review the proposed concept and seek input from DFG. A copy of the conceptual AMP is included in Appendix J.

- Conducted a field visit on June 30, 2010, with representatives from the Corps to Englebright Dam, Sinoro Bar, and Daguerre Point Dam to obtain an overview of current and planned activities related to restoration by the Corps in the Lower Yuba River.
- Solicited temporary entry permits from private landowners for the purpose of providing an option for accessing Sinoro Bar and Narrows Gateway (sites of the currently recommended spawning habitat expansion actions) to complete preliminary design and environmental reports that would be required in the event that these actions are approved for implementation.
- Met with the Yuba County Water Agency (YCWA) on August 17, 2010, to provide an update on the development of potential actions in the Lower Yuba River and discuss potential habitat expansion actions in the Upper Yuba River.
- Updated the Yuba Accord River Management Team (RMT) on the Lower Yuba River Actions at a meeting on August 18, 2010. The RMT is charged with implementing a detailed study program for the Lower Yuba River as specified in the Lower Yuba River Accord (Yuba Accord). The meeting also served as a forum for the RMT to provide feedback on the Lower Yuba River Actions based on ongoing studies by the RMT. The draft report prepared for the South Yuba River Citizens League (SYRCL) by cbec, inc. eco engineering, *Rehabilitation Concepts for the Parks Bar to Hammon Bar Reach of the Lower Yuba River* (cbec 2010**)**, also was discussed at the meeting.
- Reviewed the Friends of Deer Creek report *Gravel Augmentation for Salmonids and Other Aquatic Life in Lower Deer Creek: Gravel Augmentation Plan* (Friends of Deer Creek no date) to understand the potential effects of their gravel augmentation plan on the Lower Yuba River Actions.
- Attended the RMT's 2nd Annual Lower Yuba River Symposium on Fisheries Monitoring and Evaluation in the Lower Yuba River, on June 29, 2010. The symposium was attended by representatives of the resource agencies and other stakeholders engaged in implementation of the Yuba Accord. The Yuba Accord provides for $5.5 million through 2016, primarily for monitoring and evaluation of Lower Yuba River fisheries and habitat. The symposium serves as the public review of the results of the RMT monitoring and evaluation efforts.
- Reviewed a report prepared for the Corps by Dr. Pasternack, *Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River, CA* (Pasternack 2010b).
- Commissioned a second report by Dr. Pasternack *Estimate of the Number of Spring-Run Chinook Salmon Supportable by River Rehabilitation in the Narrows Reach of the Lower Yuba River* (Appendix K) (Pasternack 2010c) to provide an independent analysis of the number of spring-run Chinook salmon

that could be supported by expanding the spawning habitat at additional locations in the Narrows Reach of the Lower Yuba River.

- Reviewed a report prepared by the Corps, *Draft Environmental Assessment for the Lower Yuba River Gravel Augmentation Project Yuba and Nevada Counties, California* (Corps 2010).
- Identified six juvenile rearing habitat expansion sites (Appendix L) and further developed them as potential restoration actions (i.e., fewer targeted sites and more detailed plans).

Modified Lower Yuba River Actions

The Lower Yuba River Actions defined in the Draft HEP were modified based on new information obtained from the activities described above. These modifications are listed below.

- The Deer Creek gravel augmentation component was removed from consideration due to concerns from DFG regarding the attraction of spring-run Chinook salmon into Deer Creek. Water temperatures and water quality in Deer Creek are not conducive to supporting spring-run Chinook salmon.
- The juvenile habitat restoration actions were removed from the Licensees' recommended actions because their contribution to the HET was low relative to that of the spawning habitat expansion actions.
- An additional spawning habitat expansion site was identified in the Narrows Reach (Narrows Gateway) and included as a component of the recommended actions.
- As noted above, a draft concept for an AMP was developed to address concerns raised by several parties regarding the option to install a seasonally operated segregation weir (Appendix J).

The modified Lower Yuba River Actions are described in more detail in Chapter 3. The newly defined Lower Yuba River Actions were scored based on application of the HEA Evaluation and Selection Criteria as had been done previously for all other actions. The results of that scoring are presented in Appendix F.

Upper Yuba River

Re-Evaluation of Potential Actions in the Upper Yuba River Watershed

NMFS comments on the Draft HEP included a request that potential actions in the Upper Yuba River watershed be re-evaluated based on additional information provided by NMFS since release of the Draft HEP. NMFS promoted potential actions related to the reintroduction of spring-run Chinook salmon into the Upper Yuba River watershed throughout the process of preparing the HEP. On June 29, 2010, NMFS submitted an HEA questionnaire detailing a comprehensive Upper Yuba River reintroduction plan. NMFS suggested that selected components of the Upper Yuba River reintroduction plan could be implemented to meet the goals of the HEA (Wantuck pers. comm.).

The HEA questionnaire submitted by NMFS proposed reintroduction of spring-run Chinook salmon and steelhead into the Upper Yuba River above Englebright Dam by trapping and transporting adult and juvenile fish around the dams and reservoirs in the North, Middle, and South Yuba River tributaries. The reintroduction plan calls for (1) constructing facilities at Daguerre Point Dam to collect and hold adult fish; (2) transporting adult fish to release points in the three tributaries; (3) constructing and operating state-of-the-art facilities for collecting downstream migrating juveniles; and (4) transporting juveniles for release downstream. Extensive monitoring to evaluate adult and juvenile fish movement in the Yuba River and the success of the program also was included in the proposed reintroduction plan.

Re-evaluation of potential actions in the Upper Yuba River watershed by the Licensees included the following activities that were in addition to those performed when developing the Draft HEP:

- Reviewed the *Yuba River Fish Passage, Conceptual Engineering Project Options*, prepared for NMFS by MWH, dated February 2010 (MWH 2010).
- Reviewed the HEA questionnaire describing the Upper Yuba River reintroduction options (i.e., Upper Yuba River Actions) that was submitted by NMFS on June 29, 2010 (Appendix I).
- Selected actions from the HEA questionnaire that potentially could meet the terms and conditions of the HEA (described below), and applied the HEA Evaluation and Selection Criteria to those actions (see Appendix F).
- Monitored the progress of the Yuba Salmon Forum and solicited input from key stakeholders (YCWA and the Corps).

Results from the following related studies commissioned by NMFS and referenced in the questionnaire were not available for consideration in developing this Final HEP:

- RIPPLE modeling being conducted by Stillwater Sciences to determine the capacity of the Upper Yuba River watershed for spring-run Chinook salmon (anticipated completion date is November 2010; however, the report was not available when the Final HEP was issued); and
- a detailed reintroduction plan for spring-run Chinook salmon to the Upper Yuba River, to be conducted by R2 Resources (anticipated completion date is December 2010).

The Licensees carefully evaluated the available options for an Upper Yuba River reintroduction program. The Steering Committee extracted potential actions from the proposed plan that focused on reintroduction of spring-run Chinook salmon and steelhead into the North Yuba River above New Bullards Bar Reservoir, as the North Yuba River seems to present the best opportunity for a reintroduction program. These actions are referred to as the Upper Yuba River Actions.

Upper Yuba River Actions

The Upper Yuba River Actions include:

- constructing an adult collection facility at Daguerre Point Dam,
- transporting up to 3,000 adult spring-run Chinook salmon (the amount required to achieve the HET) and an undetermined number of steelhead from Daguerre Point Dam to release locations above New Bullards Bar Reservoir,
- constructing juvenile collection facilities in the North Yuba River or in upper New Bullards Bar Reservoir, and
- transporting the juveniles for release below Englebright Dam.

These actions would be maintained for an approximately 50-year term to meet the requirements of the HEA.

The Upper Yuba River Actions were scored against the HEA Evaluation and Selection Criteria. The results of that scoring, along with scoring for the original reintroduction action and the Lower Yuba River Actions, are presented in Appendix F. The Upper Yuba River Actions scored significantly lower than the Lower Yuba River Actions for all criteria combined.

Based on the scoring and some of the key points discussed below, which are grounded in the specific language of the HEA, the Licensees could not recommend the Upper Yuba River Actions for consideration under the HEA.

Key points include:

- length of time to implement;
- feasibility, sustainability, and lack of volitional passage;
- cost effectiveness; and
- source of broodstock.

Each of these points is discussed below.

Length of Time to Implement. A clear intent of the HEA is that the selected actions be implemented in a timely manner to benefit salmon and steelhead as soon as possible. Evaluation Criterion (h) in Section 4.1.1 of the HEA addresses the issue of timing: "acceptable length of time to implement (earlier gains are favored over later gains)." The following working definition was developed for this criterion (found in Appendix F):

> Sacramento River spring-run Chinook salmon are in need of immediate assistance to support their recovery. Thus, factors important to the success of a project include not only the length of time to implement the project but also the length of time to realize benefits. Thus, "shovel-ready" projects (i.e., those projects for which implementation can begin within approximately 5 years) will be favored. 'Implementation' means initiation of construction after approval of the Final HEP.

> The more favorable projects are those that need minimal additional public process… In addition, projects that benefit spring-run Chinook within a relatively short period of time (e.g., approximately 10 years or less) will be favored. … [P]rojects that can be implemented sooner and realize benefits within a relatively short period will be preferred.

Any program to reintroduce anadromous fish into the Upper Yuba River Basin must occur in the context of ongoing and planned legal proceedings and with the cooperation of resource agencies, water users, and additional stakeholders. Several hydroelectric projects in the Upper Yuba River are the subject of ongoing or pending FERC relicensing proceedings (e.g., Nevada Irrigation District's Yuba-Bear Project (anticipated final application submittal April 2011), PG&E's Drum-Spaulding Project (anticipated final application submittal April 2011), and YCWA's Yuba River Development Project (current license expires 2016).

NMFS has convened the Yuba Salmon Forum to bring stakeholders together, in part to discuss the issues related to implementation of a reintroduction plan for anadromous salmonids in the upper watershed. To date, key agencies, including YCWA and DFG, have not endorsed the concept of a trap-and-transport program for anadromous fish reintroduction above Englebright Dam; therefore, the action does not yet have tangible evidence of "favorable local/political support" (Evaluation Criterion [i] of the HEA). Nor have the affected parties agreed that the reintroduction program would be consistent with "other resource uses such as water supply, public safety, flood control, recreation and power production" (Evaluation Criterion [l] of the HEA).

The Licensees recognize that reintroduction of anadromous fish into the Upper Yuba River will require extensive negotiations among the parties associated with relicensing of projects in the Upper Yuba River. It is not unreasonable to assume that a reintroduction program of this scale could take at least 10 years to reach the implementation stage, once agreement is obtained on the specific actions to be taken. Recent projects on the Klamath River and Battle Creek support such an assumption. On the Klamath River, in February 2010, the Klamath Basin Restoration Agreement and Klamath Hydroelectric Settlement Agreement, which stipulates implementation over the next 10 years, was signed after years of negotiation. Planning for the Battle Creek Restoration Project for Salmon and Steelhead began in the mid 1990s. The project was memorialized in a Memorandum of Understanding signed voluntarily, outside of a relicensing proceeding, by the project partners in 1999 and began construction in 2010.

Feasibility, Sustainability, and Lack of Volitional Passage. The clear intent of the HEA is that the selected actions would favor:

- proven rather than experimental techniques (Evaluation Criterion [a] of the HEA);
- supporting a self-sustaining population of spring-run Chinook salmon and steelhead (Evaluation Criterion [c] and Approval Criterion [c] of the HEA); and

- volitional passage with minimal human intervention (Evaluation Criterion [e] of the HEA).

Evaluation Criterion (a) requires evaluating the feasibility of potential actions: "favorable feasibility (technically feasible; supported by accepted science; low potential for disease and other risks; proven actions are favored over experimental actions)." As noted in the working definition for this criterion (found in Appendix F):

> Actions/projects should have a high likelihood of success. The type of action should be technically feasible, with a proven track record of results in similar settings. There should be a high degree of scientific support both in terms of the feasibility of the action and its potential contribution to the Habitat Expansion Threshold (HET).

Successful programs exist in the Pacific Northwest to trap and transport anadromous fish around natural and artificial barriers. There is no precedent for a trap and transport of spring-run Chinook in California. However, every successful program has been the result of an extensive developmental period, often lasting decades, involving the use of prototypes and other experiments in order to devise facilities and operations that meet the biological needs of the transported fish, as well as the hydrologic and geographical features of the site. From the report prepared for NMFS by MWH (2010), "Regardless of which fish passage option is selected, an interim or pilot program would likely be established to determine the overall feasibility of the reintroduction of anadromous fish into the upper Yuba River watershed. …Evaluations of successful spawning and rearing prior to any large scale construction activity are recommended to justify the actual cost and benefit of the passage facilities."

Any reintroduction program in the Upper Yuba River would need to start in an experimental mode and, therefore, would not provide the timely and sustainable increase in habitat potential envisioned in the HEA. For example, there is no readily apparent way to effectively collect downstream migrating smolts in New Bullards Bar Reservoir or in the North Yuba River. Development of a facility and techniques to collect juvenile fish would be a biological and engineering challenge. Furthermore, the Licensees are unable to promote an experimental program with an uncertain outcome for an approximately 50-year term to meet the requirements of the HEA.

Evaluation Criterion (c) requires evaluating the sustainability of the potential actions: "favorable sustainability of action." As described in the working definition of this criterion (found in Appendix F):

> The intent of the HEA is to create "permanent" solutions to problems, or at least to provide benefits through the term of a typical FERC license (i.e., up to 50 years). Where possible, projects should address the root cause of current habitat constraints rather than dealing with their symptoms or surface expression and should consider the potential effects of climate change. Once implemented, projects ideally would be self-sustaining (i.e., requiring a minimum amount of maintenance over the long term). In conjunction with Evaluation Criterion (e), projects providing volitional access for fish to currently unoccupied habitat would likely be considered more sustainable than passage projects requiring high levels of human intervention.

Trap-and-transport operations are not sustainable, given the need for annual trapping and transport activities. Moreover, there is a potentially high carbon footprint from such a long-term transport operation. It is an entirely artificial means to circumvent migrational barriers that requires a high level of human intervention.

Cost Effectiveness. Evaluation Criterion (d) considers the cost effectiveness and economic feasibility of potential actions: "favorable cost effectiveness and economic feasibility (including consideration of costs necessary to operate and maintain the expansion)." As described in the working definition for this criterion (found in Appendix F):

> Project funding under the HEA includes capital cost, operations and maintenance (O&M), and project administration. Projects that show efficient use of funds for these cost elements will be favored. One measure of cost effectiveness is the estimated net increase in the population of spawning fish (i.e., the contribution toward the HET) versus the total cost of the action. Projects that include cost sharing, labor sharing, or other measures that allow the HEP to leverage funds, while making meaningful change, would also be favored.

The HEA signatories recognized that cost is a "key consideration" of the agreement and committed to a "good faith effort to achieve the Habitat Expansion Threshold at the least cost to the Licensees" (Section 10 of the HEA). The Licensees are allowed to withdraw from the HEA if the life-cycle cost of the habitat expansion actions exceeds $15 million for both Licensees combined (Section 11.1 of the HEA). This cost is not intended as a cap but to provide a decision criterion for the Licensees and to emphasize that cost is a legitimate consideration in implementation of the agreement.

Cost effectiveness is a criterion for evaluation of HEA projects by the Licensees (Section 4.1.1[d] of the HEA) and for selection of actions to be included in the HEP (Section 4.1.2[b] of the HEA). The Licensees scored actions for cost effectiveness in terms of the cost required to achieve the HET (Appendix F) (i.e., the most cost-effective action is the one that achieves the goal of the HEA for the least cost).

Because of the expense associated with a trap-and-transport program, the Upper Yuba River Actions proposed by NMFS scored poorly in regard to cost effectiveness (see Table F-1 in Appendix F). Even a trap and transport focusing only on reintroduction into the North Yuba River would require significant capital expenses to construct adult collection facilities at Daguerre Point Dam and to devise a juvenile collection facility in the North Yuba River. Each of these facilities would need to be staffed throughout the season, while active transport of adults and juveniles would create significant operational expenses throughout the term of the obligation under the HEA.

In theory, it may be possible to partner with the other major stakeholders, for example other agencies operating in the watershed. However, based on the status of various relicensing proceedings in the watershed, it is unlikely that partnerships with these agencies could be achieved in a reasonable timeframe (i.e., within approximately the next 5 years). Additionally, the Corps does not have a mechanism to secure funding for a voluntary effort without congressional approval; therefore, a partnership with the Corps is an unlikely scenario.

As a means to expand habitat to achieve the HET, trap and transport fails in regard to cost effectiveness compared to the recommended actions.

Source of Broodstock. A key limitation with near-term implementation of a reintroduction program is the lack of a clear source of broodstock for a trap-and-transport operation. It is questionable whether 2,000 to 3,000 spring-run Chinook salmon could be collected at Daguerre Point Dam, and doing so would likely extirpate the present population (considered a Core 1 population[5] in the NMFS Public Draft Recovery Plan) and preclude development of a self-sustaining spring-run Chinook salmon population in the Lower Yuba River. Similarly, removing sufficient steelhead at Daguerre Point Dam to support an Upper Yuba River population would negatively affect the Lower Yuba River steelhead population. The only apparent alternative to collecting returning spring-run Chinook salmon at Daguerre Point Dam would be to use fish from the Feather River Hatchery to start a population in the Upper Yuba River, an option with dubious genetic basis.

2.5 Conclusion

The Licensees concluded that the Lower Yuba River Actions are most consistent with the intent and criteria of the HEA and could be implemented relatively quickly to benefit spring-run Chinook salmon and steelhead. The Upper Yuba River Actions, while laudable, presented technical, legal, social, and logistical hurdles that would preclude their completion in a timely manner—coupled with uncertain prospects for effectiveness. Furthermore, the Lower Yuba River Actions recommended by the Licensees are fully compatible with an Upper Yuba

[5] *Core 1 populations* are defined by NMFS as "populations identified as having the highest priority for recovery action implementation based on known ability to support independent populations, thereby contributing to the ESU/DPS-level recovery criteria"(the Viable Salmonid Population spatial diversity criteria) (NMFS 2009).

River reintroduction program and could serve as a springboard from which to launch such actions in the future. The Licensees suggest that development of a viable, self-sustaining population of spring-run Chinook salmon below Englebright Dam provides the most biologically robust source of broodstock to fuel a reintroduction program once the many technical, legal, social, and logistical hurdles are overcome. The Lower Yuba River Actions represent a sizeable contribution to development of a Yuba River spring-run Chinook salmon population that is fully supportive of goals in the NMFS Public Draft Recovery Plan.

Chapter 3 describes the recommended Lower Yuba River Actions, and Chapter 4 presents an in-depth discussion on the rationale for recommending that the Lower Yuba River Actions be approved by NMFS under the HEA.

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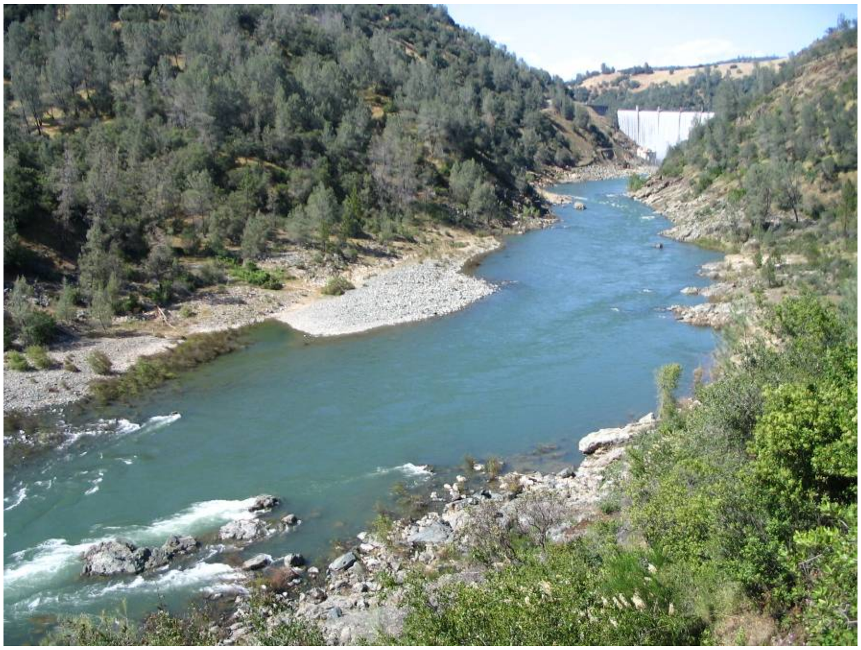
Chapter 3
Recommended Lower Yuba River Actions



Lower Yuba River
(Photo courtesy of William T. Mitchell, ICF International, 2005)

3.1 Description of Habitat Expansion Actions

3.1.1 Background

The Yuba River historically was a major contributor of spring-run Chinook salmon to the Sacramento River system. However, like most of the major tributaries to the Sacramento River, the habitat potential of the Yuba River has been considerably diminished, by extreme geomorphic alteration resulting from hydraulic and dredge mining for gold and then by construction of dams that blocked access to major spring-run Chinook salmon spawning areas.

Construction of Englebright Dam at river mile (RM) 23 blocked access to most of the Yuba River system. Historically, spring-run Chinook salmon production areas were in the upper stream reaches, and spring-run Chinook salmon did not spawn in the lower river reaches that constitute the currently accessible portion of the Yuba River. In part, this was because conditions below the site of Englebright Dam historically were not conducive to production of spring-run Chinook salmon; the river was too warm in summer and fall. However, New Bullards Bar Dam on the North Yuba River now releases cold water through much of the summer and fall from its very deep reservoir. Consequently, water temperatures below Englebright Dam are now suitable for spring-run Chinook salmon. Currently, both fall-run and spring-run Chinook salmon spawn below Englebright Dam, although the fall-run are far more abundant.

The primary intent of the Lower Yuba River Habitat Expansion Actions (Lower Yuba River Actions, also referred to as the *recommended actions*) is to provide conditions that would encourage development of an independent spring-run Chinook salmon population and provide ancillary benefits to steelhead. Development of conditions suitable for healthy populations of spring-run Chinook salmon and steelhead can be expected to provide benefits to other native species, as well.

The Lower Yuba River Actions would substantially contribute to restoration of normative riverine processes in the Lower Yuba River. These normative processes have been severely impacted due to the legacy of historical hydraulic mining in the Yuba River watershed, in addition to construction of upstream dams including Englebright Dam. The Lower Yuba River Actions would address channel degradation issues and enhance aquatic habitat in the Lower Yuba River, primarily for the benefit of spring-run Chinook salmon.

Individual actions in the Lower Yuba River were proposed to the Steering Committee by AFRP, DFG, Friends of Deer Creek, SYRCL, and USFWS. The individually proposed actions led the Licensees to develop three related actions that were combined to form the recommended Lower Yuba River Actions. During development of the Lower Yuba River Actions, the Licensees consulted with the RMT, DFG, and Dr. Pasternack to refine and focus the actions. Members of the RMT have expressed their support for the actions. Their detailed evaluation of the Lower Yuba River Actions, as originally envisioned in the Draft HEP, is included in Appendix M.

The recommended Lower Yuba River Actions include two actions to expand spawning habitat and an optional action to support segregation of spring-run and fall-run Chinook salmon using a seasonally operated segregation weir if deemed necessary by the resource agencies (NMFS, USFWS, and DFG).

3.1.2 Location

The Lower Yuba River Actions are located on the Lower Yuba River between Englebright Dam (RM 23) and a yet to be determined location downstream of the Narrows Pool (RM 21) (Figure 3-1).

One spawning habitat expansion site is located in the Englebright Dam Reach (defined as the Yuba River between Englebright Dam and Deer Creek [RM 22]), and one is located in the Narrows Reach (defined as the Yuba River between Deer Creek and the outlet of the Narrows Pool). The proposed site of the segregation weir is downstream of the Narrows Pool.

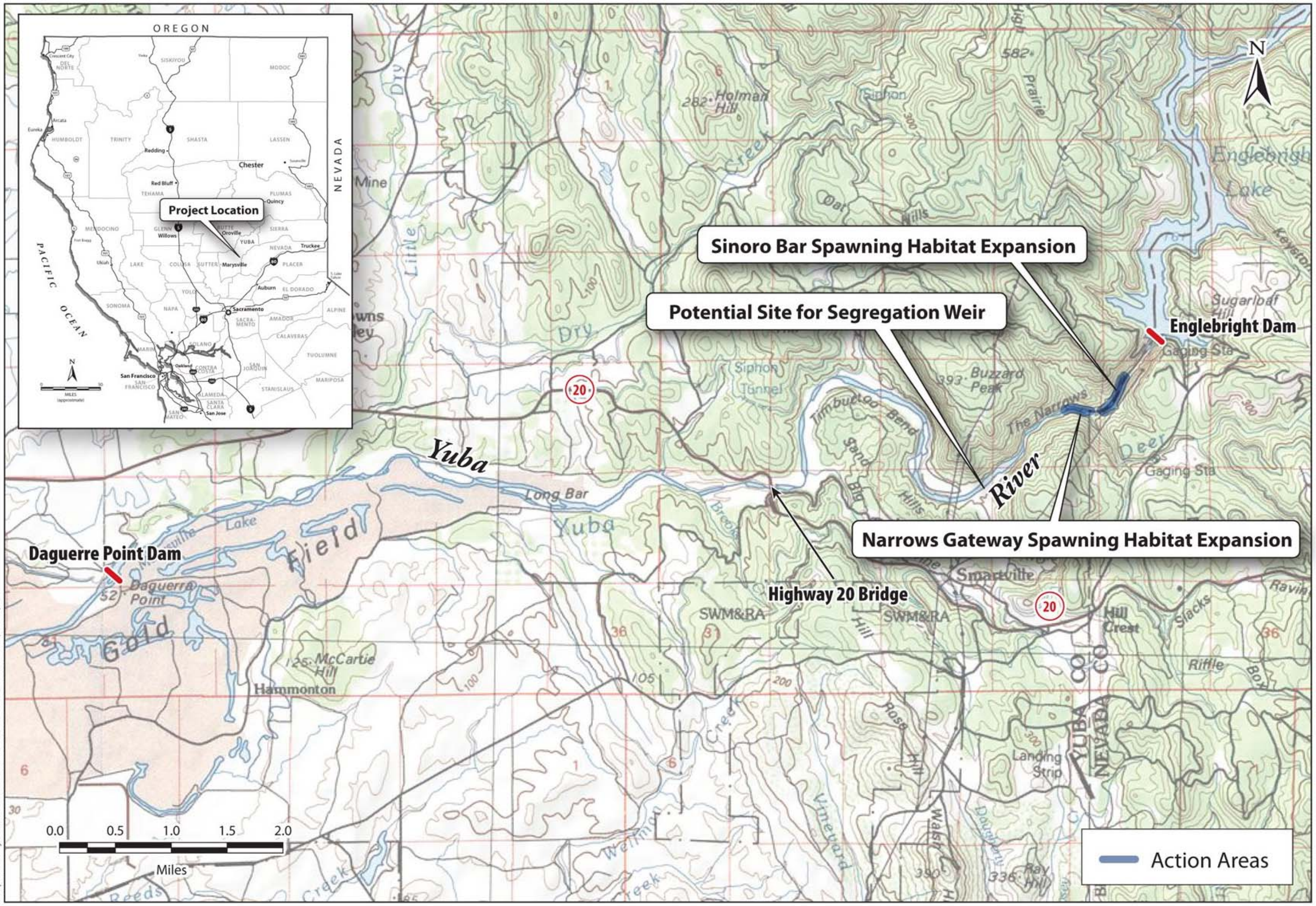


Figure 3-1
Lower Yuba River Habitat Expansion Actions

3.1.3 Purpose

The Lower Yuba River Actions are intended to provide habitat conditions below Englebright Dam on the Yuba River that are necessary to promote development of a viable, independent population of spring-run Chinook salmon and provide ancillary benefits to steelhead. The recommended actions would enhance separation of spring-run and fall-run Chinook salmon in the Lower Yuba River by increasing the amount of habitat in the river with characteristics more typical of spring-run fish than of fall-run fish. Implementation of these actions would meet the requirements of the HEA, including contribution to the HET (see Chapter 4 and Appendix N).

3.1.4 Recommended Actions

The Lower Yuba River Actions consist of three individual actions. These actions, when considered as a whole, provide greater benefits relative to the HEA criteria than the individual actions considered independently. Additionally, as discussed in Section 4.3.11, these actions contribute to a larger integrated plan for management of spring-run Chinook salmon in the Lower Yuba River.

The recommended Lower Yuba River Actions are as follows:

- Sinoro Bar spawning habitat expansion – expand spawning habitat in the Sinoro Bar geomorphic unit of the Englebright Dam Reach of the Lower Yuba River (described in Section 3.3.1);
- Narrows Gateway spawning habitat expansion – expand spawning habitat in the Narrows Gateway geomorphic unit of the Narrows Reach of the Lower Yuba River (described in Section 3.3.2); and
- segregation weir (optional) – plan for, and if deemed necessary by the resource agencies (NMFS, USFWS, and DFG), install a seasonally operated segregation weir at a location downstream of the Narrows Pool (described in Section 3.4).

The locations of these actions in the Lower Yuba River watershed are shown in Figure 3-1.

The combined actions would promote increased production of spring-run Chinook salmon and steelhead by increasing the quantity and quality of spawning and rearing habitat. The HEA directs that actions also should encourage separation of spawning spring-run and fall-run Chinook salmon. The Licensees conclude that this goal can be achieved by increasing the amount of habitat in the Lower Yuba River with characteristics more typical of spring-run fish than fall-run fish. This would be accomplished by enhancing conditions in the upper, higher gradient reaches of the Lower Yuba River (i.e., the Englebright Dam Reach and the Narrows Reach). To prevent the potential for redd superimposition in these reaches, a segregation weir downstream of the Narrows Reach is included as an optional action to allow for mechanical separation of the two runs. The inclusion of the segregation weir considerably enhances the value of the actions listed above relative to the HEA criteria. However, consultation with DFG and the RMT has indicated that implementation of a weir to separate spring-run and fall-run Chinook salmon in a way that benefits spring-run fish may not be supported by currently available data. Ongoing migration and genetic studies would provide information on the future value of, or need for, the segregation weir.

3.1.5 Sources

Representatives of the following organizations were helpful in identifying and defining the Lower Yuba River Actions through completed HEA questionnaires (Appendix D), meetings, and personal communications: DFG, Friends of Deer Creek, Pacific State Marine Fisheries Commission, the RMT, SYRCL, UC Davis (Dr. Gregory Pasternack), USFWS, and YCWA.

3.2 Context for Action

3.2.1 Description of the Watershed

The following description of the Yuba River watershed and the Lower Yuba River draws largely on descriptions by YCWA et al. (2007) and California State University, Sacramento (2008) with other sources noted. The Yuba River Basin drains approximately 1,340 square miles of the western Sierra Nevada, including portions of Sierra, Placer, Yuba, and Nevada Counties. The Yuba River is a tributary of the Feather River, which is a tributary of the Sacramento River. The primary watercourses of the Upper Yuba River watershed are the South, Middle, and North Yuba Rivers, which flow into Englebright Reservoir. The average annual unimpaired flow of the Yuba River at Smartsville is 2.45 million acre-feet (MAF); however, a significant portion of this water is diverted out of the watershed and is not available to the Lower Yuba River. The annual unimpaired flow has ranged from a maximum of approximately 4.9 MAF in 1986 to a minimum of approximately 370,000 acre-feet in 1977.

The Lower Yuba River is approximately 23 miles long and stretches from Englebright Dam downstream to the confluence with the Feather River at Marysville. Englebright Dam is an impassable barrier to anadromous fish. The dam was constructed in 1941 to control mining debris and provide flood control. Construction of New Bullards Bar Dam on the North Yuba River in 1969 allowed Englebright Dam operations to switch from flood control to provision of water for hydroelectricity, irrigation, and fisheries (NMFS 2007). The short reach immediately below Englebright Dam to the Deer Creek confluence has been greatly altered by mining debris and dam operations, and is lacking gravel.

Below the confluence with Deer Creek, the Narrows is a step-pool reach with significant amounts of alluvial sediment and significant rapids (Pasternack 2008).

Downstream of the Narrows, the Lower Yuba River consists of alternating runs, pools, and riffles. The river flows through a valley moderately confined by the Sierra foothills until it reaches Long Bar (RM 15), where it enters an alluvial valley and flows to Daguerre Point Dam (Kozlowski 2004). This dam, located approximately 11 miles downstream of Englebright Dam, was constructed in 1906 to provide flood control and to trap mining debris (Kozlowski 2004). The purpose of the dam was later modified to include diversion of water for irrigation; the entire reservoir behind the dam is presently filled with hydraulic mine waste and sediments, and has no water storage capacity (NMFS 2007).

Daguerre Point Dam is 25 feet tall, with fish ladders on either side that allow passage of some migratory species (Kozlowski 2004). The fish ladders have suboptimal design, and sheet flow across the dam spillway may obscure attraction to the ladder entrances, particularly during high flows (NMFS 2007). The reach from Long Bar to RM 8 is within the Yuba Goldfields and is confined by dredger tailings and low gravel bars. Below the Yuba Goldfields to the confluence with the Feather River, the river banks are frequently armored with boulders and broken concrete (Kozlowski 2004).

3.2.2 Status of Spring-Run Chinook Salmon and Steelhead Runs

3.2.2.1 Spring-Run Chinook Salmon

Little information has been published regarding the status of spring-run Chinook salmon in the Lower Yuba River. Historical numbers likely were considerably higher than observed today but probably were greatly diminished by gold mining, construction of impassable dams, and water diversions (Yoshiyama et al. 2001). The following account is taken from the *Biological Opinion for the U.S. Army Corps of Engineers' Operation of Englebright and Daguerre Point Dams on the Yuba River, California* (2007 BiOp) (NMFS 2007):

> There is limited information on the current population size of spring-run Chinook salmon in the lower Yuba River. Before 2001, when DFG conducted a study to quantify the number of adult spring-run Chinook salmon immigrating into the Yuba River by trapping fish in the fish ladder at Daguerre Point Dam, there was almost no specific information on the run timing and size of the population in the Yuba River. In the 2001 DFG study, which involved limited sampling of fish ascending the north ladder, a total of 108 adult Chinook salmon were estimated to have passed the dam between the dam between March 1, 2001, and July 31, 2001 (DFG 2002c).
>
> Spawning and carcass surveys conducted by DFG and private consultants funded by the YCWA have likewise detected the persistence of spring-run

> Chinook salmon in the Yuba River, although none of these reports provided estimates specifically for spring-run Chinook salmon.
>
> Infrared and videographic sampling on both ladders at Daguerre Point Dam since 2003 has provided more robust estimates of spring-run Chinook salmon numbers migrating into the Yuba River. However, these estimates should be considered as *minimum* numbers, as periodic problems with the sampling equipment have caused periods when fish ascending the ladders were not counted. In years when these sorts of gaps in data occurred during the spring-run migration period, it is likely that some migrating adults were not counted, and the true numbers may be higher than those reported below (DFG unpublished data)…. The detection of adipose fin clips on some of these fish indicates that they were hatchery strays, most likely from the Feather River Hatchery. The short time period in which this device has been in operation, coupled with the three to four year life cycle of these fish make it difficult to determine decisive trends in the spring run population. While the recent data from 2006 and 2007 indicates a reduction in total abundance, passage in May (the primary spring-run migration month) of 2007, was the highest detected in that month since the device was installed.
>
> In general, the current data indicate that adult escapement of spring-run Chinook salmon is relatively low and fluctuating, and has been greatly reduced from estimated historic levels.

The recent total abundance of adult spring-run Chinook salmon in the Lower Yuba River ranged from 214 fish in 2006 to 1,250 fish in 2003, based on the infrared and videographic sampling described by NMFS (2007).

3.2.2.2 Steelhead

As with spring-run Chinook salmon, there is little information on the status of steelhead in the Lower Yuba River. The historical population size likely was considerably greater than recent abundance estimates. The following account is by NMFS (2007):

> DFG estimated a spawning population of only about 200 fish annually prior to 1969. During the 1970s, DFG annually stocked hatchery steelhead from Coleman National Fish Hatchery into the lower Yuba River, and by 1975 estimated a run size of about 2,000 fish (DFG 1991). DFG stopped stocking steelhead in the lower Yuba River in 1979, and currently manages the river to protect natural steelhead through strict "catch-and-release" fishing regulations.
>
> Infrared and videographic sampling on both ladders at Daguerre Point Dam since 2003 has provided estimates of steelhead numbers migrating up the Yuba River. However, these estimates should be considered as *minimum* numbers, as periodic problems with the sampling equipment have caused periods when fish ascending the ladders were not counted.

The total abundance of adult steelhead estimated to have passed Daguerre Point Dam from 2003 to 2007 ranged from 150 fish in 2006 to 762 fish in 2004 (NMFS 2007).

3.2.3 Limiting Factors

The primary factors identified as constraints to establishing a viable, independent spring-run Chinook salmon population in the Lower Yuba River (NMFS 2009) include:

- lack of suitable spawning habitat in the Englebright Dam Reach and the Narrows Reach,
- lack of spatial or temporal segregation of spawning spring-run and fall-run Chinook salmon,
- straying of hatchery fish to the Lower Yuba River,
- fish passage impediments at Daguerre Point Dam, and
- lack of habitat complexity and diversity in the Yuba Goldfields area below the Highway 20 Bridge.

These factors are discussed below.

3.2.3.1 Lack of Suitable Spawning Habitat

Seasonal flows, water temperatures, and channel characteristics in the Lower Yuba River between Englebright Dam and Daguerre Point Dam are generally suitable for holding, spawning, and rearing of spring-run Chinook salmon based on their known life history and habitat requirements. The suitability of the river for summer holding (June through September) and late summer-early fall spawning (August through October) generally increases in an upstream direction, with the highest quality habitat in the 4-mile reach between the Narrows Pool and the Highway 20 Bridge known as Timbuctoo Bend. This reach is characterized by a series of deep, bedrock-formed pools and large spawning riffles that currently support high densities of fall-run Chinook spawners. Water temperatures in this reach typically reach suitable levels for spawning by early to late September.

Spawning by the majority of fall-run and virtually all spring-run Chinook salmon and steelhead in the Lower Yuba River occurs between Daguerre Point Dam and the Narrows Pool. Early-arriving adults (i.e., phenotypic spring-run) tend to spawn farther upstream than later arrivals (i.e., phenotypic fall-run). Little spawning habitat now exists in the 2-mile reach extending from the Narrows Pool upstream to Englebright Dam because of its steep gradient, lack of sediment supply, and armoring by rock debris (Pasternack 2008). This reach has received considerable attention for spawning habitat rehabilitation specifically aimed at spring-run Chinook salmon because of the presence of high-quality holding habitat, favorable summer water temperatures, and distance from the primary fall-run spawning areas farther downstream. Although water temperatures in this reach are believed to be most suitable for spring-run holding, spawning, and egg incubation, the lack of suitable spawning substrate currently limits spawning success. Spring-run Chinook salmon are known to hold in this reach and attempt to spawn despite the lack of suitable spawning habitat (NMFS 2007).

3.2.3.2 Lack of Temporal or Spatial Segregation of Spawning Spring-Run and Fall-Run

Englebright Dam is a complete migration barrier to anadromous fish, precluding migration of Chinook salmon to historical holding and spawning areas upstream of the dam. Consequently, both fall-run and spring-run Chinook salmon are restricted to areas below the dam. Because the two runs spawn at similar times and potentially interbreed, genetic swamping of the relatively smaller numbers of spring-run Chinook salmon by more abundant fall-run fish could occur, to the detriment of the spring-run. Competition for spawning sites or destruction of spring-run redds by later-spawning fall-run fish may also occur in areas of limited spawning habitat.

3.2.3.3 Straying of Hatchery Fish

Straying of Feather River Hatchery fish to the Lower Yuba River represents another potential constraint to establishing a productive, locally adapted stock of spring-run Chinook salmon in the Lower Yuba River. Given the proximity of the Feather River Hatchery and current planting practices, it is likely that hatchery strays make up a significant fraction of the spring-run fish that occur in the Yuba River. The potential risk posed by these fish to establishing a Yuba River spring-run stock is heightened by the uncertain genetics of Feather River Hatchery fish (Hedgecock et al. 2001).

3.2.3.4 Fish Passage Impediments

Daguerre Point Dam is recognized as an impediment to upstream migration of adult salmon and steelhead under certain flow conditions. Adult passage through the existing fish ladders is severely impaired during high flows (≥ 2,000 cubic feet per second) that commonly occur during the upstream migration periods for spring-run Chinook salmon and steelhead (NMFS 2007, ENTRIX and Monroe 2002). Factors contributing to reduced passage success include inadequate attraction flows, proximity and orientation of the ladder entrances to the spillway, periodic obstruction of the ladders by sediment and woody debris, and operating criteria that require closure of the ladders at high flows (NMFS 2007). Under these conditions, adult salmon and steelhead are subject to delay and injury as they attempt to ascend the dam face, potentially leading to reduced resistance to disease, increased prespawning mortality, and reduced egg viability. Adult spring-run Chinook salmon are particularly sensitive to such delays because of their need to conserve energy for summer holding and maturation, and their need to reach suitable holding areas before downstream water temperatures reach harmful levels. Daguerre Point Dam also may adversely affect outmigration success of juvenile salmon and steelhead. During downstream migration, juvenile salmon and steelhead may be disoriented or injured as they plunge over the spillway, increasing their exposure and vulnerability to predators in the large pool at the base of the dam.

3.2.3.5 Lack of Habitat Complexity

Historical gold mining activities in the Yuba River watershed dramatically reduced the diversity and complexity of riverine, floodplain, and riparian habitats in the Lower Yuba River. Within the Yuba Goldfields area (RM 8–14), confinement of the river by massive deposits of cobble and gravel derived from hydraulic and dredge mining activities resulted in a relatively simple river corridor dominated by a single main channel and large cobble-dominated bars, with little riparian and floodplain habitat. Englebright Dam has contributed to reductions in habitat complexity and diversity by preventing the transport of sediment, woody material, and nutrients from upstream sources to the lower river.

Low habitat complexity and diversity has been identified as a limiting factor for salmon and steelhead production in the Lower Yuba River, primarily through their effect on juvenile rearing success (Lower Yuba River Fisheries Technical Group 2005). Loss of off-channel habitats such as floodplains, riparian, and wetland habitats has substantially reduced the productive capacity of the Central Valley for many native fish and wildlife species, and evidence is growing that such habitats were once of major importance for the growth and survival of juvenile salmon (Moyle 2002). Recent observations on the Lower Yuba River indicate that remnant side channels and associated riparian vegetation play a similar role by providing flood refugia, protection from predators, and abundant food for young salmonids and other native fishes. These habitats also promote extended rearing and expression of the stream-type rearing characteristic of spring-run Chinook salmon.

3.3 Spawning Habitat Expansion Actions

3.3.1 Sinoro Bar Spawning Habitat Expansion

Sinoro Bar
(Photo courtesy of Chip McConnaha, ICF International, 2010)

This action is designed to expand spawning habitat for spring-run Chinook salmon and steelhead in the Sinoro Bar geomorphic unit of the Englebright Dam Reach of the Lower Yuba River. The following descriptions of the Englebright Dam Reach and the Sinoro Bar geomorphic unit are based on Pasternack (2008, 2009, 2010a [Appendix H], 2010b), Pasternack et al (2010), and the Corps (2010). The Englebright Dam Reach is approximately 1 mile in length and extends from Englebright Dam downstream through a relatively straight bedrock canyon to the Deer Creek confluence. This reach is characterized by steep rock walls; long, deep pools/runs interspersed with short rapids/chutes; and relatively small amounts of alluvial material. Spawnable gravels are in short supply.

An important feature of this reach is the occurrence of shot rock deposits. Shot rock is irregularly shaped (angular) rock blasted from surrounding canyon slopes. It originated from rock excavation during construction of Englebright Dam and hillside scouring during major floods. There are three shot rock deposits in the Englebright Dam Reach. The largest of these deposits is at Sinoro Bar, which is located on the north bank of the Yuba River immediately upstream of the Deer Creek confluence (Figure 3-2). Sinoro Bar is a relatively high point-bar that extends along the lower third of the reach. The deposit covering the bar is primarily a mixture of angular cobbles and boulders.

Note: Sinoro Bar, Area 3, is proposed for spawning habitat expansion

Source: Adapted from Pasternack 2008

Figure 3-2
Shot Rock Deposits in the Englebright Dam Reach

The Sinoro Bar geomorphic unit extends from the rapid upstream from Sinoro Bar downstream to the Deer Creek confluence (Figures 3-3 and 3-4). The rehabilitation area (surface area of 46,486 square meters [m^2]; valley centerline of 650 meters [m]; mean width of 71.5 m) is comprised of Sinoro Bar along the north bank and the active channel that is characterized by long, deep runs/pools and short rapids/chutes along the south bank (Pasternack 2010a).

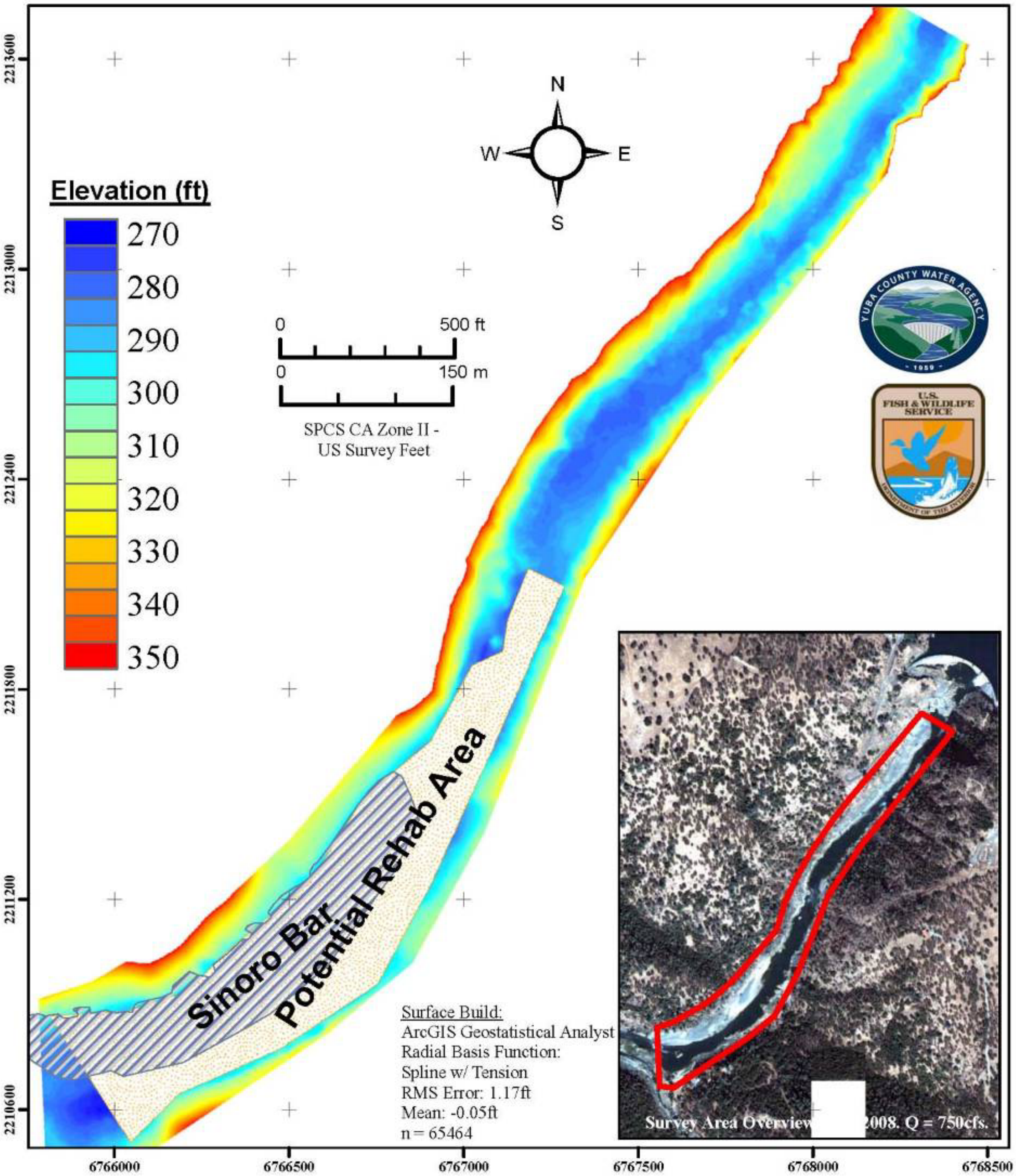
The geomorphic goals of this action are to reshape the streambed, redistribute the slope, expand the wetted width, and reduce substrate size to create riffle/run areas with gravels of suitable size for spawning. An additional geomorphic goal is to maximize the sustainability of the action by designing it to integrate with existing controlling landforms. The ultimate ecological goal is to expand spawning habitat for spring-run Chinook salmon and steelhead, while also providing a diversity of habitat features for multiple life stages of these species.

This action involves the following three primary components: (1) removal of shot rock deposited on the surface of Sinoro Bar; (2) reshaping the streambed; and (3) placement and contouring of gravel in the streambed to create suitable spawning habitat.

These components are consistent with recommendations of Pasternack, based on an analysis of historical channel conditions in this reach (Pasternack 2008, 2009, 2010a; Pasternack et al 2010). Historically, gravel bars suitable for spawning were present in what is currently known as the Englebright Dam Reach; however, spawning habitat is now severely limited due to a lack of gravel. Expansion of spawning habitat in the Englebright Dam Reach would benefit spring-run Chinook salmon in particular, as spring-run are known to hold and attempt to spawn in this reach despite the lack of suitable spawning habitat.

3.3.1.1 Removal of Shot Rock

A significant portion of the shot rock deposit that currently covers Sinoro Bar would need to be removed as the initial step. Pasternack (2009) applied a DEM to determine the spatial pattern of fill depth and total volume of sediment stored in Sinoro Bar. The model yielded an estimated total volume of sediment of 128,940 cubic meters (m^3) and a fill depth range of 0–12.1 m. This estimate was assumed to be the maximum volume of shot rock deposited at Sinoro Bar; the actual volume could be substantially less. A reasonable estimate of the volume of material that would need to be removed to prepare the site for spawning habitat expansion is 50,000 m^3 (Pasternack pers. comm.).



The potential rehabilitation area is delineated by a polygon with an orange-dot fill, while the area of Sinoro Bar is delineated by a polygon with grey diagonal lines.

Source: Pasternack 2010c

Figure 3-3
Topographic Map of Englebright Dam Reach with Sinoro Bar Expansion Area Highlighted

Source: Pasternack 2010a

Figure 3-4
Photo of Sinoro Bar Hydrographic Unit

The shot rock would be removed by heavy equipment in a stepwise manner. A preliminary phase would be initiated to remove the shot rock on the surface of the bar in order to determine the underlying materials and the need for additional removal efforts. The bulk of the shot rock would be hauled offsite. However, some of the shot rock would be used onsite to fill holes in the stream channel created by mining operations, and some would be incorporated into the final design of the spawning beds to help stabilize the alluvial spawning gravels.

3.3.1.2 Reshaping the Streambed

The streambed would need to be recontoured in preparation for gravel placement. The elevation of Sinoro Bar would be reduced sufficiently to reintegrate it into the active channel area and allow for wider riffles/runs that are not constrained by the excessive height of the current bar. The bed slope would be redistributed to change rapid-pool and chute-pool sequences into riffle-pool and run-pool sequences. Morphological diversity would be incorporated by creating a functional mosaic of geomorphic forms, rather than excessively large contiguous areas of uniform habitat. In particular, holding pools with associated cover would be incorporated into the design of the expanded spawning habitat. Finally, the effort to reshape the streambed would include design considerations for maximizing the sustainability of this action.

3.3.1.3 Gravel Placement and Contouring

Following removal of the shot rock and reshaping of the streambed, clean gravel of suitable spawning size would be placed in the streambed and contoured to yield water depths and velocities consistent with salmon spawning microhabitat needs. Pasternack (2009) estimated that approximately 100,000 m^3 of gravel would be needed for the initial gravel placement (roughly two-thirds the volume of Sinoro Bar itself). However, based on further analysis, Pasternack (pers. comm.) indicated that a more reasonable estimate for the volume of gravel that would be needed to create spawning habitat at this site is 45,000 m^3. Gravel would be purchased and hauled from a local quarry to the project site by truck and distributed by heavy equipment.

The spawning habitat created by the Sinoro Bar action is expected to be highly sustainable based on current geomorphic conditions and the inclusion of specific design considerations (Pasternack 2010a). However, it is likely that long-term maintenance activities, including periodic gravel augmentation following flood events, would be required to sustain the quantity and quality of spawning habitat. This would likely be at least partially accomplished through a gravel augmentation program that the Corps is required to perform. Under the 2007 BiOp issued by NMFS, the Corps is required to develop and implement a long-term gravel augmentation program in the Yuba River below Englebright Dam (NMFS 2007).

In November 2007, a pilot gravel injection project was initiated by the Corps, with 450 short tons of spawning-sized gravel placed below Englebright Dam (in the pool below the Narrows 2 Powerhouse). Based on the initial pilot project, the Corps is proposing to place an additional 2,000 to 5,000 short tons of spawnable-sized gravel below Englebright Dam, downstream of the Narrows 1 Powerhouse in November 2010 (Corps 2010). This would likely be the first of multiple gravel injections over a period of a few years, as proposed for the Corps by Pasternack (2010b).

Additional gravel placement or other maintenance activities as needed to sustain the spawning habitat expansion action at Sinoro Bar over the approximately 50-year life of the action would be the responsibility of the Licensees.

3.3.2 Narrows Gateway Spawning Habitat Expansion

Narrows Gateway
(Photo courtesy of Chip McConnaha, ICF International, 2010)

This action is designed to expand spawning habitat for spring-run Chinook salmon and steelhead in the Narrows Gateway geomorphic unit of the Narrows Reach of the Lower Yuba River. The following descriptions of the Narrows Reach and the Narrows Gateway geomorphic unit are based on Pasternack (2010c) (Appendix K). The Narrows Reach is approximately 1 mile in length and extends from Deer Creek downstream, through a narrow bedrock canyon, to the bottom end of the Narrows Pool. The upper third of this reach, comprised of the Narrows Gateway geomorphic unit and the S-turn geomorphic unit, is characterized by a series of rapids, chutes, runs, and small pools; scattered bedrock outcrops; and a few cobble/gravel bars. The middle third consists of a long rapid (Skinny Escalator) and a long run (Narrows Respite), as the river transitions into the Narrows Pool. The lower third consists entirely of the Narrows Pool, which is the longest and deepest pool in the Lower Yuba River. Only the upper third of the reach contains alluvial bars with cobble and gravel. However, spawnable habitat is limited due to (1) high, stable bars that constrict the active channel, creating narrow, moderately deep, and fast rapids; and (2) streambed armoring (coarsening of the surface substrate).

The Narrows Gateway geomorphic unit is located at the upstream end of the Narrows Reach, immediately downstream of the Deer Creek confluence (on the south bank) and the Sinoro Bar spawning habitat expansion site (on the north bank) (Figures 3-5 and 3-6). The entire alluvial extent of the Narrows Gateway (area of 15,833 m²; valley centerline of 217.9 m; mean width of 72.7 m) is recommended for rehabilitation (Pasternack 2010c). It is currently comprised of two active channels separated by a cobble bar. The main channel along the north bank consists of a series of high-velocity rapids, chutes, and runs. The side channel along the south bank is influenced by Deer Creek and is primarily riffle habitat. The two channels converge in a pool at the base of the cobble bar.

The geomorphic goals of this action are similar to those at Sinoro Bar and include reshaping the streambed, redistributing the slope, expanding the wetted width, and reducing substrate size to create riffle/run areas with gravels of suitable size for spawning. An additional geomorphic goal is to maximize the sustainability of the action by designing it to integrate with existing controlling landforms. The ultimate ecological goal is to expand spawning habitat for spring-run Chinook salmon and steelhead, while also providing a diversity of habitat features for multiple life stages of these species.

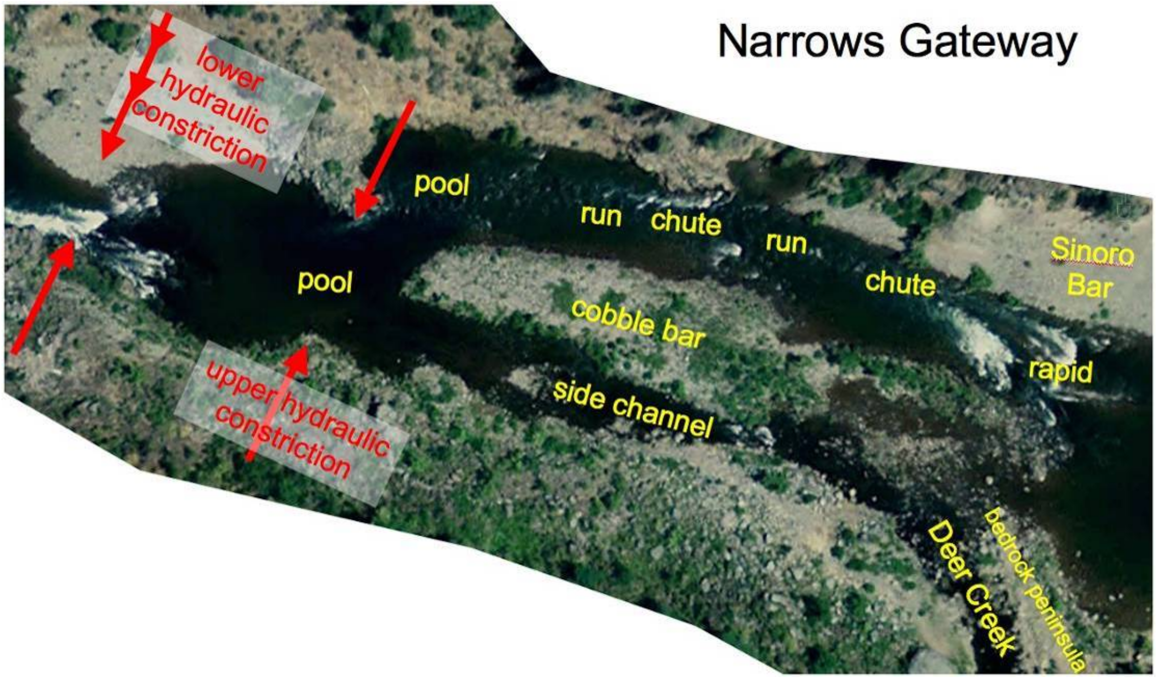
This action involves the following three primary components (1) removal of excess cobbles and boulders from Narrows Gateway; (2) reshaping of the streambed; and (3) placement and contouring of gravel in the streambed to create suitable spawning habitat.

These components are consistent with recommendations of Pasternack (2010c), based on an analysis of historical channel conditions in this reach. Historically, the Narrows Reach has experienced dramatic geomorphic change due to mining, upstream dam construction, and recurring floods. Alluvial features that were at one time quite prevalent are now substantially reduced, and spawning habitat is limited. Expansion of spawning habitat in Narrows Gateway would benefit both spring-run Chinook salmon and steelhead.

3.3.2.1 Removal of Excess Cobbles and Boulders

Excess cobbles and small boulders that occur on high bars or are part of the armored layer of the streambed in Narrows Gateway would be removed as the initial step in the rehabilitation process. The actual volume of material that would be removed is unknown at this time. Test digs would need to be conducted to make this determination. A conservative estimate can be made by assuming removal of material to a depth of 0.33 m over the entire recommended rehabilitation area (i.e., 15,833 m^2). This results in a volume estimate of 5,225 m^3.

Rather than excavating and hauling this material offsite, heavy equipment could be used to scrape the material off the streambed and move it into the active stream channel downstream. The best location for instream disposal of this material is at the head of the Skinny Escalator geomorphic unit, which is located approximately 325 m downstream from the lower end of Narrows Gateway (Figure 3-7). Material placed in the Skinny Escalator, a narrow, steep rapid, would be mobilized and carried downstream to the Narrows Pool, where it would be deposited. Due to the exceptionally large capacity of the Narrows Pool, no significant impact would be expected as a result of this operation.



Source: Pasternack 2010c

Figure 3-5
Aerial Photo of Narrows Gateway Geomorphic Unit, with Identified Features

Source: Pasternack 2010c

Figure 3-6
Photo of Narrows Gateway Geomorphic Unit

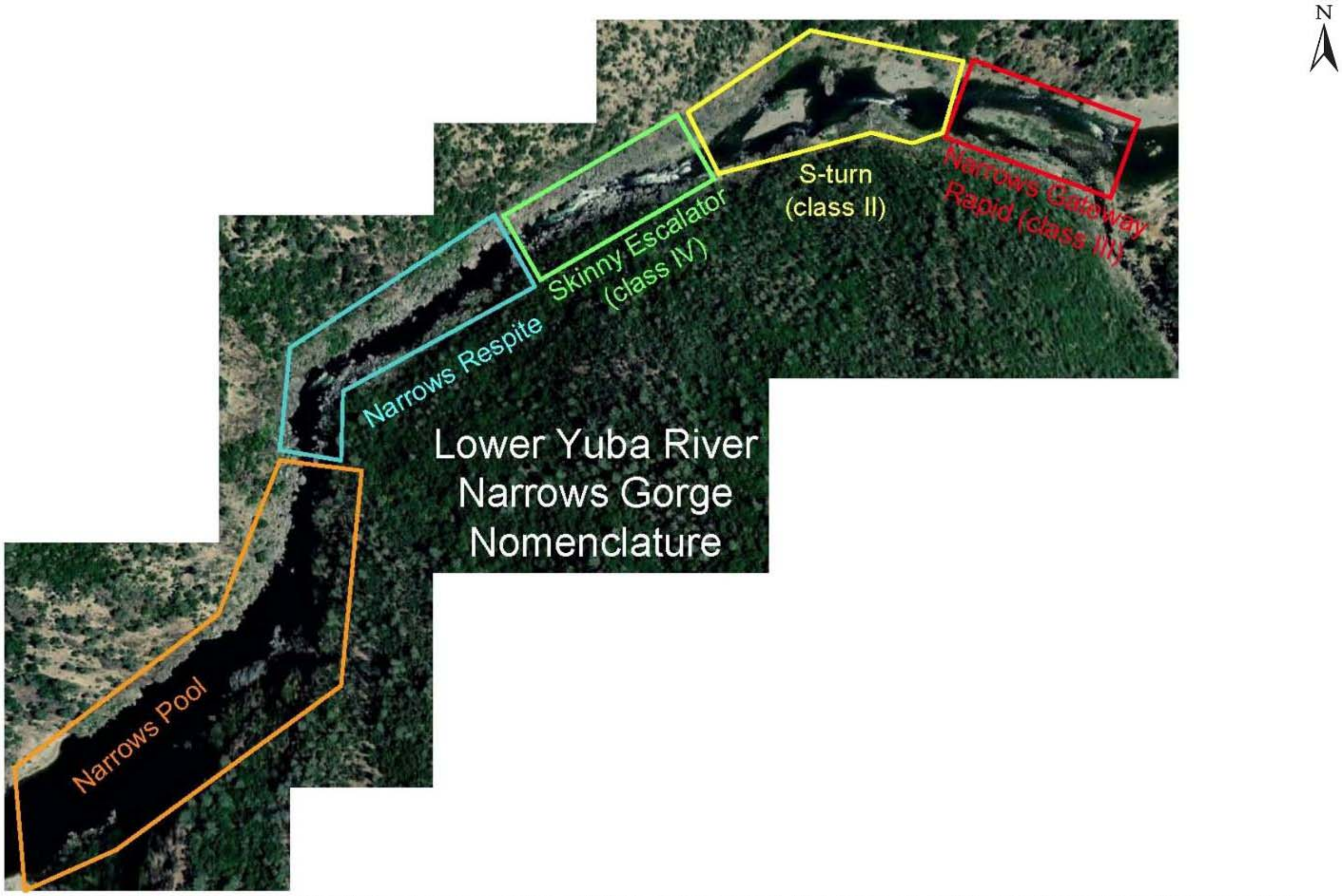
3.3.2.2 Reshaping the Streambed

As part of the effort to remove the excess cobbles and small boulders in Narrows Gateway, the streambed would need to be recontoured in preparation for gravel placement. The elevation of emergent bars would be reduced to reintegrate them into the active channel area and allow for wider riffles that are not constrained by excessively high bars. The bed slope would be redistributed to change rapid-pool and chute-pool sequences into riffle-pool sequences. Morphological diversity would be incorporated by creating a functional mosaic of geomorphic forms, rather than excessively large contiguous areas of uniform habitat. In particular, holding pools with associated cover would be incorporated into the design of the expanded spawning habitat. Finally, the effort to reshape the streambed would include design considerations for maximizing the sustainability of this action.

3.3.2.1 Gravel Placement and Contouring

Following removal of the excess cobbles and small boulders and reshaping of the streambed in Narrows Gateway, clean gravel of suitable spawning size would be placed in the streambed and contoured to yield water depths and velocities consistent with salmon spawning microhabitat needs. The actual volume of gravel that would be introduced is unknown at this time. A conservative estimate can be made by assuming placement of gravel to a depth of 1 m over the entire recommended rehabilitation area (i.e., 15,833 m^2). This results in a volume estimate of 15,833 m^3. Gravel would be purchased and hauled from a local quarry to the project site by truck and distributed by heavy equipment.

The spawning habitat created by this action is expected to be highly sustainable based on the resiliency of alluvial landforms in Narrows Gateway through time (Pasternack 2010c). However, it is likely that long-term maintenance activities, including periodic gravel augmentation, would be required to sustain the quantity and quality of spawning habitat. This would likely be at least partially accomplished through a gravel augmentation program that the Corps is required to perform (as discussed in Section 3.3.1.3 above). Additional gravel placement or other maintenance activities as needed to sustain the spawning habitat expansion action in Narrows Gateway over the approximately 50-year life of the action would be the responsibility of the Licensees.



Aerial photograph of the Narrows Reach showing geomorphic-unit delineations and establishing a nomenclature for the individual features at this spatial scale (2009 NAIP)

Source: Pasternack 2010c

Figure 3-7
Aerial Photo of the Narrows Reach

3.3.3 Objectives and Benefits

The spawning habitat expansion actions at Sinoro Bar and Narrows Gateway would address the substrate changes that have occurred in these portions of the Lower Yuba River due to mining activities and construction and operation of Englebright Dam. Historically, spring-run Chinook salmon and steelhead migrated far beyond the existing dam site and spawned in higher elevation reaches of the watershed. With Englebright Dam acting as a complete barrier to upstream migration, salmon and steelhead are now limited to spawning in the lower river below the dam. The existing spawning habitat has been altered by mining activities in the watershed, scouring of gravel beds downstream of the dam, blockage of downstream movement of source gravel at the dam, and deposition of shot rock at three primary locations within the Englebright Dam Reach. This has resulted in a virtual lack of suitable spawning habitat in the Englebright Dam Reach and the Narrows Reach.

The lack of suitable spawning gravel in these reaches is a critical limiting factor for spring-run Chinook salmon in the Lower Yuba River. The primary objective of the spawning habitat expansion actions is to address this limiting factor by creating suitable spawning areas in the Yuba River at Sinoro Bar and Narrows Gateway.

3.3.4 Estimated Cost

3.3.4.1 Capital Cost

The prefeasibility-level capital cost estimates for the spawning habitat expansion actions at Sinoro Bar and Narrows Gateway are approximately $5.9 million and $1.8 million, respectively. The estimated capital cost for the combined actions is $7.7 million.

3.3.4.2 Operations and Maintenance

As discussed in Sections 3.3.1.3 and 3.3.2.3, it is likely that long-term maintenance activities, including periodic gravel augmentation, would be required to sustain the quantity and quality of spawning habitat at Sinoro Bar and Narrows Gateway. This would be at least partially accomplished through a gravel augmentation program that the Corps is required to perform under the 2007 BiOp. Additional gravel placement or other maintenance activities to sustain the spawning habitat expansion actions at Sinoro Bar and Narrows Gateway over the approximately 50-year life of these actions would be the responsibility of the Licensees. The estimated annual O&M cost for these activities is $8.0 million.

3.3.5 Implementation Schedule

Design and permitting work for the spawning habitat expansion actions could be initiated as soon as approval is received on the HEP and the Licensees receive FERC licenses for their respective hydroelectric projects. The design and permitting phase of these actions is assumed to require from 1 to 2 years.

The spawning habitat expansion actions at Sinoro Bar and Narrows Gateway would be implemented concurrently and would use the same access roads and mobilization areas. Currently, two options are being evaluated for heavy equipment access: (1) use of existing roads on the south side of the river that reach the mouth of Deer Creek; and (2) construction of a new road on the north side of the river from YCWA's Narrows 2 Powerhouse access road to the project site.

Assuming use of existing access roads from the south, road upgrades and in-channel habitat expansion activities (i.e., shot rock removal, excess cobble/boulder removal, streambed reshaping, and gravel placement) would be completed over a single summer/fall season. Assuming construction of a new road on the north side, road construction and in-channel habitat expansion activities would be completed over two successive summer/fall seasons. The actual timing of this work would depend on the magnitude of flow releases below Englebright Dam and requirements established under a DFG Streambed Alteration Agreement (SAA) for in-channel work, including one or more temporary crossings of the Yuba River.

3.3.6 Implementation Responsibilities of Licensees

As soon as NMFS approves the Final HEP, the Licensees would prepare a Preliminary Design Report for the spawning habitat expansion actions. When the Licensees accept each of the new FERC licenses for the Oroville, Poe, and Upper North Fork Feather River Projects, the Licensees would begin the final design and permitting phase. Implementation of the spawning habitat expansion actions would include removal of shot rock from Sinoro Bar, removal of excessive cobbles and boulders from Narrows Gateway, recontouring of the streambed, and placement and contouring of gravel to create spawning habitat. Further project details would be developed through field testing, agency discussions, and additional geomorphic modeling by Dr. Pasternack as needed.

Each Licensee would be responsible for one-half of the total costs of these actions. The Licensees would consult with landowners and other stakeholders throughout the planning and implementation phases, and would jointly hire contractors to complete the work.

The Licensees would provide annual O&M as needed for the approximately 50-year life of the project to ensure the sustainability of the spawning habitat expansion actions.

3.3.7 Other Issues

Several permits would be required to implement the spawning habitat expansion actions. An issue of particular note is the timing of instream work at Sinoro Bar. Assuming that heavy equipment would be moved down to the south side of the river, it would need to be moved across the river to reach Sinoro Bar on the north bank. Due to high streamflow conditions below Englebright Dam during most of the year, as required by the Yuba Accord, the window of opportunity for moving the equipment across the river likely would be limited to the late summer/fall period. This period would at least partially overlap with the spawning period for both spring-run and fall-run Chinook salmon.

The potential sensitivity to conducting the instream work, including a temporary crossing of the Yuba River to access Sinoro Bar, would need to be addressed through an SAA issued by DFG. The Licensees have been coordinating with DFG regarding the HEP recommended actions and issues associated with obtaining an SAA. DFG has expressed support for the spawning habitat expansion actions and has indicated that an SAA likely would be issued for the instream work (Hill pers. comm.).

Additionally, the Licensees would need to engage local landowners to obtain permission for accessing the stream channel in order to implement the spawning habitat expansion actions. Currently, two options are being evaluated for heavy equipment access: (1) use of existing access roads on the south side of the river that reach the mouth of Deer Creek; and (2) construction of a new road on the north side of the river from YCWA's Narrows 2 powerhouse access road to the project site. Constructing an access road on PG&E's property on the north side of the river is possible but raises a number of environmental concerns (i.e., impacts to terrestrial resources and erosion issues). Accessing the work sites by crossing private property on the south side of the river appears to be the most feasible option. As a result, the Licensees have been coordinating with the private landowners regarding the use of their property to access these sites. The landowners have been supportive of the spawning habitat expansion actions and have offered to help develop them by providing historical information related to the subject stream reaches. The Licensees have solicited temporary entry permits from the landowners and expect to receive the permits in the near future, based on positive communications.

3.4 Segregation Weir

Narrows Pool Outlet (Potential site for the optional segregation weir would be downstream of Narrows Pool)
(Photo courtesy of Scott Morford, UC Davis, 2006)

3.4.1 Description

The HEA directs that actions are to benefit spring-run Chinook salmon and steelhead, and should encourage the separation of spawning fall-run and spring-run Chinook salmon. There is evidence that natural segregation of fall-run and spring-run Chinook salmon would occur, such that fall-run fish would spawn mainly below the Narrows Pool and spring-run fish would spawn in the expanded habitat above the Narrows Pool. However, during years with high escapement of fall-run Chinook salmon, superimposition and competition for appropriate spawning habitat can limit spring-run Chinook salmon spawning success. For this reason, the Lower Yuba River Actions include an optional action to construct and operate a segregation weir at the upstream end of Timbuctoo Bend that would allow for mechanical separation of the two runs, if deemed necessary in the future by the resource agencies (NMFS, USFWS, and DFG).

The use of weirs to separate species or races of salmon is a well-proven technique and is used or planned for use in other Sacramento River streams, including Battle Creek and Clear Creek, and the Feather River, respectively. Although this action does not independently expand available habitat, inclusion of the action could considerably enhance the value of the spawning habitat expansion actions at Sinoro Bar and Narrows Gateway for spring-run Chinook salmon.

The seasonal segregation weir would be used to provide near-exclusive access for spring-run Chinook salmon to the uppermost holding and spawning habitat on the Lower Yuba River between Englebright Dam (RM 23) and the Narrows Pool (RM 21). This reach contains the highest potential to create quality spring-run salmon holding and spawning habitat in the Lower Yuba River based on the frequency of large, deep pools; geomorphic features that allow for the restoration/creation of spawning habitat; and favorable summer water temperatures. The weir would be operated (or removed) to permit passage of Chinook salmon during the primary spring-run Chinook salmon migration period and operated (or installed) to prevent passage of Chinook salmon during the primary fall-run Chinook migration period. While any segregation weir is unlikely to provide 100 percent segregation, the weir could be operated to attain a favorable proportion of spring-run Chinook salmon utilizing the newly created habitat area, as determined by the resource agencies.

The weir is not intended to create an absolute barrier within the river, or to confine all spring-run Chinook salmon to a limited portion of the river. The expectation is a continuum of Chinook spawning above Daguerre Point Dam, with spring-run Chinook salmon concentrating above the Narrows Pool and fall-run fish concentrating below that point. Passage of steelhead migrating during the latter period would need to be addressed in the design and construction and/or operation of the weir.

The location, seasonal operation, and design of the weir would need to be determined based on migration timing, channel and flow characteristics, and habitat needs (i.e., the amount of habitat needed to establish a viable spring-run Chinook salmon population). Preliminary acoustic tagging studies have indicated that some portion of spring-run Chinook salmon may hold downstream of Daguerre Point Dam until early fall (Alber 2010). Based on this preliminary information, it is unclear what proportion of spring-run Chinook salmon hold below the dam; consequently, this issue would require further investigation to determine appropriate timing of operation.

Another major consideration would be the ability of the weir to operate effectively over the range of flows anticipated during the primary fall-run Chinook migration period (July through December). This suggests possible use of a resistance board weir, although the design of the weir is yet to be determined and would be developed in coordination with the resource agencies. Resistance board weirs rely on a cable anchored to the substrate at the upstream end of the weir site. Panels with some form of floatation on one end and a shackle on the other are then secured to this cable. This arrangement provides an impassable barrier to anadromous salmonids, while allowing boats and debris to depress the weir and pass over the top (Stewart 2003). In periods of extremely high flow, this type of weir is designed to lie along the bottom due to the increased force of the water. Resistance board weirs have been used extensively in Alaska and on the Stanislaus River in California (Anderson et al. 2007). Board weirs also can accommodate video monitoring to estimate abundance, another element that could be incorporated into this action, if needed.

3.4.1.1 Adaptive Management Plan

Conceptually, the segregation weir could be managed under two strategies, a long-term strategy and an in-season strategy. The long-term strategy would determine the overall need for installation of the segregation weir to ensure adequate separation between the runs. The in-season strategy would involve an annual decision whether to install the segregation weir based on projections for the seasonal abundance of fall-run Chinook salmon. For example, should the fall-run projections indicate a high potential for spawning overlap with spring-run, the weir could be installed. The Steering Committee anticipates that the segregation weir would be adaptively managed by the resource agencies, with funding provided by the Licensees.

If the resource agencies decided that a greater degree of segregation was required than was occurring naturally, they could install the segregation weir and manage it to achieve a particular proportion of spring-run over fall-run Chinook salmon. This could be accomplished through implementation of described in an Adaptive Management Plan (AMP) (see Appendix J for a proposed concept for an AMP related to the optional segregation weir). If the resource agencies determined that an adequate degree of natural segregation was occurring between the spring-run and fall-run Chinook salmon at the Sinoro Bar and Narrows Gateway spawning habitat expansion sites, and that a segregation weir was not a necessary component of the Lower Yuba River Actions, the Licensees would consider funding other restoration actions in the Lower Yuba River, such as the juvenile rearing habitat expansion actions described in Appendix L.

3.4.2 Objectives and Benefits

The objective of the segregation weir option is to provide a mechanical means of spatially segregating spring-run Chinook salmon from fall-run Chinook salmon. Both runs have been confined to the lower reaches of the Yuba River since construction of Englebright Dam in 1941 (DFG 1991). Spring-run Chinook salmon are unable to migrate beyond this barrier into the higher elevation reaches they historically occupied and are therefore unable to naturally segregate themselves from fall-run Chinook salmon. This spawning overlap threatens the spring-run population in a variety of ways, including destruction of redds due to superimposition, competition for spawning grounds limiting the usable habitat for spring-run Chinook salmon, and introgression causing the loss of a genetically distinct spring-run Chinook salmon.

Installation of a segregation weir addresses all three of these issues. By using the weir to exclude fall-run Chinook salmon from the habitat being utilized by spring-run Chinook salmon, superimposition of fall-run redds upon the earlier constructed spring-run redds would be minimized. Similarly, competition for spawning habitat would be minimized by removing fall-run Chinook salmon from specific reaches designated as habitat for spring-run Chinook salmon.

Genetic introgression is one of the biggest issues associated with the limitations imposed upon spring-run Chinook salmon by large dams. Spawning overlap can contribute to hybridization between fall-run and spring-run Chinook salmon, thereby compromising genetic distinctions between the two runs. However, a study by Banks et al. (2000) seems to indicate that, even when these two runs spawn in the same reaches, they may naturally segregate to some degree. Additionally, strays from the Feather River Hatchery potentially compromise the Yuba River spring-run Chinook salmon genetics (Reedy pers. comm.). By installing a segregation weir and preserving the spring-run Chinook salmon phenotype, it is likely that the spring-run genotype also would be preserved. Waples et al. (2004) suggest a coarse estimate that, in most basins (including the Sacramento River Basin), the spring-run genotype may have evolved in a period as short as 80–100 years. Given the current phenotypic spring-run Chinook salmon stock present in the Lower Yuba River, it is likely that restoration and conservation of spring-run Chinook salmon genetics could be realized in a considerably shorter period following spatial segregation.

3.4.3 Estimated Cost

3.4.3.1 Capital Cost

The pre-feasibility capital cost estimate for installing a resistance board weir to segregate spring-run Chinook salmon from fall-run Chinook salmon, including permitting, design, and construction, is approximately $300,000.

3.4.3.2 Operations and Maintenance

Pre-feasibility cost estimates for O&M include annual installation and removal of the weir, and repairs as necessary. Annual O&M costs are estimated at approximately $52,000. O&M costs are conservatively estimated to be $2.6 million for a period of 50 years. This amount is likely an overestimate because seasonal installation of the segregation weir would be dependent on necessity and spring-run Chinook salmon holding behavior.

3.4.4 Implementation Schedule

Assuming a decision by the resource agencies that a segregation weir is warranted, its implementation would occur following completion of the spawning habitat expansion actions upstream. With local stakeholder and agency support, implementation would likely be possible in less than 1 year following the decision to proceed. However, this action would be adaptively managed and would be implemented only if spawning overlap was determined to be a major limiting factor within the upper reaches of the Lower Yuba River and if the weir was supported by the resource agencies.

3.4.5 Implementation Responsibilities of Licensees

As soon as NMFS approves the Final HEP, the Licensees would prepare a Preliminary Design Report for implementation of the segregation weir. When the Licensees accept each of the new FERC licenses for the Oroville, Poe, and Upper North Fork Feather River Projects, the Licensees may begin the final design and permitting phase for implementation of the segregation weir, assuming that consensus exists that the weir is needed to provide separation of spring-run Chinook salmon from fall-run Chinook salmon.

Each Licensee would be responsible for one-half of the capital costs (including permitting, design, and construction of the weir) and one-half of the O&M costs (including annual installation and removal and necessary repairs). It is possible that the Licensees could provide funding for DFG or another party for the long-term operation and maintenance of the structure. The Licensees would consult with other stakeholders throughout the planning and implementation phases.

3.4.6 Other Issues

Two primary issues are associated with installation of a segregation weir on the Lower Yuba River. These concerns relate to potential adverse effects on spring-run Chinook salmon and potential adverse effects on fall-run Chinook salmon.

Preliminary results indicate that at least some phenotypic spring-run Chinook salmon hold in the pool immediately downstream of Daguerre Point Dam. The proportion of spring-run holding downstream is still unclear. A primary concern related to installing a segregation weir is unintentional exclusion of spring-run Chinook salmon from the habitat above the weir. This could result from spring-run Chinook salmon migrating late during the typical fall-run Chinook salmon migration period. While this could be potentially problematic, these fish would still be able to spawn within the Timbuctoo Bend reach—currently the most heavily utilized spawning reach. Additionally, selection for the early returning fish could be beneficial to the establishment of a genotype more consistent with the historical populations, thereby providing a more favorable stock for future reintroduction to the upper watershed.

The other concern is that the segregation weir could negatively affect fall-run Chinook salmon or steelhead by decreasing the available spawning area. Therefore, if the weir is determined to be necessary, it is essential that installation timing and operations minimize potential negative impacts on fall-run Chinook salmon and steelhead, as well as spring-run Chinook salmon. By placing the weir below and in close proximity to the Narrows Pool, adverse effects to fall-run Chinook salmon would be minimal, since very few fish utilize the reaches of stream above the proposed location of the weir for spawning.

3.5 Summary

The recommended actions consist of the following three components, collectively referred to as the Lower Yuba River Actions:

- expansion of spawning habitat at Sinoro Bar in the Englebright Dam Reach above the Deer Creek confluence;
- expansion of spawning habitat at Narrows Gateway in the Narrows Reach below the Deer Creek confluence; and
- the option of planning for and installing a seasonally operated segregation weir on the Yuba River below the outlet of the Narrows Pool to segregate spring-run and fall-run Chinook salmon if deemed necessary by the resource agencies (NMFS, USFWS, and DFG).

The Licensees estimated a pre-feasibility-level cost estimate for implementing each component of the Lower Yuba River Actions. The total estimated costs are presented in Table 3-1.

Table 3-1. Estimated Costs of the Recommended Lower Yuba River Actions

Recommended Action	Total Estimated Cost (millions of dollars)
Sinoro Bar and Narrows Gateway spawning habitat expansion	\$15.7[a]
Optional segregation weir	\$2.9[a]
Design and permitting	\$0.9
Contingency (20%)	\$3.9
Total estimated cost of Lower Yuba River Actions	**\$23.4**

[a] Total estimated costs include capital costs and operations and maintenance costs for 50 years.

Each Licensee would be responsible for one-half of the total costs of these actions. The Licensees would provide annual O&M as needed for the approximately 50-year life of the project to ensure the sustainability of the spawning habitat expansion actions.

Based on the next steps presented in Chapter 5 and the timeline provided in Appendix A, the Lower Yuba River Actions can be implemented within approximately 5 years once approved by NMFS.

The Licensees would consult with landowners and other stakeholders throughout the planning and implementation phases, and would jointly hire contractors to complete the work. As discussed in Chapter 4, the Licensees envision the recommended actions as part of an overall integrated plan for the Lower Yuba River. The Licensees would continue to work with the resource agencies and other stakeholders in the watershed to ensure the success of all ongoing and planned programs.

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Chapter 4
Rationale for Selection of Habitat Expansion Plan Actions

4.1 Introduction

The actions recommended by the Licensees under the HEA (the Lower Yuba River Actions) are described in detail in Chapter 3. The results of the Steering Committee's analysis and scoring of the recommended actions relative to the Evaluation and Selection Criteria specified in the HEA are provided in Appendix F.

The recommended actions achieve the goals of the HEA by expanding habitat in the Yuba River below Englebright Dam to support spawning, rearing, and holding of spring-run Chinook salmon and steelhead. The Licensees expect that the actions will be a significant part of a coordinated effort between the Licensees, resource agencies, landowners, and citizens groups to create a spring-run Chinook salmon management area in the upper portion of the Lower Yuba River from Englebright Dam down to the outlet of the Narrows Pool—a distance of approximately 2 miles. Steelhead are expected to benefit from the recommended habitat expansion actions as well.

The Lower Yuba River Actions consist of the following three separate components that are expected to work synergistically with other actions in the Lower Yuba River implemented by the resource agencies, the Corps, and local entities (Figure 4-1):

- expansion of spawning habitat at Sinoro Bar in the Englebright Dam Reach above the Deer Creek confluence (Figure 4-2);
- expansion of spawning habitat at Narrows Gateway in the Narrows Reach below the Deer Creek confluence (Figure 4-3); and
- the option for a seasonally operated segregation weir on the Yuba River below the outlet of the Narrows Pool (Figure 4-4) if deemed necessary by the resource agencies (NMFS, USFWS, and DFG).

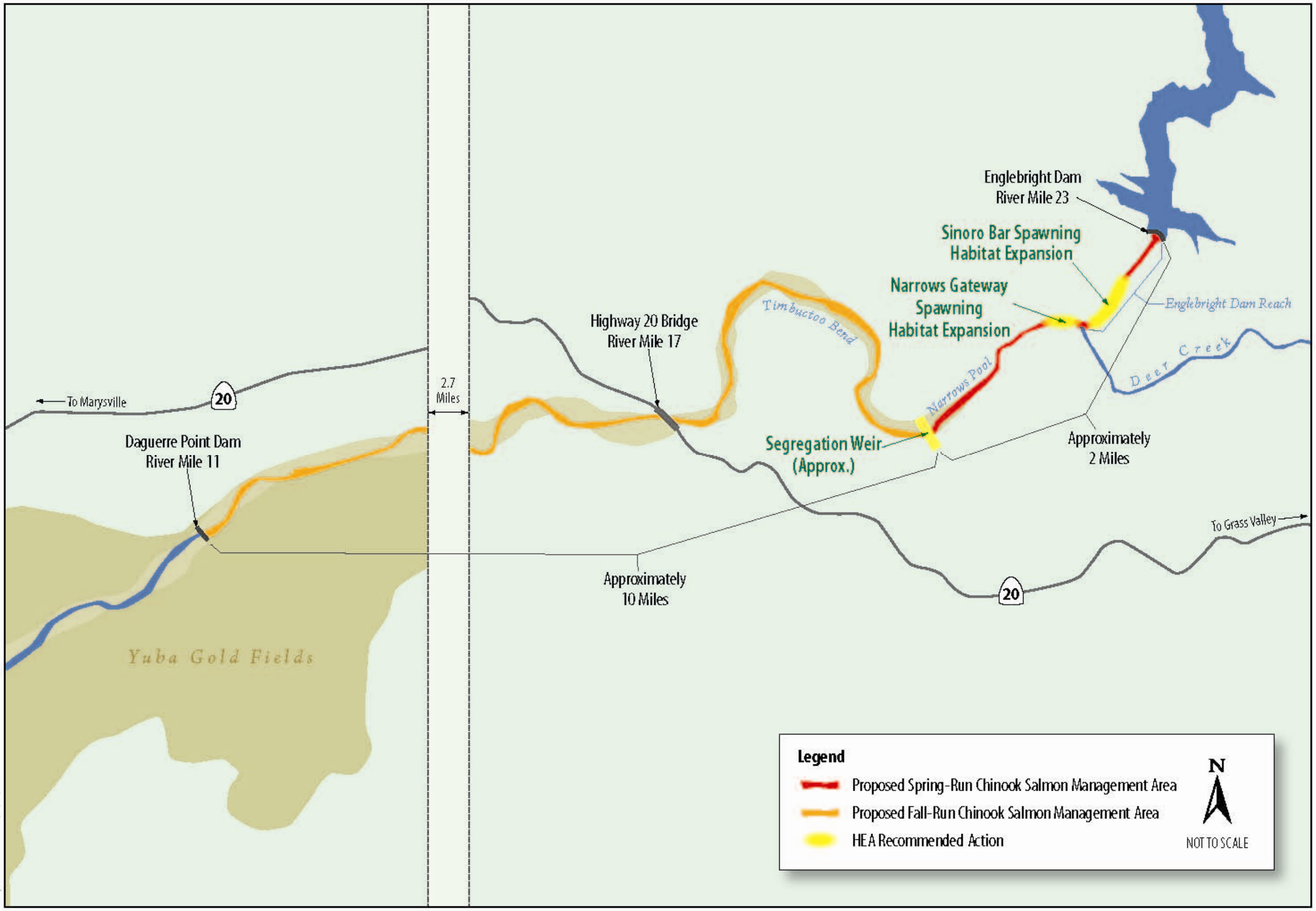

Figure 4-1
Recommended Habitat Expansion Actions in the Lower Yuba River

(Photo courtesy of Chip McConnaha, ICF International)

Figure 4-2
Sinoro Bar

(Photo courtesy of Chip McConnaha, ICF International)

Figure 4-3
Narrows Gateway

(Photo courtesy of Scott Morford, UC Davis)

Figure 4-4
Narrows Pool (potential site for the optional segregation weir would be downstream of the Narrows Pool)

4.2 Limiting Factors

The Lower Yuba River Actions would expand spawning habitat for spring-run Chinook salmon and steelhead in the upper portion of the Lower Yuba River from Englebright Dam to the outlet of the Narrows Pool, referred to as the HEP action area. This section of the Yuba River is tightly confined within valley walls, with limited-to-nonexistent floodplain. The area has been heavily impacted by hydraulic mining that continues to depress native fish production. Hydraulic mining in the upper watershed during the 19th century mobilized immense amounts of gravel and rock into the HEP action area and further downstream. Mining debris filled the valley and significantly aggraded the river channel. The river has since cut down to its present grade. During the 20th century and continuing to the present, mining has reworked the gravel within the HEP action area and has significantly altered the channel and riverine features (Pasternack et al. 2010).

Flow and temperature in the HEP action area are controlled to a large degree by upriver storage projects, particularly operation of the largest reservoir, New Bullards Bar. Flows from New Bullards Bar Dam are managed under the Yuba Accord, which provides flows to enhance conditions in the Lower Yuba River for salmonids. Due to the release of cold water from New Bullards Bar Reservoir under the Yuba Accord, late summer and fall water temperatures below Englebright Dam remain lower, and flows higher, than occurred in the area historically.

Englebright Dam was constructed in 1941 to block the downstream movement of mining debris, cutting off the natural recruitment of gravel into the HEP action area. Construction of the dam dislodged considerable amounts of angular cobbles and boulders (termed shot rock) from the canyon walls. This material has moved downstream, armoring features such as Sinoro Bar and, along with mining practices in the area, degraded their value as salmonid spawning habitat (Pasternack et al. 2010).

Deer Creek enters the Yuba River from the south and divides the HEP action area into two hydraulic reaches, the Englebright Dam Reach and the Narrows Reach.

The Englebright Dam Reach contains Sinoro Bar, a large, stable gravel bar originally created by mining activities (Pasternack et al. 2010). Conditions on Sinoro Bar are degraded with respect to its value as salmonid habitat, due to shot rock armoring that has accumulated since the construction of Englebright Dam (Pasternack 2010a). The Narrows Reach is tightly confined by canyon walls. Within the Narrows Reach, Pasternack (2010c) defined five geomorphic units moving downstream: Narrows Gateway, S-Turn, Skinny Escalator, Narrows Respite, and the Narrows Pool. Narrows Gateway and the S-Turn are described as having rapid-chute-run-pool sequences with considerable potential for spring-run Chinook spawning and rearing (Pasternack 2010c). The Skinny Escalator section is a Class IV boulder rapid that transitions into the Narrows Pool through Narrows Respite, a calm stretch of deeper water. The Narrows Pool is a deep (30-foot) pool with considerable value as holding habitat for adult spring-run Chinook salmon.

According to the Public Draft Recovery Plan, conditions in the Englebright Dam Reach and the Narrows Reach are constrained with respect to spring-run Chinook salmon production by (1) hydrologic changes resulting from operation of upstream dams; (2) elimination of gravel and wood recruitment from upstream areas due to Englebright Dam; (3) armoring of the channel and gravel bars by shot rock; (4) channel aggradation resulting from hydraulic mining debris deposited prior to construction of Englebright Dam; and (5) channel and bed alterations from small-scale dredge mining (Figure 4-5) (NMFS 2009). Flow alterations (constraint 1) in the Lower Yuba River are now managed through the Yuba Accord, while the Corps is charged to inject gravel and large wood below Englebright Dam under the NMFS 2007 BiOp (constraint 2). The recommended actions address the remaining three habitat constraints.

(Photo courtesy of Jim Butler)

Figure 4-5
Photo of a Gold Mining Operation on Sinoro Bar circa 1960

4.3 Rationale for Selection of Recommended Actions

The rationale for the Licensees recommending the Lower Yuba River Actions is grounded in the goals, terms, and conditions of the HEA and the ability of the actions to provide a significant, timely, and much needed contribution to the conservation and recovery of spring-run Chinook salmon and steelhead. The recommended actions were selected because they:

- fully meet the HET;
- support separating spring-run and fall-run Chinook salmon;
- support development of an independent, self-sustaining population of spring-run Chinook salmon;
- provide timely benefits to spring-run Chinook salmon and steelhead;
- are cost effective, feasible, and sustainable;
- require minimal human intervention;
- are buffered from the effects of climate change by flow management practices under the Yuba Accord;

- are consistent with NMFS' recovery goals and plan;
- have local and political support;
- are eligible under the HEA; and
- support an integrated plan for management of spring-run Chinook salmon in the Lower Yuba River.

Each of these items is discussed further in the following sections.

4.3.1 Contribution to the HET

The recommended actions fully meet the HET. The recommended actions provide expanded habitat with the potential to significantly exceed the HET. In Section 2.2, "Habitat Expansion Threshold," the HEA states:

> The specific goal of the Agreement is to expand spawning, rearing and adult holding habitat sufficiently to accommodate an estimated net increase of 2,000 to 3,000 Spring Run [Chinook salmon] for spawning ("Habitat Expansion Threshold") in the Sacramento River Basin as compared to the habitat available under any relevant Existing Requirements or Commitments. The Habitat Expansion Threshold is focused on Spring-Run as the priority species, as expansion of habitat for Spring-Run typically accommodates Steelhead as well.

In other words, the HEP actions need to expand habitat in the Sacramento River to accommodate spring-run Chinook salmon and steelhead by providing a sufficient quantity of habitat to support the numeric goal of the HET and with qualities consistent with the habitat needs of spring-run Chinook salmon. As stated in Section 6.1 of the HEA, the Licensees are obligated to provide habitat but are not obligated to guarantee or verify fish production or habitat utilization. The actual number of fish that return is determined to a large degree by factors outside the Yuba River, including conditions in the Sacramento River, the Bay-Delta, and the Pacific Ocean that are beyond the scope of the HEA.

The HEA directs the Licensees to use the "[c]ontribution to achieving the Habitat Expansion Threshold" (Section 4.1.2[a] of the HEA) as a criterion for selection of habitat expansion actions. NMFS is directed to consider the "extent to which" the recommended habitat expansion action(s) "meet the Habitat Expansion Threshold" (Section 4.2.3[a] of the HEA) in their evaluation of the Final HEP. However, the HEA does not specify a methodology for estimating the contribution of recommended actions to the HET. For this reason, the Licensees developed a method to estimate the contribution to the HET.

In keeping with the language of the HEA, the Licensees assumed that actions benefiting spring-run Chinook salmon would also benefit steelhead, and no explicit evaluation of the actions was made with regard to their benefits for steelhead.

The actual number of Chinook salmon (spring-run and fall-run) spawning above Timbuctoo Bend has not been consistently evaluated; anecdotally, it appears that very few Chinook salmon presently spawn in this area. Consequently, the recommended actions should minimally affect fall-run Chinook salmon, which spawn primarily in Timbuctoo Bend below the Narrows Pool (PSMFC 2009). For purposes of evaluating contribution to the HET, the Licensees assumed a baseline habitat potential of 200 Chinook spawners in the HEP action area. The recommended actions represent an expansion of habitat in the Lower Yuba River above the baseline.

The HET evaluation methodology used by the Licensees provided a consistent and transparent approach that related actions to identified habitat limitations in the HEP action area. The method is described in some detail in Appendix N. In summary, the method involved two steps. First, the *quantity* of habitat for spawning by spring-run Chinook salmon was estimated based on the extent of habitat expansion and estimates of Chinook salmon spawning densities in the Yuba River and elsewhere. Second, the *quality* of the expanded habitat for spring-run Chinook salmon was evaluated. In this step, the estimated quantity of expanded habitat was adjusted to reflect existing habitat limitations across life stages of spring-run Chinook salmon. The evaluation of environmental conditions reduced the area-based spawner estimates to account for environmental limitations not addressed by the recommended actions, resulting in a more conservative estimate of contribution to the HET. Adjustments for environmental conditions were made by comparing the expected environmental conditions in the expanded habitat to the life-history needs of spring-run Chinook salmon.

The quantity of habitat created by the recommended actions and the capacity for spring-run Chinook salmon spawning were estimated independently by Pasternack (2010a, 2010c). Dr. Pasternack first estimated the area of expanded spawning habitat that would be created by the recommended actions in the Lower Yuba River. He then reduced the total area based on his estimates of non-spawning habitat types (e.g., pools). Next, he divided the spawning habitat area created by the recommended actions by a range of estimates of typical Chinook salmon redd size, to estimate the number of Chinook redds that could occupy the expanded habitat. Redd sizes vary in nature based on local conditions and spawner densities. For purposes of drawing conclusions about contribution to the HET, the Steering Committee used Dr. Pasternack's estimates based on his "most reasonable" assumed redd size of 11.1 square meters/redd. The estimated number of redds was used to estimate spawning capacity by multiplying the number of redds by 2.0, a conservative estimate of fish per redd in the Lower Yuba River (Table 4-1).

The next step the Steering Committee took in determining the contribution of the recommended actions to the HET was to adjust Pasternack's estimates of spawning habitat capacity based on the quality of the expanded habitat. This step reduced Dr. Pasternack's capacity estimates to account for habitat limitations not included in the spawning area calculations. These adjustments accounted for presumed passage loss at Daguerre Point Dam, the assumed effectiveness of the recommended actions to address habitat limitations, and habitat limitations not addressed by the recommended actions. The Steering Committee developed a working hypothesis regarding the relative importance of habitat attributes for spring-run Chinook and then qualitatively described habitat limitations in the HEP action area based on published accounts and expert knowledge (see Appendix N). This allowed the Steering Committee to make conclusions regarding factors limiting spring-run Chinook salmon production in the target area and to evaluate the effectiveness of the recommended actions in addressing these limitations. The result was a significant reduction in the area-based estimates, which provided the basis for the Licensees' conclusions regarding the extent to which the recommended actions would meet the HET (Table 4-1).

Table 4-1. Estimated Contribution of Recommended Actions to the Habitat Expansion Threshold

Recommended Action	Area-Based Estimate of Number of Spawners Supported by the Action (Pasternack 2010a, 2010c)	Estimated Contribution to the HET (Area-Based Estimate Adjusted for Environmental Conditions)[a]
Sinoro Bar spawning habitat expansion	5,058	2,928
Narrows Gateway spawning habitat expansion	2,282	1,253
Estimated total contribution of the recommended actions to the HET—increase in total spring-run Chinook salmon habitat in the Sacramento River Basin	7,340	**4,182**[b]

[a] This value reflects the potential number of adult fish that can be supported by habitat expansion. Actual results of the actions could differ due to a variety of factors both inside and outside the Yuba River. This estimated contribution to the Habitat Expansion Threshold (HET) was calculated using the methodology described in Appendix N of the Final HEP, which yielded a specific number. The estimated contribution of the recommended actions to the HET represents an index of the increase in quality and quantity of habitat for spring-run Chinook salmon. The calculation is not meant to imply a degree of precision.

[b] Discrepancy in total due to rounding.

The recommended actions are estimated to expand habitat sufficiently to exceed the HET. By creating normative riverine features in the HEP action area, including pools, riffles, and shallow-water habitat, the recommended actions are expected to increase juvenile rearing habitat as well. These estimates of expanded habitat potential significantly exceed the HET. On this basis, the Licensees concluded that the recommended actions satisfy the requirements of the HEA to expand habitat "sufficiently to accommodate an estimated net increase of 2,000 to 3,000 Spring Run [Chinook salmon] for spawning ("Habitat Expansion Threshold") in the Sacramento River Basin" (Section 2.2 of the HEA). The habitat expansion is consistent with the biological needs of steelhead and is expected to provide benefits to steelhead as well.

4.3.2 Segregation of Spring-Run and Fall-Run Chinook Salmon

The recommended actions support separating spring-run and fall-run Chinook salmon. As discussed in the previous section, the recommended actions exceed the HET. However, because the Yuba River also supports fall-run Chinook salmon, it is possible that both runs of Chinook would utilize the expanded habitat created by the recommended actions. The Approval Criteria in the HEA call for the recommended actions to "support[s] segregating Spring-Run habitat from Central Valley fall-run Chinook salmon" (Section 4.2.3[d] of the HEA). The Licensees expect that some natural segregation of the two runs would occur based on habitat preferences and behavior.

The recommended actions support the separation of the two races by providing habitat with qualities consistent with spring-run Chinook salmon. For example, the recommended actions would expand habitat above the main fall-run Chinook salmon spawning area at Timbuctoo Bend and provide gradient and substrate conditions consistent with spring-run Chinook salmon spawning. Natural segregation may presently occur in the Lower Yuba River, with spring-run fish tending to occupy areas closer to Englebright Dam (Alber 2010) while fall-run fish concentrate lower in the river—in the Timbuctoo Bend area (PSMFC 2009). The intent of the recommended actions is to create a continuum of Chinook salmon spawning in the Lower Yuba River, with spring-run fish concentrating in the HEP action area and fall-run fish concentrating lower in the river.

To further support segregation of the two runs, the Licensees added a third action, the optional use of a segregation weir or other physical barrier to be located below the Narrows Pool and operated by the resource agencies (NMFS, USFWS, and DFG). Complete segregation of the two runs is not necessary. There is evidence that, despite spatial and temporal overlap, spring-run and fall-run populations of Chinook salmon in the Central Valley have maintained genetic separation (Banks et al. 2000)—presumably due to behavioral factors. Because it appears that few Chinook salmon presently use the habitat above the Narrows Pool, a weir is expected to minimally affect the existing population of fall-run Chinook salmon in the Yuba River. The weir could be used at the discretion of the resource agencies to address at least three situations:

1. To promote development of a self-sustaining population of spring-run Chinook in the initial years following completion of the spawning habitat expansion actions in the HEP action area. Resource agencies may choose to enhance segregation after habitat expansion to ensure optimal conditions for developing the spring-run Chinook population.
2. To address in-season conditions that suggest the need for additional segregation to protect the spring-run Chinook population. In years when projected returns of fall-run Chinook are especially strong relative to the return of spring-run, managers may elect to use the weir to protect the spring-run Chinook salmon in the HEP action area.

3. To address conditions over time regarding segregation of the two runs. With experience, resource agencies may conclude that a weir is needed on a permanent basis to enhance separation of the two runs. Alternatively, as the spring-run Chinook salmon population increases in response to the expanded habitat, the agencies may conclude that a weir is not necessary.

The Licensees suggest that the resource agencies devise an explicit AMP for the weir, with specific criteria and tests of management hypotheses. A concept for an AMP is provided in Appendix J. If the agencies decide that a segregation weir is not needed prior to its construction, the Licensees would consider funding other restoration actions in the Lower Yuba River, such as the expansion of juvenile rearing habitat below the Highway 20 Bridge (see Appendix L).

4.3.3 Development of an Independent, Self-Sustaining Population of Spring-Run Chinook Salmon

The recommended actions support development of an independent, self-sustaining population of spring-run Chinook salmon. Presently, the only remaining independent, self-sustaining populations in the Central Valley spring-run Chinook salmon ESU occur in Mill, Deer, and Butte Creeks (Lindley et al. 2004). The lack of spatial diversity within the ESU impedes recovery of spring-run Chinook salmon and increases the risk of extirpation of the ESU. For this reason, development of new populations of spring-run Chinook salmon in the Central Valley is a high priority in the Public Draft Recovery Plan (NMFS 2009).

Expansion of habitat to create an independent, self-sustaining population of spring-run Chinook salmon is not included in either the Evaluation Criteria (Section 4.1.1 of the HEA) or Selection Criteria (Section 4.1.2 of the HEA) that the Licensees are directed to use to develop the HEP. However, NMFS is directed to consider the extent to which the HEP "*supports* establishing a geographically separate, self-sustaining population of Spring-Run [Chinook]" (emphasis added) in approving the Final HEP (Section 4.2.3[c] of the HEA). As discussed further under "Integrated Plan for Management of Spring-Run Chinook Salmon in the Lower Yuba River," the Licensees envision the recommended actions working in concert with actions by other parties in the Lower Yuba River to create conditions likely to lead to development of an independent, self-sustaining population of spring-run Chinook salmon.

The recommended actions provide considerable support for development of an independent, self-sustaining population of spring-run Chinook salmon in the Yuba River. NMFS has defined a *viable population* under the ESA to be one with a low risk of extinction in the wild over a 100-year time frame (McElhany et al. 2000). Based on that premise, the Central Valley Technical Recovery Team (TRT) established criteria to evaluate risk of extinction for salmon populations (Lindley et al. 2007). Several of these criteria involve risk over time or population dynamics that are beyond the scope of the HEA analysis. However, the TRT criteria also specify abundance levels to minimize extinction risk that can be related to the HET and the estimated contribution of the recommended actions to the HET. The TRT criteria state that a population with low risk of extinction needs an effective population size in excess of 500 fish. *Effective population size* refers to the number of successful spawners in a population and is typically significantly less than total abundance. For example, Lindley et al. (2007) assume that effective population size is 20 percent of the total observed abundance of salmon.

The HET is expressed in terms of habitat to support spring-run Chinook spawning—not a specific fish abundance. Because a redd, by definition, represents successful spawning by at least one male and one female fish, the HET can be related to effective population size by assuming that habitat for each redd represents at least two adult spawners (and typically more). In this light, the recommended actions provide habitat sufficient to support an effective population size that exceeds the NMFS risk criteria for a viable population.

The Licensees have not attempted to make any conclusions regarding the actual abundance of fish that might return to the Yuba River as a result of the recommended actions. However, given the amount of habitat provided by the recommended actions, there is considerable reason to believe that an independent population of spring-run Chinook salmon can develop in the HEA action area, especially in conjunction with the optional use of a segregation weir and other management actions by the resource agencies and other stakeholders in the Lower Yuba River.

As discussed under "Eligibility under the HEA," the actions required of the Corps under the 2007 BiOp are distinct and separate from those recommended by the Licensees under the HEA. Nevertheless, the two sets of actions are complementary, with important synergisms that provide increased support for development of a self-sustaining, independent population of spring-run Chinook salmon. For example, the Corps program would complement the Licensees commitment to maintenance of the expanded habitat at Sinoro Bar and Narrows Gateway, while the recommended actions would provide an enhanced geomorphic framework for the Corps gravel augmentation program.

Other actions outlined in the 2007 BiOp that complement the HEP recommended actions include injection of woody debris below Englebright Dam, which would further enhance the expanded habitat at Sinoro Bar and Narrows Gateway. The Corps also is required under the 2007 BiOp to enhance passage conditions at Daguerre Point Dam and to screen irrigation diversions, further adding to improved conditions and further supporting establishment of a self-sustaining spring-run Chinook salmon population.

It should be noted that a potential limitation for establishment of a new independent population of spring-run Chinook salmon in the Yuba River is the incursion of fish from the Feather River Hatchery into the Yuba River. Mixing of natural and hatchery spring-run fish can impede development of a locally adapted population and lower overall fitness of the population (Lindley et al.

2007). Straying of fish from the Feather River will affect all restoration proposals in the entire Yuba River; it is the result of hatchery practices and conditions that are beyond the scope of the HEA.

4.3.4 Timely Benefits to Spring-Run Chinook Salmon and Steelhead

The recommended actions provide timely benefits to spring-run Chinook salmon and steelhead. The HEA is clearly intended to provide actions that create near-term benefits to spring-run Chinook salmon and steelhead. As noted in Section 5 of the HEA, the "Parties share a mutual interest in completing implementation of approved habitat expansion action(s) as early as reasonably feasible, consistent with the Licensees obtaining necessary approvals and permits." Evaluation Criterion (h) states that "earlier gains [from projects] are favored over later gains" (HEA Section 4.1.1[h] of the HEA). Selection Criterion (d) directs the Licensees to select actions that "can be accomplished in a reasonable period of time" (Section 4.1.2 [d]of the HEA). Finally, Approval Criterion (f) directs NMFS to evaluate the HEP in part on whether the recommended actions are "expected to be implemented within a reasonable period of time" (Section 4.2.3 [f] of the HEA). Beyond the clear intent of the HEA, the Licensees looked for actions that would provide a timely and much needed contribution to the conservation and recovery of spring-run Chinook salmon and steelhead.

The recommended actions in the Lower Yuba River can provide benefits in the near future that can be sustained over an approximately 50-year period and beyond. While recognizing that all actions operate within a complex array of legal and social constraints, the Lower Yuba River Actions are relatively free of legal entanglements and are supported by the resource agencies and stakeholders[1]. With timely approval of this plan by NMFS, implementation of the recommended actions can commence quickly and begin providing benefits to spring-run Chinook salmon and steelhead within the following year.

4.3.5 Cost Effectiveness, Feasibility, and Sustainability

The recommended actions are cost effective, feasible, and sustainable. The HEA calls for recommended actions to be cost effective (Section 4.1.1[d]) of the HEA), feasible (i.e. supported by accepted science, low risk and non-experimental) (Section 4.1.1[a] of the HEA) and sustainable over time (Section 4.1.1[c] of the HEA). As discussed in the working definitions for HEA criteria in Appendix F, the most cost-effective actions are those that achieve the

[1] The resource agencies have expressed support for the individual actions as part of an overall restoration program, although some agencies may not agree that the actions meet the terms and conditions of the HEA.

goals of the HEA at the lowest cost. Furthermore, the signatories to the HEA recognized that cost is a key consideration in the successful implementation of the HEA, and agreed to make a good faith effort to achieve the HET at the least cost to the Licensees (Section 10 of the HEA). The Licensees concluded that the Lower Yuba River Actions represent the most cost-effective approach available to meet the goals of the HEA. Although the costs of the recommended actions significantly exceed the cost threshold that allows the Licensees to withdraw from the HEA (Section 11.1 of the HEA), they are substantially less than the costs of alternatives such as trap and transport of fish into the Upper Yuba River.

The Lower Yuba River Actions are entirely feasible and use well proven techniques that rely substantially on natural processes to create and maintain habitat. Reconstruction of instream gravel bars and features to enhance habitat quantity and quality has been used successfully on several California rivers, such as the Mokelumne River (Pasternack 2010a), Trinity River, Clear Creek, and elsewhere. The use of weirs to separate species or races of salmon is a well proven technique that is used or planned for use in other Sacramento River tributaries, including Battle Creek, Clear Creek, and the Feather River.

The expected sustainability of the Lower Yuba River Actions is high. The actions rely, to a large degree, on natural processes to create and maintain habitat in the HEP action area after initial restoration actions. Necessary maintenance of the habitat features has been accounted for but will be enhanced by the distribution (by natural processes) of gravel provided by the Corps, as specified in their Draft EA (Corps 2010).

4.3.6 Minimal Human Intervention

The recommended actions require minimal human intervention. Habitat features required by instream life stages of anadromous salmonids develop through processes involving flow, channel form, and structural elements such as large wood (Abbe and Montgomery 1996). These processes create and maintain instream habitat and significantly affect the long-term performance of anadromous salmonids (Gregory and Bisson 1996). Achievement of the HET requires expanding habitat in the Sacramento River Basin sufficiently to accommodate spring-run Chinook salmon beyond the present capabilities of the system. Actions that require “minimal human intervention … to achieve access to expanded spawning, rearing and adult holding habitat” are favored over those that require “a high degree of human intervention” (Section 4.1.1 [e]of the HEA).

The Licensees concluded that expansion of habitat as defined in the HEA was best achieved through reliance on natural hydrologic-geomorphic processes whenever possible and that these natural processes were the most likely means to achieve needed habitat quantity and quality that could be sustained over time. However, the Licensees also recognize that the Yuba River is far from a natural system and that habitat expansion will require significant initial action as well as long-term maintenance over an approximately 50-year period.

The stream channel below Englebright Dam has been greatly altered by construction of Englebright Dam, hydraulic mining in the Upper Yuba River, and dredge mining in the Lower Yuba River. Channel form also is affected by infrastructural constraints like bridges and roads, irrigation withdrawals, and other land use. Nonetheless, the recommended actions in the Lower Yuba River rely to a large degree on natural hydrologic-geomorphic processes to provide long-term stability of features conducive to spring-run Chinook salmon and steelhead. The Lower Yuba River Actions would remove shot rock and excess cobbles/boulders that currently armor the channel and would allow flow to shape channel features and distribute sediment and large wood (Pasternack 2010a, 2010c).

The habitat features created by the recommended actions would require periodic maintenance by the Licensees due to the elimination of natural processes, such as gravel recruitment into the Lower Yuba River as a result of Englebright Dam, and the reduced frequency of flood events due to upstream flow management. As discussed further under “Integrated Plan for Management of Spring-Run Chinook Salmon in the Lower Yuba River,” maintenance of the recommended actions would be aided by other planned actions such as the injection of gravel below Englebright Dam by the Corps (Pasternack et al. 2010).

4.3.7 Effects of Climate Change

The recommended actions can buffer the effects of climate change on Central Valley spring-run Chinook salmon. Climate change is not explicitly referred to in the HEA but was considered by the Licensees with regard to the sustainability of an action (see the working definition for Evaluation Criterion [c] in Appendix F). Climate change operating at global and regional scales is expected to significantly alter environmental conditions in the Central Valley (Hayhoe et al. 2004) and add to the degradation of habitat conditions in the Sacramento River Basin for anadromous salmonids (Lindley et al. 2007). Warmer average annual temperatures are expected, along with decreased average rainfall and increased frequency of storm events. All of these changes are expected to result in further degradation of conditions for anadromous salmonids and negative impacts on already severely depressed populations. The effects of climate change are expected to be most severe on the floor of the Sacramento River Valley below the rim dams that now block fish access into the upper portions of most watersheds. NMFS has expressed considerable concern about the effects of climate change on the likelihood of recovery of listed salmon populations in the Central Valley (Lindley et al. 2007, NMFS 2009). Concern about the potential for increased adverse conditions for salmonids resulting from climate change has been a basis for the NMFS promoting trap-and-transport actions into upper watersheds such as the Yuba River, and their desire to develop new populations in areas where the effects of climate change might be buffered.

The Lower Yuba River Actions offer benefits that can be sustained in the face of climate change. In fact, the Lower Yuba River may be the best opportunity available to develop a new spring-run Chinook salmon population that can withstand the effects of climate change without reliance on the significant capital construction and annual maintenance costs of a trap-and-transport operation.

The basis for advancing the Lower Yuba River Actions as a hedge against climate change impacts is twofold. First, the Lower Yuba River is large enough to provide significant capacity for spring-run Chinook salmon, including the potential to meet the fish abundance criteria for a viable population advanced by Lindley et al. (2007). Second, and perhaps more to the point, water temperatures in the Lower Yuba River can likely be maintained within the physiological needs of spring-run Chinook salmon—even as average air temperatures increase due to climate change. Upper Yuba River reservoirs, such as the one behind New Bullards Bar Dam, are very deep and provide a significant resource of cold water that can be released to control downstream flow and temperature conditions. Importantly, the Yuba Accord provides the legal basis for managing conditions in the Lower Yuba River to maintain conditions suitable for anadromous salmonids. Assuming that they are maintained beyond 2016[2], the Yuba Accord flows will continue to provide suitable habitat conditions in the Lower Yuba River that can sustain a spring-run Chinook salmon population in the face of climate change—especially given the recommended actions in the Lower Yuba River.

4.3.8 Consistency with NMFS Recovery Goals and Plan

The recommended actions are consistent with NMFS recovery goals and plan. The HEA calls for actions to be consistent with the NMFS Viable Salmonid Population (VSP) concept (McElhany et al. 2000) and ESA recovery goals and recovery plan (Section 4.1.1[j] of the HEA). The VSP concept has been widely applied to ESA salmon recovery and provides useful metrics to describe the performance of salmonid populations and population groupings, such as ESUs. McElhany et al. (2000) conclude that, to be viable under the ESA, individual populations (e.g., Mill Creek spring-run Chinook salmon) must have sufficient *abundance*, *productivity*, and *biological diversity* to weather expected environmental constraints and variability; sufficient *spatial diversity* must exist between populations within an ESU (e.g., Central Valley spring-run Chinook salmon) such that the ESU is not vulnerable to local and regional catastrophes (e.g., volcanic eruption). The VSP concept does not provide criteria for VSP parameters, although Lindley et al. (2007) propose criteria that may be used in recovery of Central Valley salmonid populations. The recommended actions appreciably add to the abundance, productivity, and biological diversity of spring-run Chinook salmon in the Yuba River and support development of a geographically separate population that increases spatial diversity of the Central Valley spring-run Chinook salmon ESU.

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2 The Yuba Accord remains in effect through at least 2016, when the current license for the Yuba River Development Project expires. The flows and temperatures outlined in the Yuba Accord were assumed to continue either through an extension to the accord or through post-relicensing conditions.

The NMFS strategy for recovery of ESA-listed fish populations in the Central Valley is most completely described in their Public Draft Recovery Plan. The plan calls for actions in both the Lower Yuba River (below Englebright Dam) and the Upper Yuba River. Although NMFS does not consider the Lower Yuba River spring-run Chinook salmon population to be a viable, independent population under present conditions, the population is classed as a Core 1 population in the Public Draft Recovery Plan. The plan defines *Core 1 populations* as "populations identified as having the highest priority for recovery action implementation based on known ability to support independent populations, thereby contributing to the ESU/DPS-level recovery criteria" (the VSP spatial diversity criteria). Further, the recovery plan characterizes the Lower Yuba River as having "a high potential to support a viable independent population of spring-run Chinook salmon" because of (1) suitable flow and water temperature; (2) lack of a hatchery; (3) availability of spawning habitat; and (4) high habitat restoration potential. Except for the optional segregation weir, the recommended actions in the Lower Yuba River are included in the NMFS Public Draft Recovery Plan as "key near-term and long-term habitat restoration actions" in the Lower Yuba River needed to "secure a viable independent population of spring-run Chinook salmon." (NMFS 2009.)

4.3.9 Local and Political Support

The recommended actions have local and political support. The HEA calls for the Licensees to screen potential actions for "favorable local/political support" (Section 4.1.1[h] of the HEA). To be successful, any action implemented under the HEA must have the support of affected landowners, resource agencies, and other concerned parties. In developing the recommended actions, the Licensees expended considerable effort to coordinate with local landowners, resource agencies, the Corps, YCWA, and other stakeholder groups and to address concerns and recommendations (see Chapter 2 and Appendix C). Given the diversity of interests and concerns in the Central Valley, it is unrealistic to expect universal support for any action that significantly changes conditions in an area as important as the Lower Yuba River. Nevertheless, overall support for the recommended actions has been positive. The Licensees believe that most concerns have been addressed in this Final HEP and that the recommended actions can be implemented with the support of landowners, resource agencies, and concerned parties.

4.3.10 Eligibility under the HEA

The recommended actions are eligible under the HEA. As defined in Section 3.2 of the HEA, "Existing Requirements and Commitments," (a—d):

> For purposes of this Agreement, the term "Existing Requirements and Commitments" is intended to encompass actions expected to occur in a timeframe comparable to implementation of habitat expansion action(s)

under this Agreement. Existing Requirements and Commitments may include but are not limited to:

(a) legal or regulatory requirements that are the subject of any form of binding order issued by a regulatory agency or court of competent jurisdiction, at the time NMFS approves the habitat expansion action(s);

(b) legal or regulatory requirements that are the subject of ongoing or imminent administrative or judicial action by an agency or court of competent jurisdiction at the time NMFS approves the habitat expansion action(s);

(c) obligations or commitments set forth in a draft license application, final license application, settlement agreement, or agreement-in-principle in a pending hydroelectric relicensing proceeding at the time NMFS approves the habitat expansion action(s); and

(d) reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions of any final Biological Opinion that has been issued at the time NMFS approves the habitat expansion action(s).

The intent of the HEA is to increase habitat for spring-run Chinook salmon and steelhead "compared to the habitat available under any relevant Existing Requirements or Commitments" (Section 2.2 of the HEA). The close relationship between the actions of various parties raises the issue of eligibility of the recommended actions under the HEA.

NMFS comments on the Draft HEP state that the recommended actions in the Draft HEP should be considered within the scope of the actions required in the NMFS 2007 BiOp and therefore do not meet the HEA Approval Criteria regarding eligibility (see Appendix G). As explained below, the recommended actions are not currently part of a final biological opinion, nor are they an existing legal or regulatory requirement. Consequently, the spawning habitat expansion actions at Sinoro Bar and Narrows Gateway are eligible under the HEA.

Currently, two documents direct resource management activities in the Lower Yuba River and thus hold the potential to affect the eligibility of the Lower Yuba River Actions being recommended under the HEA: the Yuba Accord and the NMFS 2007 BiOp. The Yuba Accord is a collaborative agreement to provide flows and temperatures that are conducive to successful production of listed anadromous salmonids within the Lower Yuba River. The Final HEP does not recommend any change to flows in the river; thus, the Yuba Accord does not affect the eligibility under the HEA of actions recommended in the Final HEP.

The 2007 BiOp requires significant actions from the Corps, including implementation of a gravel augmentation program in the Lower Yuba River. The HEP recommended actions would work in concert with the actions required in the 2007 BiOp to create an environment conducive to the creation of a viable population of spring-run Chinook salmon in the Lower Yuba River.

4.3.10.1 Corps Gravel Augmentation Program

The HEP recommended spawning habitat expansion actions at Sinoro Bar and Narrows Gateway are independent of, and complementary to, the Corps' gravel augmentation program below Englebright Dam. The purpose of the HEP recommended actions is to create spawning habitat where negligible amounts currently exist in the lower portion of the Englebright Dam Reach and the upper portion of the Narrows Reach. The spawning habitat expansion action at Sinoro Bar (Englebright Dam Reach) involves the removal of shot rock, replacement of the shot rock with gravel, and recontouring of the streambed to create new spawning habitat. The spawning habitat expansion action at Narrows Gateway (Narrows Reach) involves creation of additional spawning habitat immediately downstream of Sinoro Bar through removal of the armored surface layer of the streambed, replacement of the armored layer with gravel, and recontouring of the streambed.

In contrast, the Corps gravel augmentation program is designed to provide a periodic injection of gravel to compensate for the loss of gravel recruitment caused by Englebright Dam. The 2007 BiOp contains, as one of its Reasonable and Prudent Measures, the following:

1. *The Corps shall develop and implement a long-term gravel augmentation program to restore quality spawning habitat below Englebright Dam.*

   A) *The Corps shall utilize information obtained from the pilot gravel injection project to develop and commence implementation of a long-term gravel augmentation program within three years of the issuance of this biological opinion.*

The Corps initiated a pilot gravel injection project in November 2007, with 450 short tons of spawning-sized gravel placed below Englebright Dam (in the pool below Narrows 2 Powerhouse). Based on the results of this and other geomorphic studies, Pasternack (2010b) prepared the *Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River, CA*. As part of that plan, the Corps is proposing to place an additional 2,000 to 5,000 short tons of spawnable-sized gravel below Englebright Dam (approximately 115 feet downstream of the Narrows 1 powerhouse, to avoid potential impacts to powerhouse operations) in November 2010 (Corps 2010). This would likely be the first of multiple gravel injections in the upper portion of the Englebright Dam Reach over a period of a few years, as proposed for the Corps by Pasternack (2010b).

Pasternack (2010b) indicates that implementation of the full plan is designed to erase the current deficit of gravel in the Englebright Dam Reach; however, rehabilitation at Sinoro Bar and Narrows Gateway is clearly beyond the scope of the plan. The Corps program would likely create new spawning habitat upstream of Sinoro Bar/Narrows Gateway and potentially help to sustain the spawning habitat created downstream by the HEP recommended actions.

As noted, the HEP spawning habitat expansion actions and the Corps gravel augmentation program are complementary. Each set of actions would independently provide expanded spawning habitat, and the Corps program could help to sustain the HEP actions over time through periodic introduction of gravel to Sinoro Bar and Narrows Gateway. Other actions outlined in the 2007 BiOp that complement the HEP recommended Lower Yuba River Actions include injection of woody debris (which could aid in gravel retention and improved microhabitat conditions), improvements to passage at Daguerre Point Dam, and screening of diversions downstream of the Lower Yuba River habitat expansion actions.

4.3.10.2 Existing Legal and Regulatory Requirements

The 2007 BiOp recently was challenged in federal court (*South Yuba River Citizens League and Friends of the River v. National Marine Fisheries Service et al.*). The July 8, 2010 court order found that the 2007 BiOp had failed to provide a rational connection between the determination that operation of Englebright Dam would perpetuate unmitigated stressors and the conclusion by NMFS that those stressors would not jeopardize the listed fish. Given that, the court held it could not conclude whether the measures required in NMFS Incidental Take Statement achieved the goal of not jeopardizing the species ─ that is, the court could not decide on the record whether the measures were inadequate [July 8, 2010 Order p. 70].

More importantly, the court's ruling did not center on the Corps gravel augmentation program, which currently is being implemented. Accordingly, it appears that the other stressors identified in the litigation would be subject to change in any revised biological opinion that may be issued as a result of the court's ruling. The ruling does address inadequate language related to fish passage at Daguerre Point Dam, inadequate language addressing screening at the South Yuba-Brophy diversion, failure to consider the effects of fish straying from the Feather River Fish Hatchery, failure to address the effects of climate change, failure to include a discussion of effects from the condition of the Delta, and failure to address the potential threat of poaching. It should be noted that the court discussed the Corps gravel augmentation program and concluded that the reliance of the biological opinion on the proposed gravel augmentation program was itself reasonable.

Consequently, the expansion of spawning habitat recommended in the Final HEP is not part of any legal or regulatory requirement that is the subject of any form of binding order issued by a regulatory agency or court of competent jurisdiction. In addition, there is no evidence to indicate that the gravel augmentation program that is currently being undertaken by the Corps will be expanded upon by the court or by NMFS at a future time to include the recommended HEP actions.

4.3.10.3 Conclusion

According to the HEA, actions that are part of a final biological opinion when NMFS approves the Final HEP and actions that are "expected to occur in a timeframe comparable to implementation of habitat expansion action(s) under this Agreement" are ineligible. The actions recommended in this Final HEP are not currently part of a final biological opinion and, pending a timely determination from NMFS, the Final HEP will be approved or denied prior to development of any Reasonable and Prudent Measures and Terms and Conditions for a new biological opinion. Consequently, the spawning habitat expansion actions at Sinoro Bar and Narrows Gateway are eligible under the HEA.

The Final HEP assumes that the Corps gravel augmentation program will continue over the long term; however, the Licensees recognize their responsibility for maintaining habitat expansion actions at the spawning rehabilitation sites (Sinoro Bar and Narrows Gateway) for the term of their obligation under the HEA regardless of actions by the Corps under the 2007 BiOp. Therefore, gravel augmentation necessary to sustain the habitat created will be assured by one or both of these two processes.

4.3.11 Integrated Plan for Management of Spring-Run Chinook Salmon in the Lower Yuba River

The recommended actions support an integrated plan for management of spring-run Chinook salmon in the Lower Yuba River. The recommended actions would substantially improve conditions in the Lower Yuba River for spring-run Chinook salmon and support the development of an independent, self-sustaining spring-run Chinook salmon population in the Yuba River. However, development of a new, self-sustaining population of spring-run Chinook salmon in the Lower Yuba River would depend on the actions of all concerned management entities and groups to develop the required habitat conditions.

The vision of the Licensees is that resource agencies and concerned parties will work together to develop habitat conditions in the Yuba River below Englebright Dam capable of supporting independent, self-sustaining populations of spring-run Chinook salmon, fall-run Chinook salmon, and steelhead. Additionally, these habitat conditions should support sport fisheries in the Lower Yuba River and the harvest management goals of the fishery management agencies—as well as broader goals in the Yuba River, including reintroduction of anadromous salmonids into areas above Englebright Dam. The effectiveness of the HEP recommended actions will be magnified by the efforts of other parties to achieve this vision.

The recommended actions, in effect, divide the Lower Yuba River into two management zones: an area below the Narrows Pool where the management emphasis would be on production of fall-run Chinook salmon and an area above that point where the management emphasis would be on production of spring-run Chinook salmon (Figure 4-1). DFG has indicated support for managing the HEA action area to support spring-run Chinook salmon (Hill pers. comm.). The Narrows Pool would provide deep holding habitat for adult spring-run fish before they move into the Narrows Reach and the Englebright Dam Reach to spawn. The expectation is that the bulk of spring-run Chinook salmon spawning in the Lower Yuba River would occur in the Narrows and Englebright Dam Reaches, in the habitat created by the recommended actions.

The recommended actions, plus those expected to be completed by other parties, create the conditions necessary to achieve the vision articulated above and allow the HEA actions to support development of the geographically separate, self-sustaining population of spring-run Chinook salmon in the Lower Yuba River called for in the Public Draft Recovery Plan. Listed below, for example, are the HEP recommended actions arrayed with actions planned or required of other parties, in addition to a natural feature, that support development of an independent population of spring-run Chinook salmon in the Lower Yuba River (HEP recommended actions shown in bold type):

- Management of the upper portion of the Lower Yuba River for spring-run Chinook salmon (DFG)
- Gravel and wood injection below Englebright Dam (Corps)
- **Sinoro Bar spawning habitat expansion (HEA)**
- **Narrows Gateway spawning habitat expansion (HEA)**
- Narrows Pool (natural holding pool)
- **Optional segregation weir (HEA)**
- Daguerre Point Dam passage enhancement (Corps)
- Yuba Goldfields juvenile rearing habitat expansion (SYRCL, USFWS, Western Aggregates)
- Lower Yuba River flow/temperature management (Yuba Accord, YCWA)

The benefits of the recommended actions under the HEA would be amplified by these additional actions. The recommended actions would, in particular, be enhanced by the actions of the Corps under the BiOp for their operation of Englebright and Daguerre Point Dams. The 2007 BiOp requires the Corps to provide spawnable gravel and large wood below Englebright Dam (but above and not connected to Sinoro Bar), and to correct passage problems for adult and juvenile Chinook salmon and steelhead at Daguerre Point Dam (NMFS 2007). The addition of gravel and large wood above Sinoro Bar would add to the habitat potential of the spawning area in the Englebright Dam Reach and would contribute to maintenance of the spawning habitat expansion at Sinoro Bar and Narrows Gateway (Pasternack et al. 2010).

4.4 Summary

In summary, the Lower Yuba River Actions represent an excellent opportunity to meet the goals, terms, and conditions of the HEA. They provide a significant, timely, and much needed contribution to the conservation and recovery of spring-run Chinook salmon with ancillary benefits to steelhead. Upon approval, the Licensees are confident that, with the support of the HEA signatories and other stakeholders, the Lower Yuba River Actions can be implemented within a reasonable time frame (i.e., within approximately 5 years), providing an almost immediate benefit to spring-run Chinook salmon.

Table 4-2 summarizes the attributes assigned to the Lower Yuba River Actions by the Licensees, as well as an evaluation of these actions based on applying the NMFS Approval Criteria specified in the HEA. Approval of the Final HEP will be determined by NMFS, after input from the HEA signatories and other stakeholders, using the Approval Criteria. Chapter 5 describes the remaining phases of the HEA.

Table 4-2. Application of NMFS Approval Criteria to Lower Yuba River Habitat Expansion Actions (Lower Yuba River Actions)

Action Attributes	Lower Yuba River Actions
Estimated contribution to the Habitat Expansion Threshold[a]	4,182 adult spring-run Chinook salmon[b]
Estimated cost	~$23.4 million[c]
NMFS Approval Criteria Evaluation[d]	
Estimated to meet the Habitat Expansion Threshold?	Yes
Assures necessary testing, operations, and maintenance?	Yes
Supports establishing geographically separate self-sustaining population?[e]	Yes
Supports segregating spring-run from fall-run?[e, f]	Yes
Eligible?	Yes
Expected to be implemented in a reasonable period of time?	Yes

Note: The Lower Yuba River Habitat Expansion Actions (Lower Yuba River Actions) consist of expanding spawning habitat at Sinoro Bar and Narrows Gateway in the Lower Yuba River and the option of planning for and installing a seasonally operated segregation weir on the Yuba River below the outlet of the Narrows Pool, if deemed necessary by the resource agencies (National Marine Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Game).

[a] This value reflects the potential number of adult fish that can be supported by habitat expansion. Actual results of the actions could differ due to a variety of factors both inside and outside the Yuba River.

[b] This estimated contribution to the Habitat Expansion Threshold (HET) was calculated using the methodology described in Appendix N of the Final HEP, which yielded a specific number. The estimated contribution of the recommended actions to the HET represents an index of the increase in quality and quantity of habitat for spring-run Chinook salmon. The calculation is not meant to imply a degree of precision.

[c] A 20-percent contingency was added to the estimate due to uncertainties in available cost information.

[e] Criterion not required for approval.

[f] Segregation may occur naturally or, if deemed necessary by the resource agencies, with installation of an optional segregation weir.

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Chapter 5
Remaining Phases of the Habitat Expansion Agreement

This chapter discusses the remaining phases and actions associated with the HEA, including:

- pre-approval consultation and approval of a Final HEP by NMFS;
- a preliminary design phase that includes preparation of feasibility-level designs and cost estimates for the approved action(s), and preparation of a Preliminary Design Report;
- FERC licensing;
- a final design and permitting phase that entails preparation of bid-level designs and cost estimates, and a Final Design and Permitting Report;
- an implementation phase and Final Report; and
- a final test phase, with functional start-up testing and preparation of a Final Test Report.

A description of each phase is provided in the following sections. The timing for each phase is presented in Appendix A.

Throughout each of the remaining phases of the HEA, the Licensees will continue to coordinate with the HEA signatories and other stakeholders, and in particular with landowners that could be affected by implementation of the approved action(s).

5.1 Final HEP

As required in Section 4.2 of the HEA, the Licensees have prepared and submitted this Final HEP to NMFS for review and approval. The Licensees have also distributed this Final HEP to the HEA signatories and other stakeholders, for their information only. As stated in the HEA, the Licensees will not solicit comments on the Final HEP.

The following sections describe the steps that will be taken before NMFS will consider approval of the Final HEP, including pre-approval consultation, application of the NMFS Approval Criteria, and a determination of whether the recommended action(s) meet the HET.

5.1.1 Pre-Approval Consultation

Before approving the Final HEP, NMFS will commence a 60-day consultation process with the HEA signatories, State Water Board, and other stakeholders. During this consultation period, NMFS will consider comments received on the Final HEP and will specifically address comments provided by the HEA signatories or other stakeholders pertaining to whether the habitat expansion actions(s) recommended by the Licensees in the Final HEP are already existing requirements and commitments (i.e., actions that are expected to occur in a timeframe comparable to implementation of habitat expansion action[s] under the HEA; see Section 3.2 of the HEA). Additionally, NMFS will consult with USFWS and DFG to consider the potential benefits and impacts of recommended habitat expansion action(s) on resident fish at the location of the action(s). (Section 4.2.2 of the HEA.)

5.1.2 NMFS Approval Criteria

In determining whether to approve the Final HEP, NMFS will review information submitted by the Licensees, comments received from the HEA signatories and other stakeholders, and any other relevant information. NMFS will consider the extent to which the habitat expansion action(s) recommended in the final plan meet the following Approval Criteria:

a. estimated to meet the HET;

b. assures necessary testing, operation, and maintenance;

c. supports establishing a geographically separate, self-sustaining population of spring-run Chinook salmon;

d. supports segregating spring-run Chinook salmon habitat from Central Valley fall-run Chinook salmon;

e. meets the requirements for eligible habitat expansion action(s) pursuant to Section 3 of the HEA (including, but not limited to, dam removals, dam reoperation, creation or enhancement of fishways, water temperature and/or flow improvements, or other physical habitat enhancements); and

f. is expected to be implemented within a reasonable period of time. (Section 4.2.3 of the HEA.)

Pursuant to the HEA, NMFS will not withhold approval for any recommended habitat expansion action(s) determined by NMFS to meet all six Approval Criteria listed above. In addition, NMFS may approve recommended habitat expansion action(s) that meet at least the following four Approval Criteria: (a), (b), (e), and (f). (Section 4.2.4 of the HEA.)

5.1.3 Determination That the Recommended Habitat Expansion Actions Meet the HET

The actions recommended in this Final HEP (the Lower Yuba River Actions) meet the HET, as required under the HEA. However, if NMFS does not agree that the Lower Yuba River Actions meet the HET, the Licensees and NMFS may select a neutral third party with appropriate expertise to make an independent estimate of the contribution of recommended actions to the HET. NMFS will take into consideration the independent estimate before making its final decision whether to approve the Lower Yuba River Actions. (Section 4.2.5 of the HEA.)

If NMFS determines that the Lower Yuba River Actions would not meet the HET, NMFS may consult with the Licensees to consider the acceptability of the recommended actions and, at the discretion of NMFS, either:

- accept the recommended actions as meeting the overall goal of the HEA and substantially meeting the HET, within a reasonable margin of estimating error;
- identify other habitat expansion action(s) mutually acceptable to NMFS and the Licensees that may be approved by NMFS, in which case NMFS may approve the Final HEP (as modified to incorporate the mutually acceptable habitat expansion action[s]) after consulting with the HEA signatories and other stakeholders; or
- deny approval of the Final HEP (Section 4.2.6 of the HEA).

5.1.4 Approval Decision by NMFS

After completing its review of the Final HEP, NMFS will provide the HEA signatories with a written notice of its approval decision. If NMFS does not approve the Final HEP, the written notice will identify the specific reasons why the Final HEP was not approved. In such case, the Licensees will have an opportunity to assess and amend the deficiencies identified by NMFS, and to submit a modified plan for review and approval by NMFS. The Licensees will distribute the modified plan to the HEA signatories and other stakeholders, for information only. Upon its approval of the modified Final HEP, NMFS will provide the HEA signatories with a written notice of its decision. (Section 4.2.7 of the HEA.)

Within 90 days after the effective date of written notice by NMFS approving the Final HEP, the Licensees will distribute to the HEA signatories, other stakeholders, and FERC, for information only:

- the approved HEP reflecting any modifications during the NMFS approval process; and

- an updated schedule for each of the remaining process phases, as identified in Section 4 of the HEA and described in the following sections (Section 4.2.8 of the HEA).

As stated in Section 7.1 of the HEA, NMFS and the resource agencies are responsible for providing timely information and consultation as requested by the Licensees, and for diligent and timely processing of all permits, approvals, and rights necessary for implementing the HEA, subject to the availability of the agency's resources and authority.

5.2 Preliminary Design Phase

For the preliminary design phase of the approved action(s), the Licensees will:

- prepare feasibility-level designs and cost estimates for the approved action(s),
- prepare and distribute semi-annual status reports,
- prepare a Preliminary Design Report, and
- submit the Preliminary Design Report to NMFS for a consistency determination.

Each task is described below.

5.2.1 Feasibility-Level Designs and Cost Estimates

After the Licensees have distributed an approved HEP, as described above, they will begin the preliminary design phase for the recommended action(s). During the preliminary design phase, the Licensees will prepare feasibility-level designs and cost estimates for the habitat expansion action(s) presented in the approved HEP. If the habitat expansion action(s) involve engineered fishway designs, fishway systems, or major engineered components, the Licensees will consult with the NMFS Southwest Region Fisheries Engineering Team. (Section 4.3 of the HEA.)

5.2.2 Semi-Annual Status Reports

During the preliminary design phase, the Licensees will prepare and distribute semi-annual status reports to the HEA signatories and other stakeholders. These reports will be for information only. (Section 4.3 of the HEA.)

5.2.3 Preliminary Design Report

The preliminary design phase will include the Licensees' preparation of a Preliminary Design Report, which will consist of:

- a preliminary design of the approved habitat expansion action(s);
- updated cost estimates; and
- a schedule for each of the remaining process phases, as identified in Section 4 of the HEA and described in the following sections (Section 4.3 of the HEA).

5.2.4 Consistency Determination by NMFS

After completing the Preliminary Design Report, the Licensees will submit the report to NMFS for its determination of whether the report is materially consistent with the approved HEP. The Licensees also will distribute the Preliminary Design Report to the HEA signatories and other stakeholders, for information only. (Section 4.4 of the HEA.)

After receiving the Preliminary Design Report, NMFS will have 90 days to provide the HEA signatories with a written notice of its consistency determination. The 90-day review period may be extended for good cause or if NMFS solicits additional information from the Licensees that is necessary and appropriate for NMFS to determine whether the Preliminary Design Report is materially consistent with the approved HEP. (Section 4.4 of the HEA.)

After receiving any additional information necessary and appropriate for issuance of a determination, NMFS will have 90 days to provide the HEA signatories with a written notice of its consistency determination. If NMFS determines that the Preliminary Design Report is not materially consistent with the approved HEP, the written notice will identify the specific elements of the Preliminary Design Report that are not materially consistent. In this event, the Licensees will have an opportunity to assess and amend the inconsistencies identified by NMFS and to prepare a modified Preliminary Design Report, which will be submitted to NMFS for a consistency determination. (Section 4.4 of the HEA.)

5.3 FERC Licensing

Before proceeding with the final design and permitting phase and other process phases, as identified in Section 4 of the HEA and described in the following sections, the Licensees must receive and accept new project licenses from FERC for the Oroville, Poe, and Upper North Fork Feather River Projects (Section 4.5 of the HEA).

5.4 Final Design and Permitting Phase

Following a determination of consistency by NMFS of the Preliminary Design Report, and following the Licensees' acceptance of each of the new licenses from FERC for the Oroville, Poe, and Upper North Fork Feather River Projects, the Licensees will begin the final design and permitting phase. For the final design and permitting phase of the approved action(s), the Licensees will:

- prepare bid-level design and cost estimates;
- apply for all permits, approvals, and rights necessary to implement;
- prepare and distribute semi-annual status reports;
- prepare a Final Design and Permitting Report; and
- submit a Final Design and Permitting Report to NMFS for a consistency determination.

Each task is described below. If permitting and design for the approved action(s) is already complete, the Licensees will use the completed documentation rather than begin a new permitting and design phase.

5.4.1 Bid-Level Designs, Cost Estimates, and Related Permitting

During the final design and permitting phase of the approved action(s), the Licensees will prepare bid-level designs and cost estimates and will apply for all permits, approvals, and rights necessary to implement the approved HEP. If the approved habitat expansion action(s) involve engineered fishway designs, fishway systems, or major engineered components, the Licensees will consult with the NMFS Southwest Region Fisheries Engineering Team. (Section 4.5 of the HEA.)

5.4.2 Semi-Annual Status Reports

During the final design and permitting phase, the Licensees will prepare and distribute semi-annual status reports to the HEA signatories and other stakeholders. The semi-annual status reports will be for information only. (Section 4.5 of the HEA.)

5.4.3 Final Design and Permitting Report

The final design and permitting phase will include the Licensees preparing a Final Design and Permitting Report, which will consist of:

- final designs and permit status of the approved habitat expansion action(s);
- updated cost estimates; and
- a schedule for each of the remaining process phases, as identified in Section 4 of the HEA and described in the following sections (Section 4.5 of the HEA).

5.4.4 Consistency Determination by NMFS

After completing the Final Design and Permitting Report, the Licensees will submit it to NMFS for a determination of whether the Final Design and Permitting Report is materially consistent with the approved HEP. The Licensees also will distribute the Final Design and Permitting Report to the HEA signatories and other stakeholders, for information only. (Section 4.6 of the HEA.)

After receiving the Final Design and Permitting Report, NMFS will have 90 days to provide the HEA signatories with a written notice of its consistency determination. The 90-day review period may be extended for good cause or if NMFS solicits additional information from the Licensees that is necessary and appropriate for NMFS to determine whether the Final Design and Permitting Report is materially consistent with the approved HEP. (Section 4.6 of the HEA.)

After receiving any additional information necessary and appropriate for issuance of a determination, NMFS will have 90 days to provide the HEA signatories with a written notice of its consistency determination. If NMFS determines that the Final Design and Permitting Report is not materially consistent with the approved HEP, the written notice will identify the specific elements of the Final Design and Permitting Report that are not materially consistent. In this event, the Licensees will have an opportunity to assess and amend the inconsistencies identified by NMFS and to prepare a modified Final Design and Permitting Report, which will be submitted to NMFS for a consistency determination. (Section 4.6 of the HEA.)

5.5 Implementation Phase

Following NMFS' consistency determination of the Final Design and Permitting Report, the Licensees will implement the approved HEP. For the implementation phase of the approved action(s), the Licensees will:

- implement the approved action(s) individually, jointly, or through cooperative efforts with others;
- prepare and distribute semi-annual status reports; and
- prepare and distribute a Final Report.

Each task is described below.

5.5.1 Implementation of Approved Action(s)

The Licensees will implement the approved action(s), provided, however, that if any final permit, approval, or right applied for during the final design and permitting phase contains a condition that is materially inconsistent with the approved HEP, the Licensees will resolve the inconsistency in a way that is acceptable to NMFS, after notifying and consulting with the HEA signatories and other stakeholders (Section 4.7 of the HEA).

Implementation of the approved action(s) by the Licensees may occur individually, jointly, or through cooperative efforts with others. Such implementation, and any subsequent operation and maintenance actions, will not extend beyond the term described in Section 1.4 of the HEA (i.e., through the term of the last expiring new project license received from FERC). (Section 4.7 of the HEA.)

5.5.2 Semi-Annual Status Reports

During the implementation phase, the Licensees will prepare and distribute semi-annual status reports to the HEA signatories and other stakeholders. The semi-annual status reports will be for information only. (Section 4.7 of the HEA.)

5.5.3 Final Report

Once implementation of the approved action(s) is complete, the Licensees will distribute to the HEA signatories and other stakeholders, for information only, a Final Report with updated cost and schedule information for each of the remaining phases, as identified in Section 4 of the HEA and described in the following sections (Section 4.7 of the HEA).

5.6 Final Test Phase

After completing implementation of the approved habitat expansion action(s), the Licensees will begin the final test phase. For the final test phase of the approved action(s), the Licensees will:

- perform functional start-up testing,
- prepare and distribute semi-annual status reports,
- prepare a Final Test Report, and
- submit a Final Test Report to NMFS for a functionality determination.

Each task is described below.

5.6.1 Start-Up Testing

Upon completing implementation of the approved habitat expansion action(s) as described in the approved HEP, the Licensees will perform functional start-up testing to technically validate the specified designs for the action(s), as may be required by the approved HEP and as may be further described in or modified by the Final Design and Permitting Report (Section 4.8 of the HEA).

5.6.2 Semi-Annual Status Reports

During the final test phase, the Licensees will prepare and distribute, as necessary, semi-annual status reports to the HEA signatories and other stakeholders. The semi-annual status reports will be for information only. (Section 4.8 of the HEA.)

5.6.3 Final Test Report

This final test phase will include the Licensees' preparation of a Final Test Report, which will contain the design and function of the actions implemented and the test results and conclusions from any start-up testing that may be required (Section 4.8 of the HEA).

5.6.4 Functionality Determination by NMFS

After completing the Final Test Report described above, the Licensees will submit the Final Test Report to NMFS for a functionality determination. NMFS will determine: (1) whether any functional start-up testing required by the approved HEP, as may be further described in or modified by the Final Design and Permitting Report, has been performed; and (2) whether such testing demonstrates that all element(s) of the habitat expansion action(s) relevant to the functional start-up testing are functional. The Licensees also will distribute the Final Test Report to the HEA signatories and other stakeholders, for information only. (Section 4.9 of the HEA.)

After receiving the Final Test Report, NMFS will have 90 days to provide the HEA signatories with a written notice of its functionality determination. The 90-day review period may be extended for good cause or if NMFS solicits additional information from the Licensees that is necessary and appropriate for NMFS to determine whether all element(s) of the habitat expansion action(s) relevant to the functional start-up testing are functional. (Section 4.9 of the HEA.)

After receiving any additional information necessary for issuance of a determination, NMFS will have 90 days to provide the HEA signatories with a written notice of its functionality determination. If NMFS concludes that any element(s) of the habitat expansion action(s) relevant to the functional start-up testing are not functional, the written notice will specifically identify such non-functional element(s). In this event, the Licensees will have an opportunity to assess all elements associated with the habitat expansion action(s); complete any repairs or replacement, as necessary; and prepare a modified Final Test Report, which will be submitted to NMFS for a functionality determination. (Section 4.9 of the HEA.)

5.7 Timeframes

The HEA signatories share a mutual interest in completing implementation of the approved habitat expansion action(s) as early as reasonably feasible and consistent with the Licensees obtaining necessary approvals and permits (Section 5 of the HEA).

Appendix A graphically depicts the planning and implementation steps and deadlines required by the phases described above. If the Licensees are not able to achieve the deadlines specified above or approved pursuant to the HEA, they may request an extension of time from NMFS, which extension NMFS may grant if good cause exists. If NMFS is not able to achieve the deadlines specified above or approved pursuant to the HEA, it may request an extension of time from the Licensees, which extension the Licensees may grant if good cause exists (good cause includes, but is not limited to, events or circumstances beyond the Licensees' or NMFS' reasonable control). Upon requesting an extension of time, the Licensees and NMFS will provide a written notice of such a request to the HEA signatories. The HEA signatories will then make their best efforts to ensure that the cumulative effect of these extensions does not significantly delay the Licensee(s)'s decision whether to withdraw from the HEA (see Section 11.1 of the HEA) or implement the habitat expansion action(s). (Section 5 of the HEA.)

Chapter 6
References

6.1 Printed References

Abbe, T. B., and D. R. Montgomery. 1996. Large woody debris jams, channel hydraulics and habitat formation in large rivers. *Regulated Rivers: Research and Management* 12:201–221.

Alber, L. 2010. Acoustic Telemetry: Adult Spring-Run Chinook Salmon on the Lower Yuba River. Presented at Lower Yuba River Symposium, June 29, 2010. Sacramento, CA.

Anderson, J. T., C. B. Watry, and A. Gray. 2007. Upstream fish passage at a resistance board weir using infrared and digital technology in the Lower Stanislaus River, California: 2006–2007 annual data report. Prepared for the U.S. Fish and Wildlife Service, Anadromous Fish Restoration Program. Lodi, CA.

Banks, M. A., V. K. Rashbrook, M. J. Calavetta, C. A. Dean, and H. D. 2000. Analysis of microsatellite DNA resolves genetic structure and diversity of chinook salmon (*Oncorhynchus tshawytscha*) in California's Central Valley. *Canadian Journal of Fisheries and Aquatic Sciences* 57:915–927.

California Department of Fish and Game. 1991. Final report: Lower Yuba River Fisheries Management Plan. (Stream Evaluation Report No. 91-1.) Sacramento, CA.

California Department of Water Resources. 2009. Central Valley Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin Background Report. The Natural Resources Agency, Division of Environmental Services, Sacramento, CA.

California Department of Water Resources. 2008. Final Environmental Impact Report, Oroville Facilities Relicensing (FERC Project No. 2100). Sacramento, CA.

California Department of Water Resources. 2007. Biological Assessment for Federally Listed Anadromous Fishes, Oroville Facilities Relicensing (FERC Project No. 2100). Sacramento, CA.

California Department of Water Resources. 2006. Settlement Agreement for Licensing of the Oroville Facilities (FERC Project No. 2100). Sacramento, CA.

California State University, Sacramento. Center for Collaborative Policy. 2008. Lower Yuba River Issue Assessment Report. Prepared for South Yuba River Citizen's League, Yuba County Community Development & Services Agency, and Yuba County Water Agency. April 8.

cbec. See cbec, inc. eco engineering.

cbec, inc. eco engineering. 2010. Rehabilitation Concepts for the Parks Bar to Hammon Bar Reach of the Lower Yuba River. Review Draft. Prepared by cbec, inc. eco engineering, with assistance from McBain & Trush. Prepared for South Yuba River Citizens League. July 18.

Corps. See U.S. Army Corps of Engineers.

DFG. See California Department of Fish and Game.

ENTRIX, Inc. and J. Monroe. 2002. Daguerre Point Dam Fish Passage Improvement Project 2002 Fisheries Studies: Analysis of Potential Benefits to Salmon and Steelhead from Improved Fish Passage at Daguerre Point Dam. Sacramento, CA.

Federal Energy Regulatory Commission. 2006. Draft Environmental Impact Statement: Oroville Facilities California (FERC Project No. 2100). (FERC/DEIS-0202D.) Washington, DC.

Federal Energy Regulatory Commission. 2005. Hearings on Applications; Consultation on Terms and Conditions; Motions to Intervene; Alternative Procedures. (18 CFR 4.34.) Washington, DC.

Friends of Deer Creek (no date). Gravel Augmentation for Salmonids and Other Aquatic Life in Lower Deer Creek: Gravel Augmentation Plan.

Gregory, S. V. and P. A. Bisson. 1996. Degradation and loss of anadromous salmonid habitat in the Pacific Northwest. Pages 277–314 in D. J. Stouder, P. A. Bisson, and R. J. Naiman (eds.). *Pacific Salmon and their Ecosystems*. New York: Chapman-Hall.

Hayhoe, K., D. Cayan, C. B. Field, P. C. Frumoff, E. P. Maurer, N. L. Miller, S. C. Moser, S. H. Schneider, K. N. Cahill, E. E. Cleland, L. Dale, R. Drapek, R. M. Hanemann, L. S. Kalkstein, J. Lenihan, C. K. Lunch, R. P. Neilson, S. C. Sheridan, and J. H. Verville. 2004. Emission pathways, climate change, and impacts on California. *Proceedings of the National Academy of Science* 101(34):12422–12427.

Hedgecock, D., M. A. Banks, V. K. Rashbrook, C. A. Dean, and S. M. Blankenship. 2001. Application of population genetics to conservation of Chinook salmon diversity in the Central Valley. In R. L. Brown (ed.), Contributions to the Biology of Central Valley Salmonids. California Department of Water Resources and California Department of Fish and Game. Fish Bulletin 179 (Volume 1). Sacramento, CA.

Kozlowski, J. F. 2004. Summer Distribution, Abundance, and Movements of Rainbow Trout (*Oncorhynchus mykiss*) and Other Fishes in the Lower Yuba River, California. M.S. Thesis (Ecology), University of California at Davis. Davis, CA.

Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science [online serial] (1), http://repositories.cdlib.org/jmie/sfews/vol5/iss1/art4.

Lindley, S. T., R. Schick, B. P. May, J. J. Anderson, S. Greene, C. Hanson, A. Low, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2004. Population Structure of Threatened and Endangered Chinook salmon ESUs in California's Central Valley Basin. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-360. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Santa Cruz, CA.

Lower Yuba River Fisheries Technical Group. 2005. Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration. Funded by CALFED and Yuba County Water Agency. Sacramento, CA.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units. NOAA Technical Memorandum, NMFS-NWFSC-42. U.S. Department of Commerce, Seattle, WA.

Moyle, P. B. 2002. Inland Fishes of California. University of California Press.

MWH. See MWH Americas, Inc.

MWH Americas, Inc. 2010. Yuba River Fish Passage, Conceptual Engineering Project Options. Preprepared for National Marine Fisheries Service, Sacramento, CA. February.

NMFS. See National Marine Fisheries Service.

National Marine Fisheries Service. 2007. Biological Opinion for the Operation of Englebright and Daguerre Point Dams on the Yuba River, California. File Number, 151422-SWR-2006-SA00071:MET (PCTS #2007/01232). National Marine Fisheries Service, Sacramento, CA.

National Marine Fisheries Service. 2009. Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead. Sacramento Protected Resources Division. October.

Pacific States Marine Fisheries Commission. 2009. Lower Yuba River Accord Pilot Redd Survey Report: September 15, 2008–April 27, 2009. Annual Report. Prepared for the Yuba River Management Team. Sacramento, CA.

Pasternack, G., A. Fulton, and S. Morford. 2010. Yuba River analysis aims to aid spring-run Chinook salmon habitat rehabilitation. California Agriculture 64(2):69-77.

Pasternack, G. B. 2010a. Estimate of the Number of Spring-Run Chinook Salmon That Could Be Supported by Spawning Habitat Rehabilitation at Sinoro Bar on the Lower Yuba River. Prepared for Habitat Expansion Agreement Steering Committee (California Department of Water Resources and Pacific Gas and Electric Company). July 2.

Pasternack, G. B. 2010b. Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River, CA. Prepared for U.S. Army Corps of Engineers. September 30, 2010.

Pasternack, G. B. 2010c. Estimate of the Number of Spring-Run Chinook Salmon Supportable by River Rehabilitation in the Narrows Reach of the Lower Yuba River. Prepared for Habitat Expansion Agreement Steering Committee (California Department of Water Resources and Pacific Gas and Electric Company). November 9.

Pasternack, G. B. 2009. Manuscript. Historical Analysis of the Englebright Dam Reach of the Lower Yuba River, CA to Aid Spring-Run Chinook Salmon Habitat Rehabilitation. University of California, Davis. Department of Land, Air, and Water Resources.

Pasternack, G. B. 2008. SHIRA-Based River Analysis and Field-Based Manipulative Sediment Transport Experiments to Balance Habitat and Geomorphic Goals on the Lower Yuba River. Final Report. Prepared for the Cooperative Ecosystems Study Unit (CESU) 81332 6 J002, University of California, Davis. Department of Land, Air, and Water Resources (in association with the UC Davis Center for Watershed Sciences). August (Revised January 29, 2009).

PSMFC. See Pacific States Marine Fisheries Commission.

Sommer, T., D. McEwan, and R. Brown. 2001. Factors Affecting Chinook Salmon Spawning in the Lower Feather River. Pages 269–297 in R. Brown (ed.). Contributions to the Biology of Central Valley Salmonids, Volume 1. State of California, Sacramento, CA.

South Yuba River Citizens League. 2009. About the Yuba. Available online: <http://www.syrcl.org/river/river-facts.asp>.

Stewart, R. 2003. Techniques for Installing a Resistance Board Fish Weir. Regional Information Report No. 3A03-26. Alaska Department of Fish and Game. Anchorage, AK.

SYRCL. See South Yuba River Citizens League.

U.S. Army Corps of Engineers. 2010. Draft Environmental Assessment for the Lower Yuba River Gravel Augmentation Project, Yuba and Nevada Counties, California. Sacramento District. September.

Waples, R. S., D. J. Teel, J. M. Myers, and A. R. Marshall. 2004. Life-History Divergence in Chinook Salmon: Historic Contingency and Parallel Evolution. Evolution 58(2): 386-403.

YCWA. See Yuba County Water Agency.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 2001. Historical and Present Distribution of Chinook Salmon in the Central Valley. Pp. 71–176 in R. Brown (ed.). Contributions to the Biology of Central Valley Salmonids. California Department of Fish and Game Fish Bulletin 179. Sacramento, CA.

Yuba County Water Agency, California Department of Water Resources, and U.S. Bureau of Reclamation. 2007. Proposed Lower Yuba River Accord Draft Environmental Impact Report/Environmental Impact Statement. June. Marysville, CA.

6.1.1 Personal Communications

Berry, Mike. California Department of Fish and Game. Teleconference with HEA Steering Committee, June 2, 2010.

Bratcher, Tricia. California Department of Fish and Game. Teleconference with HEA Steering Committee, June 2, 2010.

Hill, Katherine. Program Manager – Fisheries, Hatcheries, and Fish Habitat Shop. California Department of Fish and Game North Central Region (Region 2), Rancho Cordova, CA Email to the HEA Steering Committee with a management goals statement for spring-run Chinook salmon in the upper Lower Yuba River. November 4, 2010.

Pasternack, Gregory B., PhD, M.ASCE. Professor of watershed hydrology and geomorphology at the University of California, Davis. Email to the HEA Steering Committee regarding calculations of gravel volumes for the spawning habitat expansion action at Sinoro Bar. November 10, 2010.

Reedy, Gary. River Science Program Director. South Yuba River Citizens League. Nevada City, CA. Meeting with the HEA Steering Committee regarding potential habitat expansion actions in the Lower Yuba River. October 6, 2009.

Strachan, Susan. California State University, Chico. Email to Chris Wilkinson, California Department of Water Resources, regarding funding for Iron Canyon fish ladder. October 11, 2010.

Wantuck, Rick. Regional Hydropower Program Supervisor. National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS). Southwest Region. Discussion of proposed reintroduction of spring-run Chinook salmon into the Upper Yuba River in a meeting with NMFS technical staff and the HEA Steering Committee. July 21, 2010, Santa Rosa, CA.

Appendix A

Approval and Implementation Schedule for Habitat Expansion Actions

Appendix A. Approval and Implementation Schedule for Habitat Expansion Actions

HEA Section Reference	Description	November 20, 2009	February 20, 2010			November 19, 2010	January 2011	April 2011	July 2011	October 2011	January 2012		July 2012	October 2012		?	
4.1	Licensees submit Draft Habitat Expansion Plan																
4.1.3	Parties and others review and comment on Draft Habitat Expansion Plan		<90 days														
4.2	Licensees prepare and submit Final Habitat Expansion Plan (includes 6-month extension)			90 days	180 days												
4.2.7	NMFS distributes Final Habitat Expansion Plan for 60-day consultation period with Parties and others						60 days										
4.2.7	NMFS reviews, responds to comments, and approves Final Habitat Expansion Plan							~90 days[a]									
4.2.8	Licensees distribute NMFS-approved Final Habitat Expansion Plan								<90 days								
4.3	Licensees prepare Preliminary Design Report									~90 days[b]							
4.4	NMFS determines Consistency of Preliminary Design Report										<90 days						
4.5	Licensees prepare Final Design and Permitting Report (after issuance of new Project Licenses)											~180 days[c]					
4.6	NMFS determines Consistency of Final Design and Permitting Report													<90 days			
4.7	Licensees implement actions														variable		
4.8	Licensees prepare Final Test Report															variable	
4.9	NMFS determines functionality																<90 days

Notes:

a	The timing for NMFS to make an approval decision on the Final Habitat Expansion Plan is not defined in the HEA (Section 4.2.7); however, for planning purposes, the Steering Committee assumed that an approval would be made by NMFS in approximately 90 days.
b	The timing for the Licensees to prepare the Preliminary Design Report is not defined in the HEA (Section 4.3); however, for planning purposes, the Steering Committee assumed that the report would be completed in 90 days.
c	The timing for the Licensees to prepare the Final Design and Permitting Report is not defined in the HEA (Section 4.5); however, for planning purposes, the Steering Committee assumed that the report would be completed in 180 days.
HEA	Habitat Expansion Agreement
Licensees	California Department of Water Resources and Pacific Gas and Electric Company
NMFS	National Marine Fisheries Service
Parties	Signatories to the HEA

Appendix B

Habitat Expansion Actions

Appendix B1

Draft Working List of Potential Actions

Working List of Potential Habitat Expansion Actions

The following non-prioritized list of actions has been compiled by the HEA Steering Committee based on the potential of the actions to help satisfy requirements of the Habitat Expansion Agreement. The working list is pre-decisional and does not necessarily represent actions that will be selected by the HEA Steering Committee to include in the Draft Habitat Expansion Plan.

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
Northern Sierra Nevada Spring Run Salmon Diversity Group						
NS-1	Supplement flows in Antelope Creek with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to allow passage of juvenile and adult spring-, fall- and late-fall-run Chinook salmon and steelhead.	All	Antelope Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	Economic feasibility and level of local/political support for flow supplementation are unknown. Additionally, the benefit of flow supplementation to maintenance of spatial separation is unclear.
NS-2	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment (U.S. Forest Service Long-Term Anadromous Fish Conservation Strategy).	All	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	U.S. Forest Service Long-term Anadromous Fish Conservation Strategy.	
NS-3	Implement the Edwards Dam Ladder construction project (AFRP website 2005). Conduct fish passage evaluation at all agricultural diversions to determine if they meet NMFS' fish passage criteria. Design and install state-of-the-art fish passage facilities at diversions that currently do not meet the passage criteria.	Adult Immigration	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/	The Edwards Dam Ladder construction project was completed in October 2007. Juvenile bypass facilities are still needed as of October 2008.
NS-4	Develop an Antelope Creek fish passage assessment, including recommendations for improving channel connectivity, flow consolidation, and minimizing entrainment through installation of state-of-the-art fish passage facilities at diversions (AFRP Website 2005).	Adult Immigration	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-5	Evaluate and dedicate instream flows and consolidate channels to facilitate upstream attraction and passage (NMFS 2007b). Dedicate instream flows through water exchange agreements with all water users. Improve passage conditions at Paynes crossing to allow upstream passage during low flows.	Adult Immigration, Adult Holding	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	Also referred to as Tehama Wildlife Area crossing. AFRP is currently funding a fish passage feasibility study at this site, but as of October 2008 funding has not been identified for construction.
NS-6	Identify gravel starved areas in Antelope Creek and implement gravel additions.	Spawning	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-7	Build sediment retention structures; fortify streambanks with native vegetation.	Spawning, Egg Incubation	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-8	Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	Summer/Winter Rearing, Juvenile Emigration	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-9	Implement projects to increase floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).	Summer/Winter Rearing	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
NS-10	Implement projects that cooperatively work with landowners to modify existing diversions so that fish do not become entrained in agricultural fields.	Juvenile Emigration	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-11	Screen diversions in Antelope Creek	Juvenile Emigration	Antelope Creek	PG&E/CalTrout Prioritized Actions List	Collaborative Group 2006.	
NS-12	Remove the partial barrier (old agricultural dam) approximately 0.4 river miles downstream of Higgins Hole, located on private property.	Adult Immigration	Big Chico Creek	HEA Steering Committee	No reference cited.	Fish passage evaluation has not been done for this site.

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-13	Implement the Iron Canyon Fish Passage Project (AFRP Website 2005). Conduct Fish Passage evaluation at all dams and diversions to determine if they meet NMFS fish passage criteria. Design and install state-of-the-art fish passage facilities at diversions (1-mile dam, 5-mile dam) that currently do not meet the passage criteria.	Adult Immigration	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/	
NS-14	Repair the Iron Canyon fish ladder in Big Chico Creek.	Adult Immigration	Big Chico Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	
NS-15	Repair the Lindo Channel weir and fishway at the Lindo Channel box culvert at the Five-Mile Diversion in Big Chico Creek.	Adult Immigration	Big Chico Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	Need to acquire more information about the box culvert and fishway mentioned in this action.
NS-16	Protect spring-run Chinook salmon summer holding pools in Big Chico Creek by obtaining from willing sellers titles or conservation easements on lands adjacent to the pools.	Adult Holding	Big Chico Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	Benefit of this action would depend on the implementation of the Iron Canyon Fish Ladder project. Cost would be dependent on the landowners' willingness to sell.
NS-17	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment.	All	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-18	Develop a spawning gravel budget and implement an augmentation plan and use flow management to optimize spawning weighted usable area in consideration of hydrologic limitations and other species (e.g., steelhead) and life stage requirements. Implement One-mile Dam modification and gravel supplementation project (City of Chico); add spawning gravels at Five-Mile Diversion (AFRP Website 2005).	Spawning	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/	
NS-19	Identify stream reaches that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	All	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-20	Eliminate sources of chronic sediment delivery from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	Egg Incubation	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-21	Implement projects to increase floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).	Summer/Winter Rearing	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
NS-22	Cooperate with local landowners to encourage revegetation of denuded stream reaches; and establish, restore, and maintain riparian habitat on Big Chico Creek.	Juvenile Emigration, Summer/Winter Rearing	Big Chico Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	
NS-23	Purchase existing water rights from willing sellers.	All	Butte Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	All Lower Butte Creek actions need to be investigated to determine if the actions were carried out in previous restoration activities.
NS-24	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	All	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	U.S. Forest Service Long-term Anadromous Fish Conservation Strategy.	
NS-25	Maintain state-of-the-art fish passage facilities at diversions to meet NMFS' passage criteria. Study feasibility of consolidating diversion points to minimize the number of diversions on Butte Creek. Based on this study, consolidate diversions where feasible.	Adult Immigration	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	Some consolidation of diversions has already been done for the lower portion of Butte Creek as of Oct 2008; uncertain if other diversions could also be consolidated.
NS-26	Identify gravel starved areas in Butte Creek and implement gravel additions. Develop a spawning gravel budget and implement an augmentation plan and use flow management to optimize spawning weighted usable area in consideration of hydrologic limitations and other species (e.g., steelhead) and life stage requirements.	Spawning	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-27	Install and maintain real-time flow monitoring gages. Develop sustainable instream flow criteria for spawning and incubation periods. Develop and implement flow ramping protocols to protect all life stages of spring-run Chinook salmon. Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	Spawning, Egg Incubation	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-28	Reduce the number of temporary passage impediments installed to create swimming holes in Butte Creek near Chico; conduct associated public outreach projects.	Adult Immigration	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-29	Identify stream reaches that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	All	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-30	Promote or create riparian buffer strips between the Butte Creek channel and adjacent land uses.	Juvenile Emigration, Summer/Winter Rearing	Butte Creek	PG&E/CalTrout Prioritized Actions List	No reference cited.	
NS-31	Implement projects that consolidate and screen existing diversions where feasible.	Juvenile Emigration	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-32	Retrofit dams on Little Butte Creek in order to provide for more storage to use for fisheries flows.	All	Little Butte Creek	HEA Steering Committee	No reference cited.	An earthquake retrofit is necessary and might be an opportunity to increase storage to benefit fisheries flows. This would primarily benefit steelhead.
NS-33	Improve passage of chinook salmon & steelhead at dams on Deer Creek.	Adult Immigration	Deer Creek	PG&E/CalTrout Prioritized Actions List	Spring-run chinook salmon recovery brainstorming session (11/8/05).	Local support is questionable regarding landowners not associated with the watershed conservancy.
NS-34	Construct fish ladder at upper Deer Creek falls.	Adult Immigration	Deer Creek	PG&E/CalTrout Prioritized Actions List	Spring-run chinook salmon recovery brainstorming session (11/8/05).	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-35	Acquire water from willing sellers consistent with applicable guidelines or negotiate agreements to supplement instream flows in the lower ten miles of Deer Creek to ensure passage of adult and juvenile spring- and fall-run Chinook salmon and steelhead over three diversion dams.	Adult Immigration, Juvenile Emigration	Deer Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	Water exchange program is being funded through the 4-Pumps mitigation program.
NS-36	Implement water exchange agreement with the Deer Creek Irrigation Company and the Stanford-Vina Irrigation District and dedicate fish passage flows (AFRP Website 2005).	Adult Immigration, Adult Holding	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/	
NS-37	Permit and construct a state-of-the-art fish ladder that meets NMFS' adult fish passage criteria and install a new apron at the Cone-Kimball Diversion (AFRP Website 2005). Install state-of-the-art fish ladder at Stanford-Vina Dam (AFRP Website 2005, NMFS 2007b). Conduct fish passage evaluation at all agricultural diversions to determine if they meet NMFS' fish passage criteria. Design and install state-of-the-art fish passage facilities at diversions that currently do not meet the passage criteria. Study feasibility of consolidating diversion points to minimize the number of diversions on Deer Creek. Based on this study, consolidate diversions where feasible. Conduct a study designed to determine adult fish passage flows at critical riffles and fish ladders. Develop a water exchange agreement with all water users to allow implementation of those flows.	Adult Immigration	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	Project to improve fish passage at Stanford-Vina Dam is being considered as part of Deer Creek Floodplain Study as of Oct 2008; projects to improve fish passage at DCID and Cone-Kimball diversion dams are being discussed between Deer Creek Watershed Conservancy and irrigation districts as of Oct 2008.

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-38	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows (Deer Creek meadows, Childs meadows, Gurnsey Creek, and North Fork Deer Creek) to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment (Deer Creek Conservancy Watershed Report, U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	All	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	Deer Creek Watershed Existing Conditions Report. U.S. Forest Service Long-term Anadromous Fish Conservation Strategy.	
NS-39	Carry out a Deer Creek (upper) erosion reduction project (AFRP Website 2005). Restore meadows and reduce stream channel incisement and bank erosion by modifying grazing practices and excluding cattle from nearshore zones, and reduce the potential for, and magnitude of a catastrophic wildfire, and reduce sources of chronic road-related erosion (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy). Decommission Fire Mountain Lodge Hydro-electric project, and remove the earthen dam, restore the stream channel, and obliterate project roads.	Spawning, Egg Incubation	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	U.S. Forest Service Long-term Anadromous Fish Conservation Strategy.	**Fire Mt Lodge; Notice of Application for…Establishing Procedural Schedule for Relicensing…: http://edocket.access.gpo.gov/2008/E8-10957.htm**
NS-40	Build sediment retention structures; fortify streambanks with native vegetation.	Spawning, ,Egg Incubation	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-41	Identify gravel starved areas in Deer Creek and implement gravel additions. Re-design highway 32 culvert crossing at Calf Creek to allow for unimpeded bedload transport. Conduct a spawning gravel augmentation feasibility study to increase available spawning habitat. Implement spawning gravel augmentation projects if the feasibility study determines that such projects will not cause adverse ecological impacts.	Spawning	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-42	Implement projects to increase floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).	Summer/Winter Rearing	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
NS-43	Renew long-term agreements to restore and preserve riparian habitats along Deer Creek.	Juvenile Emigration, Summer/Winter Rearing	Deer Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	
NS-44	Restore a functional, seasonally inundated floodplain along lower Deer Creek to provide enhanced rearing habitat for spring-run Chinook salmon fry.	Summer/Winter Rearing	Deer Creek	PG&E/CalTrout Prioritized Actions List	Collaborative Group 2006.	
NS-45	Identify and implement projects designed to improve downstream passage conditions for juveniles.	Juvenile Emigration	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-46	Identify stream reaches that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	All	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-47	Ensure that all Feather River diversions have fish screens that meet NMFS' fish screen criteria.	Juvenile Emigration	Feather River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-48	Implement programs and measures designed to control non-native predatory fish (NMFS 2007b), including eradication programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass). Implement projects to minimize predation at weirs, diversion dams, and related structures. Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.	Juvenile Emigration	Feather/Yuba Rivers	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
NS-49	Identify stream reaches that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	All	Feather/Yuba Rivers	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-50	Improve passage of chinook salmon & steelhead at dams on Mill Creek.	Adult Immigration	Mill Creek	PG&E/CalTrout Prioritized Actions List	Spring-run chinook salmon recovery brainstorming session (11/8/05).	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-51	Supplement flows in Mill Creek with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to allow passage of juvenile and adult spring-, fall- and late-fall-run Chinook salmon and steelhead.	All	Mill Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	This action is potentially being included in the four pumps mitigation agreements. Wording has changed from original PG&E/Caltrout list from "Continue to provide flows..." to "Supplement flows..."
NS-52	Conduct fish passage evaluation at all agricultural diversions to determine if they meet NMFS' fish passage criteria. Design and install state-of-the-art fish passage facilities at diversions that currently do not meet the passage criteria. Conduct a study designed to determine adult fish passage flows at critical riffles and fish ladders. Develop a water exchange agreement with all water users to allow implementation of those flows.	Adult Immigration	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-53	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment (Mill Creek Conservancy Watershed Report, U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	All	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	Mill Creek Watershed Management Strategy Report. U.S. Forest Service Long-term Anadromous Fish Conservation Strategy.	
NS-54	Restore meadows and reduce stream channel incisement and bank erosion by modifying grazing practices and excluding cattle from nearshore zones, and reduce the potential for, and magnitude of a catastrophic wildfire, and reduce sources of chronic road-related erosion (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	Spawning, Egg Incubation	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	U.S. Forest Service Long-term Anadromous Fish Conservation Strategy.	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-55	Work with State and Federal water acquisition programs to develop dedicated instream water; participate in the lower Mill Creek Watershed Restoration Project (AFRP Website 2005).	All	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/	
NS-56	Build sediment retention structures; fortify streambanks with native vegetation.	Spawning, Egg Incubation	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-57	Implement projects to increase floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).	Summer/Winter Rearing	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
NS-58	Identify and implement projects designed to improve downstream passage conditions for juveniles.	Juvenile Emigration	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-59	Identify stream reaches that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	All	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-60	Establish, restore, and maintain riparian habitat along the lower reaches of Mill Creek.	Juvenile Emigration, Summer/Winter Rearing	Mill Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	
NS-61	Provide passage past Engelbright Dam for steelhead and Chinook salmon.	Adult Immigration, Spawning	Yuba River	PG&E/CalTrout Prioritized Actions List	Upper Yuba River Studies Program 2006	Effect of reintroduction above Engelbright reservoir on other resources, particularly resident trout fisheries, is unknown.
NS-62	Facilitate passage of spawning adult salmonids by maintaining appropriate flows through the fish ladders, or by modifying the fish ladders at Daguerre Point Dam.	Adult Immigration	Yuba River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	
NS-63	Construct improved fish passage facilities at Daguerre Point Dam to provide for segregation of adult spring-run and fall-run chinook salmon.	Spawning, Egg Incubation	Yuba River	PG&E/CalTrout Prioritized Actions List	Spring-run chinook salmon recovery brainstorming session (11/8/05).	It is difficult to determine how segregation would contribute to the HEA threshold. Impact to migrating steelhead is also a concern.
NS-64	Collaboratively design the Daguerre Point Dam fish ladder passage engineering and design of the preferred alternative described in DWR and Corps (2003) (AFRP Website 2005).	Adult Immigration	Yuba River	NMFS Recovery Plan Co-Manager Review Draft	Daguerre Point Dam Fish Passage Improvement Project 2002 Fisheries Study.	
NS-65	Facilitate passage of juvenile salmonids by modifying the dam face of Daguerre Point Dam.	Adult Immigration	Yuba River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-66	Operate reservoirs in the Yuba River basin to provide adequate water temperatures for anadromous fish.	All	Yuba River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	
NS-67	Implement actions to enhance habitat conditions and improve access within the area above Englebright Dam, including increasing minimum flows, providing passage at Our House, New Bullards Bar, and Log Cabin dams, and assessing feasibility of passage improvement at natural barriers. Design and conduct an experimental fish passage program to evaluate adult distribution, survival, spawning, and production in habitats above Englebright Dam. If the experimental fish passage program demonstrates that passage above Englebright Dam can substantively contribute to the long-term viability of the ESU, then develop and implement long-term fish passage programs.	Adult Immigration, Spawning	Yuba River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-68	Conduct gravel additions above and below Narrows Pool (Corps mitigation) (AFRP Website 2005).	Spawning	Yuba River	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/	
NS-69	Improve efficiency of screening devices at Brophy-South Yuba water diversion and other unscreened diversions.	Juvenile Emigration	Yuba River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	
NS-70	Construct or improve the fish bypasses at Hallwood-Cordua and Brophy-South Yuba water diversion.	All	Yuba River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	
NS-71	Develop and implement a large woody material restoration program along the lower Yuba River utilizing sources of wood that enter upstream reservoirs.	Juvenile Emigration, Summer/Winter Rearing	Yuba River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-72	Implement flow fluctuation and ramping rates found to be protective of embryos and juveniles by the fry stranding and redd dewatering study.	Egg Incubation, Juvenile Emigration, Summer/Winter Rearing	Yuba River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NS-73	Reduce and control flow fluctuations to avoid and minimize adverse effects to juvenile salmonids.	Juvenile Emigration, Summer/Winter Rearing	Yuba River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NS-74	Identify and implement projects designed to minimize predation on juvenile salmonids at Daguerre Point Dam and associated structures. Implement programs and measures designed to control non-native predatory fish (NMFS 2007b), including eradication programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass). Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.	Juvenile Emigration, Summer/Winter Rearing	Yuba River	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
NS-75	Purchase conservation easements (AFRP 2006b) adjacent to the Yuba River and manage those easements as seasonal floodplain habitats. Implement projects to increase floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).	Summer/Winter Rearing	Yuba River	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	No reference cited for the AFRP 2006b in the Recovery Plan.
NS-76	Purchase streambank conservation easements in the Yuba River to improve salmonid habitat and instream cover.	Juvenile Emigration, Summer/Winter Rearing	Yuba River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
Basalt and Porus Lava Spring-Run Chinook Salmon Diversity Group Threats and Associated Recovery Actions						
B-1	Implement Phase 1(b) of the package of passage, screening, and flow actions defined for the Battle Creek Restoration project, as defined by the Memorandum of Understanding.	Adult Immigration	Battle Creek	PG&E/CalTrout Prioritized Actions List	Battle Creek Restoration Plan (Kier and Associates 1999).	
B-2	Implement Phase 2 of the package of passage, screening, and flow actions defined for the Battle Creek Restoration project, as defined by the Memorandum of Understanding.	All	Battle Creek	PG&E/CalTrout Prioritized Actions List	Battle Creek Restoration Plan (Kier and Associates 1999).	
B-3	Install pipeline connections between powerhouses and diversion-canal intakes to prevent trans-basin water diversions from causing false attraction of anadromous salmonids from the North Fork to the South Fork. [1]	Adult Immigration	Battle Creek	PG&E/CalTrout Prioritized Actions List	Battle Creek Restoration Plan (Kier and Associates 1999).	The cost of installing a pipeline connection at Coleman has been estimated at approximately $18 M, making this project seem unreasonably expensive. Additionally, the landownder in the vicinity of the upper pipeline is opposed to any construction in his viewshed.
B-4	Develop and implement pulse flow schedules during peak migration periods for years with low water availability.	Adult Immigration	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
B-5	Install state-of-the-art ladders at, or remove small dams on the South Fork of Battle Creek to provide fish passage (NMFS 2007b).	Adult Immigration	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
B-6	Increase streamflows as specified in the Battle Creek Salmon and Steelhead Restoration Plan (NMFS 2007b).	All	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
B-7	Increase flow releases from remaining diversion dams affecting anadromous fish on Battle Creek as per the Battle Creek Restoration Plan (CALFED 2007). Avoid implementation of additional water projects (i.e., FERC permits) that are detrimental to the goals and objectives of the Battle Creek Salmon and Steelhead Restoration Plan.	Adult Immigration, Adult Holding	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	No reference cited for CALFED 2007 in the Recovery Plan.
B-8	Provide anadromous fish passage as specified in the Battle Creek Salmon and Steelhead Restoration Plan (CALFED 2007).	Adult Immigration	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	No reference cited for CALFED 2007 in the Recovery Plan.

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
B-9	Implement the Battle Creek Salmon and Steelhead Restoration Plan. Modernize/upgrade PG&E facilities to reduce the potential for flow fluctuations and outages.	All	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
B-10	Encourage conservation easements and other incentives to retain large blocks of land under private ownership that continue to buffer Battle Creek fish populations from intense types of streamside land management practices and human disturbance.	All	Battle Creek	PG&E/CalTrout Prioritized Actions List	Battle Creek Restoration Plan (Kier and Associates 1999).	
B-11	Encourage riparian, stream channel, and fish habitat restoration projects following ecosystem-based approaches on private lands.	All	Battle Creek	PG&E/CalTrout Prioritized Actions List	Battle Creek Restoration Plan (Kier and Associates 1999).	
B-12	Develop and increase application of alternative diversion technologies that eliminate entrainment.	Juvenile Emigration	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
B-13	Implement programs and measures designed to control non-native predatory fish (NMFS 2007b), including eradication programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass). Implement projects to minimize predation at weirs, diversion dams, and related structures. Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.	Juvenile Emigration, Summer/Winter Rearing	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
B-14	Encourage land management to protect against catastrophic wildfires through fuel reduction.	All	Battle Creek	PG&E/CalTrout Prioritized Actions List	Battle Creek Restoration Plan (Kier and Associates 1999).	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
B-15	Conduct feasibility studies for allowing spring-run Chinook salmon access to habitat above Shasta Dam, including assessing habitat suitability and passage logistics (i.e., getting immigrating adults above the dam and emigrating juveniles below it). If the feasibility studies suggest that fish passage can be successful, then design and conduct an experimental fish passage program evaluating adult distribution, survival, spawning, and production in habitats above Shasta Dam. If the experimental fish passage program demonstrates that passage above Shasta dam can substantively contribute to the long-term viability of the ESU, then develop and implement long-term fish passage programs.	Adult Immigration, Adult Holding, Spawning	Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
B-16	Implement an annual trap-and-haul operation to restore access to existing and restored habitat in tributaries upstream of Shasta Dam	Adult Immigration, Adult Holding, Spawning	Sacramento River	PG&E/CalTrout Prioritized Actions List	Calfed Bay Delta Program 2006	
B-17	Maintain the gates-up position to prevent passage impediments to listed species.	Adult Immigration	Sacramento River/Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
B-18	Conduct periodic (e.g., every 5 years) spawning gravel assessments in the upper Sacramento River (i.e., above RBDD) and implement gravel augmentation projects, as necessary.	Spawning	Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
B-19	Modify gravel pits and mounds to ensure full drainage of these features to allow flooding while preventing stranding and warm water predator habitat.	Juvenile Emigration, Summer/Winter Rearing	Upper Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	The Recovery Plan mentions this action in reference to the juveniles produced in the Sacramento River.
B-20	Restore the current Lake Red Bluff footprint to riparian habitat.	All	Upper Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	The Recovery Plan mentions this action in reference to the juveniles produced in the Sacramento River.

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
Northwestern California Spring-Run Chinook Salmon Threats and Associated Recovery Actions						
NWC-1	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	All	Beegum Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-2	Develop and implement a spawning gravel augmentation plan.	Spawning	Beegum Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-3	Eliminate sources of chronic sediment delivery from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	Spawning, Egg Incubation	Beegum Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-4	Develop cooperative water use agreements (e.g., groundwater exchange agreements) with local water users to provide flows during the immigration life stage.	Adult Immigration	Beegum Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-5	Inject LWD and boulders in the canyon reach of Clear Creek to induce gravel deposition to support pocket spawning by salmonids.	Spawning	Clear Creek	PG&E/CalTrout Prioritized Actions List	Collaborative Group 2006.	
NWC-6	Additional Gravel Supplementation in the reaches of Clear Creek directly below Whiskeytown Dam.	Spawning	Clear Creek	HEA Steering Committee	No reference cited.	This would not be self-sustaining. It would need to be redone periodically.
NWC-7	Develop a spawning gravel budget and implement an augmentation plan and use flow management to optimize spawning weighted usable area in consideration of hydrologic limitations and other species (e.g., steelhead) and life stage requirements. Develop a spawning gravel budget and implement an augmentation plan.	Spawning	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-8	Supplement flows in Clear Creek in order to provide a more natural flow regime and encourage gravel dispersal.	Spawning	Clear Creek	HEA Steering Committee	No reference cited.	This action would primarily include paying for the forfeited power generation.

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NWC-9	Increase stream flows as needed to reduce water temperatures (NMFS 2007b). Develop a real time water temperature model to track the coldwater pool in Whiskeytown Reservoir and budget releases to Clear Creek to meet a daily water temperature of 60°F at the Igo gauge from June 1 to September 15 and 56°F from September 15 to October 31. Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	All	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
NWC-10	Conduct a passage feasibility study, including an assessment of potential habitat above Whiskeytown Dam.	Adult Immigration, Adult Holding, Spawning	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-11	Develop and implement flow ramping protocols to protect all life stages of spring-run Chinook salmon.	All	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-12	Develop and implement optimal pulse flow schedules and increase flow allocation for Clear Creek in years with low water availability.	All	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-13	Eliminate sources of chronic sediment delivery from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines	Spawning, Egg Incubation	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-14	Develop a cooperative program to improve flow on Clear Creek by increasing releases from Whiskeytown Dams (USFWS 1997).	All	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	Abundance and Survival of Juvenile Chinook Salmon in the Sacramento-San Joaquin Estuary, 1994 Annual Progress Report.	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NWC-15	Increase integration of the State and Federal water projects through shared storage and conveyance agreements. Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights (AFRP website 2005). Implement projects that improve fish passage between the Sacramento River and flood bypasses.	Adult Immigration	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/	
NWC-16	Implement Lower Clear Creek Floodway Rehabilitation Project (Phase 3B) and other projects designed to improve juvenile rearing habitat (CALFED 2007).	Summer/Winter Rearing	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft		No reference cited for CALFED 2007 in the Recovery Plan.
NWC-17	Facilitate watershed protection and restoration to reduce water temperatures and siltation to improve holding, spawning, and rearing habitats for salmonids.	All	Cottonwood Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	
NWC-18	Protect/enhance existing riparian habitat and corridors (NMFS 2007b). Implement non-native plant (e.g. Arundo) eradication plan.	Juvenile Emigration, Summer/Winter Rearing	Cottonwood Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	This action, while on Cottonwood Creek, is mentioned in the Recovery Plan as benefiting Beegum Creek
NWC-19	Re-establish natural channel morphology by: (1) applying NMFS gravel mining criteria to all gravel mining projects; (2) integrating natural morphological features and functions into bank protection and other stream side development projects; and (3) implementing non-native plant (e.g. Arundo) eradication plan.	All	Cottonwood Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	This action, while on Cottonwood Creek, is mentioned in the Recovery Plan as benefiting Beegum Creek
NWC-20	Establish, restore, and maintain riparian habitat on Cottonwood Creek.	Juvenile Emigration, Summer/Winter Rearing	Cottonwood Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
NWC-21	Modify gravel mining methods to reduce their effects on salmonid spawning habitats; employ the most ecologically sound timber extraction practices by implementing the Forest Plan on federal lands within the drainage; modify and employ the most ecologically sound forestry and grazing practices by implementing the Forest Plan on federal lands and through parteneships on private and state-owned land within the drainage to reduce fine sediment loading; reduce use of seasonal diversion dams that may be barriers to migrating Chinook salmon and steelhead.	All	Thomes Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	Four actions from the PG&E/Caltrout effort were combined. In order for spring run to benefit from restoration actions on Thomes Creek, all of these actions would have to be carried out.
NWC-22	Flow consolidation through reduction of braided channels.	All	Thomes Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-23	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	All	Thomes Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
NWC-24	Develop and implement a spawning gravel augmentation plan.	Spawning	Thomes Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
Sacramento River Basinwide						
SBW-1	Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects. Implement projects that acquire strategic floodplain easements to re-establish floodplain connectivity in areas constricted by levees. Restore a continuous 100-mile stretch of ecologically viable riparian habitat to flood-prone lands along the river between Red Bluff and Colusa (The Nature Conservancy Website).	Juvenile Emigration, Summer/Winter Rearing	Lower Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	http://www.nature.org/wherewework/northamerica/states/california/	
SBW-2	Restore a continuous 100-mile stretch of ecologically viable riparian habitat to flood-prone lands along the river between Red Bluff and Colusa (The Nature Conservancy Website). Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	Juvenile Emigration, Summer/Winter Rearing	Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	http://www.nature.org/wherewework/northamerica/states/california/	
SBW-3	Promote native riparian (e.g., willows) species through eradication of non-native species (e.g., Arundo, tamarisk). Modify vegetation maintenance practices to encourage riparian growth and establish a native vegetated corridor in currently unvegetated/leveed reaches of the lower Sacramento River especially between Colusa and Verona. Restore a continuous 85-mile stretch of riparian habitat of an appropriate width to maintain ecologically viable function to flood-prone lands along both banks of the river between Colusa and Sacramento.	Juvenile Emigration, Summer/Winter Rearing	Lower Sacramento River	NMFS Recovery Plan Co-Manager Review Draft		

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
SBW-4	Modify vegetation maintenance practices to encourage riparian growth and establish a native vegetated corridor in currently unvegetated/leveed reaches of the middle Sacramento River. Restore a continuous 100-mile stretch of riparian habitat of an appropriate width to maintain ecologically viable function to flood-prone lands along both banks of the river between Red Bluff and Colusa (The Nature Conservancy Website 2007). Set back training walls and restore floodplain function in gold fields and other appropriate floodplain zones. Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects. Implement gravel injection program below Englebright Dam to restore geofluvial processes. Create and restore side-channel habitats to increase the quantity and quality of off-channel rearing (and spawning) areas.	Juvenile Emigration, Summer/Winter Rearing	Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	http://www.nature.org/wherewework/northamerica/states/california/	
SBW-5	Implement programs and measures designed to control non-native predatory fish (NMFS 2007b), including eradication programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass). Implement projects to minimize predation at weirs (e.g., Freemont Weir), diversion dams, and related structures. Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.	Juvenile Emigration, Summer/Winter Rearing	Lower Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
SBW-6	Implement programs and measures designed to control non-native predatory fish (NMFS 2007b), including eradication programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass). Implement projects to minimize predation at weirs, diversion dams, and related structures (e.g., GCID). Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.	Juvenile Emigration, Summer/Winter Rearing	Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
SBW-7	Implement projects that consolidate and screen existing diversions where feasible.	Juvenile Emigration	Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
SBW-8	Implement actions designed to decrease water temperatures in Sacramento River tributaries during late-spring through early fall, thereby decreasing thermal loading to the Sacramento River.	All	Lower Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
SBW-9	Implement actions designed to decrease water temperatures in Sacramento River tributaries during late-spring through early fall, thereby decreasing thermal loading to the Sacramento River.	All	Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
SBW-10	Develop and implement pulse flow schedules during peak migration periods for years with low water availability.	Adult Immigration	Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
SBW-11	Develop and increase application of alternative diversion technologies that eliminate entrainment. Implement projects that consolidate and screen existing diversions where feasible.	Juvenile Emigration	Lower Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	
SBW-12	Develop and increase application of alternative diversion technologies that eliminate entrainment. Implement projects that consolidate and screen existing diversions where feasible.	Juvenile Emigration	Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	

Reference Number	Description of Action	Target Life Stage(s)	Stream	Source Document	Reference Cited in Source	Notes
SBW-13	Implement programs and measures designed to control non-native predatory fish (NMFS 2007b), including eradication programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass). Implement projects to minimize predation at weirs, diversion dams, and related structures (RBDD and ACID). Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.	Juvenile Emigration, Summer/Winter Rearing	Upper Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon. (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007.)	
SBW-14	Implement projects that acquire strategic floodplain easements to re-establish floodplain connectivity in areas constricted by levees.	Summer/Winter Rearing	Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	The Recovery Plan mentions this action in reference to the juveniles produced in the Sacramento River.
SBW-15	Create a flood bypass downstream of Mill and/or Deer creeks specifically to promote spring-run Chinook salmon fry rearing.	Summer/Winter Rearing	Middle Sacramento River	PG&E/CalTrout Prioritized Actions List	Stillwater Sciences 2006.	
SBW-16	Manage spring flows in the mainstem Sacramento River to inundate shallow water habitats within the bankfull channel.	Summer/Winter Rearing, Juvenile Emigration	Middle Sacramento River	PG&E/CalTrout Prioritized Actions List	Stillwater Sciences 2006.	
SBW-17	Restore riparian corridors in lower mainstem Sacramento River between Colusa and Collinsville	Summer/Winter Rearing, Juvenile Emigration	Lower Sacramento River	PG&E/CalTrout Prioritized Actions List	Collaborative Group 2006.	
SBW-18	Pursue opportunities, consistent with efforts conducted pursuant to Senate Bill 1086 (SB 1086), to create a 50,000-acre meander belt from Keswick Dam to Colusa to recruit gravel and large woody debris, to moderate temperatures and to enhance nutrient input.	All	Upper /Middle Sacramento River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001).	

Appendix B2

Working List of Potential Actions

Working List of Potential Habitat Expansion Actions

The following non-prioritized list of actions has been compiled by the HEA Steering Committee based on the potential of the actions to help satisfy requirements of the Habitat Expansion Agreement. The working list is pre-decisional and does not necessarily represent actions that will be selected by the HEA Steering Committee to include in the Draft Habitat Expansion Plan. Nothing precludes other actions, not currently included in the list, from being considered.

Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
Northern Sierra Nevada Spring-Run Salmon Diversity Group							
NS-1	Supplement flows in Antelope Creek with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to allow passage of juvenile and adult spring-run Chinook salmon and steelhead.	All	Antelope Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	Economic feasibility and level of local/political support for flow supplementation are unknown. Additionally, the benefit of flow supplementation to maintenance of spatial separation is unclear.	L
NS-2	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	All	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	U.S. Forest Service Long-Term Anadromous Fish Conservation Strategy	Questionable match (fire) and additional information needed (meadows).	L
NS-3	Conduct fish passage evaluation at all agricultural diversions to determine if they meet NMFS' fish passage criteria. Design and install state-of-the-art fish passage facilities at diversions that currently do not meet the passage criteria.	Adult Immigration	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/	The Edwards Dam Ladder construction project was completed in October 2007. Juvenile bypass facilities are still needed as of October 2008.	L
NS-76	Install Juvenile Bypass at the Edwards Dam Ladder.	Juvenile Emigration	Antelope Creek	Questionnaire	USFWS Final Restoration Plan for the Anadromous Fish Restoration Program (2001)	AFRP funded a feasibility study, environmental documentation, permits, and design for a solution at this site in 2008. Implementation can begin in 2010 but funding needed.	L
NS-77	Conduct Antelope Creek valley floor channel analysis and implement recommended actions.	Adult Immigration, Juvenile Emigration	Antelope Creek	Questionnaire	USFWS Final Restoration Plan for the Anadromous Fish Restoration Program (2001)		L
NS-78	Reduce sources of chronic road related erosion of sediment.	All	Antelope Creek	Comment Form		On-going activity.	L
NS-5	Improve passage conditions at Paynes crossing to allow upstream passage during low flows.	Adult Immigration, Adult Holding	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft; Questionnaire	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007)	Also referred to as Tehama Wildlife Area crossing. AFRP is currently funding a fish passage feasibility study at this site, but as of October 2008 funding has not been identified for construction.	L
NS-6	Identify gravel starved areas in Antelope Creek and implement gravel additions.	Spawning	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Issue? USFS favors correcting undersized culverts to improve natural bedload instead.	L
NS-7	Build sediment retention structures; fortify streambanks with native vegetation.	Spawning, Egg Incubation	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Issue?	L

*Reference numbers are not necessarily in consecutive order, but actions are grouped by watershed.

Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
NS-8	Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	Summer/Winter Rearing, Juvenile Emigration	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Issue?	L
NS-9	Implement projects to increase floodplain habitat availability to improve habitat conditions for juvenile rearing.	Summer/Winter Rearing	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007)	Additional information needed.	L
NS-10	Implement projects that cooperatively work with landowners to modify existing diversions so that fish do not become entrained in agricultural fields.	Juvenile Emigration	Antelope Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Additional information needed.	L
NS-12	Remove the partial barrier (old agricultural dam) approximately 0.4 river miles downstream of Higgins Hole, located on private property.	Adult Immigration	Big Chico Creek	HEA Steering Committee	No reference cited	Fish passage evaluation has not been done for this site. Additional information needed.	L
NS-13	Conduct Fish Passage evaluation at all dams and diversions to determine if they meet NMFS fish passage criteria. Design and install state-of-the-art fish passage facilities at diversions (1-mile dam, 5-mile dam) that currently do not meet the passage criteria.	Adult Immigration	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/		L
NS-14	Implement Iron Canyon Fish Ladder Rehabilitation Project.	Adult Immigration	Big Chico Creek	PG&E/CalTrout Prioritized Actions List; Questionnaires	AFRP Restoration Plan (USFWS 2001)	City of Chico intends to adopt a Mitigated Negative Declaration for the project. Final report on the repair and construction is complete. CEQA complete and permitting is underway.	H
NS-16	Protect spring-run Chinook salmon summer holding pools in Big Chico Creek by obtaining from willing sellers titles or conservation easements on lands adjacent to the pools.	Adult Holding	Big Chico Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	Benefit of this action would depend on the implementation of the Iron Canyon Fish Ladder project. Cost would be dependent on the landowners' willingness to sell. Additional information needed.	L
NS-17	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	All	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
NS-19	Identify stream reaches that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	All	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Additional information needed.	L
NS-20	Eliminate sources of chronic sediment delivery from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	Egg Incubation	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Additional information needed.	L

*Reference numbers are not necessarily in consecutive order, but actions are grouped by watershed.

Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
NS-21	Implement projects to increase floodplain habitat availability to improve habitat conditions for juvenile rearing.	Summer/Winter Rearing	Big Chico Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007)	Additional information needed.	L
NS-22	Cooperate with local landowners to encourage revegetation of denuded stream reaches; and establish, restore, and maintain riparian habitat on Big Chico Creek.	Juvenile Emigration, Summer/Winter Rearing	Big Chico Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	Additional information needed.	L
NS-23	Purchase existing water rights from willing sellers.	All	Butte Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	All Lower Butte Creek actions need to be investigated to determine if the actions were carried out in previous restoration activities.	L
NS-24	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	All	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	U.S. Forest Service Long-Term Anadromous Fish Conservation Strategy	Questionable match (fire) and additional information needed (meadows).	L
NS-26	Identify gravel starved areas in Butte Creek and implement gravel additions. Develop a spawning gravel budget and implement an augmentation plan and use flow management to optimize spawning weighted usable area in consideration of hydrologic limitations and other species (e.g., steelhead) and life stage requirements.	Spawning	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
NS-27	Develop sustainable instream flow criteria for spawning and incubation periods and implement flow ramping protocols to protect all life stages of spring-run Chinook salmon.	All	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Identified in CVPIA Long-Term Plan.	L
NS-28	Reduce the number of temporary passage impediments installed to create swimming holes in Butte Creek near Chico; conduct associated public outreach projects.	Adult Immigration	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
NS-29	Identify stream reaches that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	All	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
NS-30	Promote or create riparian buffer strips between the Butte Creek channel and adjacent land uses.	Juvenile Emigration, Summer/Winter Rearing	Butte Creek	PG&E/CalTrout Prioritized Actions List	No reference cited		L
NS-31	Implement projects that consolidate and screen existing diversions where feasible.	All	Butte Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Additional information needed.	L

*Reference numbers are not necessarily in consecutive order, but actions are grouped by watershed.

Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
NS-32	Retrofit Magalia Dam on Little Butte Creek in order to provide for more storage to use for fisheries flows.	All	Little Butte Creek	HEA Steering Committee	No reference cited	An earthquake retrofit is necessary and might be an opportunity to increase storage to benefit fisheries flows. This would primarily benefit steelhead.	L
NS-34	Construct fish ladder at upper Deer Creek falls.	Adult Immigration	Deer Creek	PG&E/CalTrout Prioritized Actions List	Spring-run chinook salmon recovery brainstorming session (11/8/05)	Habitat for spring-run limiting.	L
NS-79	Provide functional fish ladder at Lower Deer Creek falls.	Adult Immigration	Deer Creek	Comment form	No reference cited	USFS supports DFG efforts to correct the ladder.	L
NS-35	Acquire water from willing sellers consistent with applicable guidelines or negotiate agreements to supplement instream flows in the lower ten miles of Deer Creek to ensure passage of adult and juvenile spring-run Chinook salmon and steelhead over three diversion dams.	Adult Immigration, Juvenile Emigration	Deer Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	Water exchange program is being funded through the 4-Pumps mitigation program.	L
NS-36	Implement water exchange agreement with the Deer Creek Irrigation Company and the Stanford-Vina Irrigation District and dedicate fish passage flows.	Adult Immigration, Adult Holding	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/	Check status of DCID exchange agreement.	L
NS-37 a	Permit and construct a state-of-the-art fish ladder that meets NMFS' adult fish passage criteria and install a new apron at the Cone-Kimball Diversion.	Adult Immigration	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007)	Project to improve fish passage at Stanford-Vina Dam is being considered as part of Deer Creek Floodplain Study as of Oct 2008; projects to improve fish passage at DCID and Cone-Kimball diversion dams are being discussed between Deer Creek Watershed Conservancy and irrigation districts as of Oct 2008. Identified in CVPIA Long-Term Plan.	L
NS-37 b	Install state-of-the-art fish ladder at Stanford-Vina Dam.	Adult Immigration	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	See NS-37 a	See NS-37 a.	L
NS-37 c	Design and install state-of-the-art fish passage facilities at diversions that currently do not meet the passage criteria. Study feasibility of consolidating diversion points to minimize the number of diversions on Deer Creek. Based on this study, consolidate diversions where feasible.	Adult Immigration	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	See NS-37 a	See NS-37 a.	L
NS-37 d	Conduct a study designed to determine adult fish passage flows at critical riffles and fish ladders; recommend and implement actions to acquire the flows indicated for passage.	Adult Immigration	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	See NS-37 a	See NS-37 a.	L

*Reference numbers are not necessarily in consecutive order, but actions are grouped by watershed.

Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
NS-38	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows (Deer Creek meadows, Childs meadows, Gurnsey Creek, and North Fork Deer Creek) to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	All	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	Deer Creek Watershed Existing Conditions Report and U.S. Forest Service Long-Term Anadromous Fish Conservation Strategy	Questionable match (fire) and additional information needed (meadows).	L
NS-80	Reduce sources of chronic road related erosion of sediment	All	Deer Creek	Comment form	No reference cited	On-going activity.	L
NS-40	Build sediment retention structures; fortify streambanks with native vegetation.	Spawning, Egg Incubation	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Issue?	L
NS-41	Identify gravel starved areas in Deer Creek and implement gravel additions. Re-design highway 32 culvert crossing at Calf Creek to allow for unimpeded bedload transport. Conduct a spawning gravel augmentation feasibility study to increase available spawning habitat. Implement spawning gravel augmentation projects if the feasibility study determines that such projects will not cause adverse ecological impacts.	Spawning	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Issue? HWY 32 culvert managed by CALTRANS (need to be included).	L
NS-44	Implement all or portions of the Deer Creek floodplain feasibility study, which can include (1) purchasing conservation easements, (2) moderate levee setbacks on both banks between Red Bridge and Stanford Vina Ranch Irrigation Company (SVRIC) dam, (3) replace current SVRIC dam with a seasonal dam, and (4) rebuild/expand Red Bridge.	Summer/Winter Rearing	Deer Creek	PG&E/CalTrout Prioritized Actions List; Questionnaire	Collaborative Group 2006, Draft Lower Deer Creek Ecosystem Restoration and Flood Management Technical Memorandum by Mark R. Tompkins and G.M. Kondolf (2008), AFRP Restoration Plan (USFWS 2001)	The Deer Creek Watershed Conservancy completed a floodplain feasibility study. The study developed two action alternatives.	L
NS-45	Identify and implement projects designed to improve downstream passage conditions for juveniles.	Juvenile Emigration	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
NS-46	Identify stream reaches that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	All	Deer Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
NS-47	Design and install state of the art fish screens at diversions that currently do not meet the NMFS fish screen criteria.	Juvenile Emigration	Feather River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
NS-90	Implement a trap-and-haul project on the North Fork Feather River.	All	Feather River	Comment form	No reference cited		H
NS-91	Implement a trap-and-haul project on the Middle Fork Feather River.	All	Feather River	Comment form	No reference cited		H

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Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
NS-49	Identify stream reaches that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	All	Feather/Yuba Rivers	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
NS-51	Purchase TNC's Mill Creek Water Rights to provide additional stream flows for spring-run Chinook and steelhead.	All	Mill Creek	PG&E/CalTrout Prioritized Actions List; Questionnaire	AFRP Restoration Plan (USFWS 2001)	Project provides 18 cfs or nearly 10% of Mill Creek base flow. Delta 4-pumps pays for pumping costs associated with Ground Water Exchange Program. TNC purchased with intent to sell. Identified in CVPIA Long-Term Plan.	L
NS-52 b	Conduct fish passage evaluation at all agricultural diversions to determine if they meet NMFS' fish passage criteria, and design and install state-of-the-art fish passage facilities at diversions that currently do not meet the passage criteria.	Adult Immigration	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
NS-81	Reduce sources of chronic road related erosion of sediment.	All	Mill Creek	Comment form	No reference cited	On-going activity.	L
NS-54	Restore meadows and reduce stream channel incisement and bank erosion by modifying grazing practices and excluding cattle from nearshore zones, and reduce the potential for, and magnitude of a catastrophic wildfire.	Spawning, Egg Incubation	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	U.S. Forest Service Long-Term Anadromous Fish Conservation Strategy		L
NS-55	Work with State and Federal water acquisition programs to develop dedicated instream water (Orange Cove water right purchase); participate in the lower Mill Creek Watershed Restoration	All	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	http://www.delta.dfg.ca.gov/afrp/		H
NS-56	Build sediment retention structures; fortify streambanks with native vegetation.	Spawning, Egg Incubation	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Issue?	L
NS-57	Implement projects to increase floodplain habitat availability to improve habitat conditions for juvenile rearing.	Summer/Winter Rearing	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007)	Issue?	L
NS-58	Identify and implement projects designed to improve downstream passage conditions for juveniles.	Juvenile Emigration	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Issue?	L
NS-59	Identify stream reaches that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	All	Mill Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Issue?	L
NS-60	Establish, restore, and maintain riparian habitat along the lower reaches of Mill Creek.	Juvenile Emigration, Summer/Winter Rearing	Mill Creek	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	Issue? Past AFRP project.	L

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Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
NS-63	Construct improved fish passage facilities at Daguerre Point Dam to provide for segregation of adult spring-run and fall-run chinook salmon.	Spawning, Egg Incubation	Yuba River	PG&E/CalTrout Prioritized Actions List	Spring-run chinook salmon recovery brainstorming session (11/8/05)	It is difficult to determine how segregation would contribute to the HEA threshold. Impact to migrating steelhead is also a concern. No preferred alternative selected yet.	H
NS-64	Modify the fish ladders at Daguerre Point Dam to provide full fish passage.	Adult Immigration	Yuba River	NMFS Recovery Plan Co-Manager Review Draft; Questionnaire	Daguerre Point Dam Fish Passage Improvement Project 2002 Fisheries Study	No preferred alternative selected yet.	L
NS-65	Facilitate passage of juvenile salmonids by modifying the dam face of Daguerre Point Dam.	Juvenile Emigration	Yuba River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	No preferred alternative selected yet.	L
NS-67a	Implement actions to enhance habitat conditions and improve access within the area above Englebright Dam, including increasing minimum flows, providing passage at Our House, New Bullards Bar, and Log Cabin dams, and assessing feasibility of passage improvement at natural barriers.	All	Yuba River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	PG&E and NID are currently relicensing projects in the upper Yuba watershed; anadromous salmonid issues in the upper watershed are generally being handled outside of FERC relicensing.	H
NS-94 a	Implement a trap-and-haul program around Englebright Dam for the North Yuba River above New Bullards Bar Reservoir.	All	Yuba River		No reference cited.		H
NS-94 b	Implement a trap-and-haul program around Englebright Dam for the North Yuba River below New Bullards Bar Reservoir.	All	Yuba River		No reference cited.		H
NS-94 c	Implement a trap-and-haul program around Englebright Dam for the Middle Yuba River in combination with increased flow releases.	All	Yuba River		No reference cited.		H
NS-69	Improve efficiency of screening devices at Brophy-South Yuba water diversion and other unscreened diversions.	Juvenile Emigration	Yuba River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	Required under Yuba River Accord and BO.	L
NS-83	Restore backwater, side-channel, and riparian/ floodplain habitat in the Lower Yuba River.	Juvenile Emigration, Summer/Winter Rearing	Yuba River	Questionnaire	No reference cited	Project will build on current AFRP-funded pilot project and complements Narrows Gravel Rehabilitation Project (NS-86).	L
NS-84 a	Rehabilitate Yuba River Narrows spawning habitat.	Spawning	Yuba River	Questionnaires	SHIRA-based river analysis (Pasternack 2009) and Draft Implementation Plan for Lower Yuba River Anadromous Fish Restoration	Rehabilitates habitat and supplies 100 tons of gravel that is then maintained under the Corps requirements. Pilot project completed in 2007. Requires injection of 54,000 cubic yards of gravel.	H
NS-84 b	Rehabilitate Yuba River Narrows spawning habitat with possible segregation weir approximately 6 miles below Englebright Dam.	Spawning	Yuba River	Questionnaire	Draft Implementation Plan for Lower Yuba River Anadromous Fish Restoration	FWS and DFG do not currently support using a segregation weir.	H
NS-89	Implement Deer Creek Salmon and Steelhead Spawning Habitat Expansion Project.	Spawning	Deer Creek/ Yuba River	Questionnaire	No reference cited	Restore habitat via gravel augmentation, barrier removal, invasive species removal, and riparian revegetation. Project enhances mitigation requirements.	L

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Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
NS-85	Operate and maintain real-time flow and temperature monitoring gages on Big Chico, Butte, Deer, and Mill Creeks (with possible expansion to Antelope Creek).	All	Big Chico, Butte, Deer, and Mill creeks	Questionnaire	AFRP Restoration Plan (USFWS 2001)	Funds continued operation and maintenance of flow gauges that lose funding in 2010.	L
NS-93	Evaluate and implement fish passage upstream of Folsom Lake into the Middle Fork (and possibly North Fork) of the American River.	All	American River	Comment Form	No reference cited.	Action may be ineligible under HEA Section 3.2 because required under OCAP BO.	H
Basalt and Porous Lava Spring-Run Chinook Salmon Diversity Group							
B-1	Implement Phase 1(b) of the package of passage, screening, and flow actions defined for the Battle Creek Restoration Project as defined by the Memorandum of Understanding (i.e., tailrace connector between Inskip Powerhouse and Coleman Canal on the South Fork Battle Creek).	Adult Immigration	Battle Creek	PG&E/CalTrout Prioritized Actions List	Battle Creek Restoration Plan (Kier and Associates 1999).	Action may be ineligible under HEA Section 3.2 because required under OCAP BO. Federal Stimulus Funding may also be available.	L
B-2	Implement Phase 2 of the package of passage, screening, and flow actions defined for the Battle Creek Restoration project, as defined by the Memorandum of Understanding (i.e., removal of Coleman Diversion Dam, South Diversion Dam, Soap Creek Feeder, and Lower Ripley Creek Feeder; fish ladder and screen construction at Inskip Diversion Dam; tailrace connector between South Powerhouse and Inskip Canal; and streamflow increases in South Fork Battle Creek).	All	Battle Creek	PG&E/CalTrout Prioritized Actions List	Battle Creek Restoration Plan (Kier and Associates 1999).	Action may be ineligible under HEA Section 3.2 because required under OCAP BO.	H
B-4	Develop and implement pulse flow schedules during peak migration periods for years with low water availability.	Adult Immigration	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
B-9	Modernize/upgrade PG&E facilities to reduce the potential for flow fluctuations and outages.	All	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
B-12	Develop and increase application of alternative diversion technologies that eliminate entrainment.	Juvenile Emigration	Battle Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L

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Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
B-15	Conduct feasibility studies for allowing spring-run Chinook salmon access to habitat above Shasta Dam, including assessing habitat suitability and passage logistics (i.e., getting immigrating adults above the dam and emigrating juveniles below it). If the feasibility studies suggest that fish passage can be successful, then design and conduct an experimental fish passage program evaluating adult distribution, survival, spawning, and production in habitats above Shasta Dam. If the experimental fish passage program demonstrates that passage above Shasta dam can substantively contribute to the long-term viability of the ESU, then develop and implement long-term fish passage programs. Implement an annual trap-and-haul operation, if warranted.	Adult Immigration, Adult Holding, Spawning	Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited.	Action may be ineligible under HEA Section 3.2 because required under OCAP BO.	H
B-18	Conduct periodic (e.g., every 5 years) spawning gravel assessments in the upper Sacramento River (i.e., above RBDD) and implement gravel augmentation projects, as necessary.	Spawning	Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Benefits steelhead but not spring-run.	L
B-19	Modify gravel pits and mounds to ensure full drainage of these features to allow flooding while preventing stranding and warm water predator habitat.	Juvenile Emigration, Summer/Winter Rearing	Upper Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	The Recovery Plan mentions this action in reference to the juveniles produced in the Sacramento River. La Barranca floodplain project needs funding for construction.	L
B-20	Restore the current Lake Red Bluff footprint to riparian habitat.	All	Upper Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
Northwestern California Spring-Run Chinook Salmon Diversity Group							
NWC-1	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	All	Beegum Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Issue?	L
NWC-2	Develop and implement a spawning gravel augmentation plan.	Spawning	Beegum Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Issue?	L
NWC-3	Eliminate sources of chronic sediment delivery from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	Spawning, Egg Incubation	Beegum Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited		L
NWC-5	Inject LWD and boulders in the canyon reach of Clear Creek to induce gravel deposition to support pocket spawning by salmonids.	Spawning	Clear Creek	PG&E/CalTrout Prioritized Actions List	Collaborative Group 2006	Issue w/ kayakers, lower priority	L

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Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
NWC-6	Clear Creek gravel supplementation in the reach where spring-run Chinook and steelhead spawn by placing gravel directly into four new sites and supplementing existing sites with "injected" gravel.	Spawning	Clear Creek	Questionnaires	Graham Matthews and Associates 2007, North State Resources 2008, and additional references provided in Questionnaire	This would not be self-sustaining. It would need to be redone periodically but works synergistically with NWC-8 and NWC-20. Potential/perfect substrate estimated to support 5,264 spring-run and 12,816 steelhead. Gravel augmentation required under OCAP BO.	H
NWC-25	Developing long-term spawning gravel supply by processing gold mine tailings on DFG and BLM properties adjacent to Clear Creek.	Spawning	Clear Creek	Questionnaire	North State Resources 2008 and additional references provided in Questionnaire	Provides Long-Term and inexpensive supply of spawning gravel, prevents entrainment of mercury, and creates functional floodplain in tailing area. CVPIA funded and completed feasibility study. Gravel augmentation required under OCAP BO.	L
NWC-9	Enhance watershed resiliency by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	All	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007)	Include only wildlife and revegetation actions (lower priority) since other issues being implemented.	L
NWC-10	Conduct a passage feasibility study, including an assessment of potential habitat above Whiskeytown Dam. If the action is feasible and passage above Whiskeytown Dam can substantively contribute to the Long-Term viability of the ESU, then develop and implement a Long-Term fish passage program.	Adult Immigration, Adult Holding, Spawning	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Feasibility concerns due to flow, mine contamination, upstream passage barriers, gravel availability, and trap-and-haul limitations	H
NWC-13	Eliminate sources of chronic sediment delivery from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	Spawning, Egg Incubation	Clear Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Lower priority since most feasible projects already completed. Parks is pursing funding for inventory.	L
NWC-18 a	Protect/enhance existing riparian habitat and corridors and establish and restore additional riparian habitat where needed.	Juvenile Emigration, Summer/Winter Rearing	Cottonwood Creek	NMFS Recovery Plan Co-Manager Review Draft	Summary of Threats and Recovery Actions for Spring-Run and Winter-Run Chinook Salmon (Notes from the Sacramento Salmon and Steelhead Recovery Workshop, May 22, 2007)	This action, while on Cottonwood Creek, is mentioned in the Recovery Plan as benefiting Beegum Creek. Some AFRP projects are in place.	L
NWC-18 b	Implement non-native plant (e.g. Arundo) eradication plan.	Juvenile Emigration, Summer/Winter Rearing	Cottonwood Creek	NMFS Recovery Plan Co-Manager Review Draft	See NWC-18 a.	See NWC-18 a.	L
NWC-19	Re-establish natural channel morphology by: (1) applying NMFS gravel mining criteria to all gravel mining projects; and (2) integrating natural morphological features and functions into bank protection and other stream side development projects.	All	Cottonwood Creek	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	This action, while on Cottonwood Creek, is mentioned in the Recovery Plan as benefiting Beegum Creek. AFRP needs funding for sediment budget study.	L

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Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
Sacramento River Basinwide							
SBW-1 a	Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	Juvenile Emigration, Summer/Winter Rearing	Upper and Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	http://www.nature.org/wherewework/northamerica/states/california/	Worth considering after assessing current carrying capacity of Sacramento River mainstem habitats.	L
SBW-1 b	Restore a continuous 100-mile stretch of ecologically viable riparian habitat to flood-prone lands along the river between Red Bluff and Colusa.	Juvenile Emigration, Summer/Winter Rearing	Upper and Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	http://www.nature.org/wherewework/northamerica/states/california/	Worth considering after assessing current carrying capacity of Sacramento River mainstem habitats.	L
SBW-3 a	Promote native riparian (e.g., willows) species through eradication of non-native species (e.g., Arundo, tamarisk).	Juvenile Emigration, Summer/Winter Rearing	Lower Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Worth considering after assessing current carrying capacity of Sacramento River mainstem habitats.	L
SBW-3 b	Modify vegetation maintenance practices to encourage riparian growth and establish a native vegetated corridor in currently unvegetated/leveed reaches of the lower Sacramento River especially between Colusa and Verona.	Juvenile Emigration, Summer/Winter Rearing	Lower Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	See SBW-3 a.	L
SBW-3 c	Restore a continuous 85-mile stretch of riparian habitat of an appropriate width to maintain ecologically viable function to flood-prone lands along both banks of the river between Colusa and Sacramento.	Juvenile Emigration, Summer/Winter Rearing	Lower Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	See SBW-3 a. May potentially be addressed under OCAP BO.	L
SBW-4 a	Modify vegetation maintenance practices to encourage riparian growth and establish a native vegetated corridor in currently unvegetated/leveed reaches of the middle Sacramento River.	Juvenile Emigration, Summer/Winter Rearing	Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	http://www.nature.org/wherewework/northamerica/states/california/	Worth considering after assessing current carrying capacity of Sacramento River mainstem habitats.	L
SBW-4 b	Create and restore side-channel habitats to increase the quantity and quality of off-channel rearing (and spawning) areas.	Juvenile Emigration, Summer/Winter Rearing	Middle Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	http://www.nature.org/wherewework/northamerica/states/california/	Worth considering after assessing current carrying capacity of Sacramento River mainstem habitats.	L
SBW-7	Implement projects that consolidate and screen existing diversions where feasible.	Juvenile Emigration	Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	May potentially be addressed under OCAP BO.	L
SBW-11	Develop and increase application of alternative diversion technologies that eliminate entrainment.	Juvenile Emigration	Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	Worth considering after assessing current carrying capacity of Sacramento River mainstem habitats.	L
SBW-14	Implement projects that acquire strategic floodplain easements to re-establish floodplain connectivity in areas constricted by levees.	Summer/Winter Rearing	Sacramento River	NMFS Recovery Plan Co-Manager Review Draft	No reference cited	The Recovery Plan mentions this action in reference to the juveniles produced in the Sacramento River. Worth considering after assessing current carrying capacity of Sacramento River mainstem habitat.	L

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Reference* Number	Description of Action	Target Life Stage(s)	Stream	Source	Reference Cited in Source	Notes	Contribution to HET (H/L)
SBW-18	Pursue opportunities, consistent with efforts conducted pursuant to Senate Bill 1086 (SB 1086), to create a 50,000-acre meander belt from Keswick Dam to Colusa to recruit gravel and large woody debris, to moderate temperatures and to enhance nutrient input.	All	Upper /Middle Sacramento River	PG&E/CalTrout Prioritized Actions List	AFRP Restoration Plan (USFWS 2001)	Worth considering after assessing current carrying capacity of Sacramento River mainstem habitats.	L
SBW-19	Operate segregation weir at ACID to separate fall-run and spring-run on mainstem.	Spawning	Upper Sacramento River	Comment form	No reference cited	DFG previously stated that they would not support this type of action.	H

Appendix B3

Short List of Potential Actions

Short List of Potential Actions

Reference Number	Description of Action	Deal Killer (No/ Maybe)	Estimated HET Contribution	Reference for Estimated HET Contribution
NS-14	Iron Canyon Fish Ladder Rehabilitation Project in Big Chico Creek.	No	1,000	DFG - Historical
NS-35, NS-37a, NS-37b, NS-95, NS-44	Supplement flows, passage at DCID, Cone-Kimball, and Stanford-Vina Diversions, Floodplain Project in lower Deer Creek.	No	1,000	DFG - Historical and GRANDTAB
NS-5, NS-1, NS-77, NS-3, NS-10	Paynes Crossing, supplement flow, Valley Floor Channel Project, modify ag diversion to provide passage and reduce entrainment in Antelope Creek.	No	>= 500	DFG - Historical
NS-55	Develop dedicated instream water (Orange Cove water right purchase) in Mill Creek; lower Mill Creek Watershed Restoration Project.	No	1,900	Questionnarie
NS-64, NS-65, NS-84b, NS-83, NS-89	Adult & juvenile passage at Daguerre Point Dam, Yuba River Narrows spawning habitat w/ segregation weir, backwater, side-channel, and riparian/floodplain habitat, Deer Creek Habitat Expansion Project in the lower Yuba River.	Maybe	>= 2000	Questionnarie
NS-67b	Fish Passage into Upper Yuba Watershed.	Maybe	500 (Middle Yuba)	UYRSP Team 2006
NS-84 b	Rehabilitate Yuba River Narrows spawning habitat with segregation weir in the lower Yuba River.	Maybe	>= 2000	Questionnarie
NS-90	Trap-and-haul project on the North Fork Feather River.	Maybe	500-2500	Payne & Associates 2004 (FERC)
NS-91	Trap-and-haul project on the Middle Fork Feather River.	Maybe	< 500 below natural barrier; unknown above	DWR 2007 (FERC Report)
NS-93	Trap-and-haul program on the Middle Fork (and possibly North Fork) of the American River.	Maybe	Unknown	
NS-94 a	Trap-and-haul program on the North Yuba River above New Bullards Bar Reservoir with habitat restoration.	Maybe	Unknown	
NS-94 b	Trap-and-haul program on the North Yuba River below New Bullards Bar with habitat restoration.	Maybe	Unknown	
NS-94 c	Trap-and-haul program on the Middle Yuba River in combination with increased flow releases and habitat restoration.	Maybe	>= 500	UYRSP Team 2006
B-2	Phase 2 of the Battle Creek Restoration project.	Maybe	1250-2500	Kier & Associates 1999
B-15	Trap-and-haul program on the Sacramento River at Shasta Dam.	Maybe	Unknown	

NWC-10	Trap-and-haul program in Clear Creek at Whiskeytown Dam.	Maybe	Unknown	
NWC-6, NWC-25	Clear Creek gravel supplementation, processing tailings and restoring floodplain habitat.	Maybe	5,264	Questionnarie
SBW-19	Segregation weir in the Sacramento River at the Anderson-Cottonwood Irrigation District (ACID) Dam .	Maybe	7,500	Cramer Fish Sciences

Appendix B4

Ranked Preliminary List of Viable Actions with Evaluation Criteria Scoring

Ranked Preliminary List of Viable Actions

					EVALUATION CRITERIA																	Summary	
Reference Number	**Description of Action**	**Deal Killer (No/ Maybe)**	**Estimated HET Contribution**	**Reference for Estimated HET Contribution**	**(a)** Feasibility	**(b)** Scale	**(c)** Sustainability	**(d)** Cost Effective	**(e)** Minimal Intervention	**(f)** Separation-Genetic	**(g)** Separation-Catastrophe	**(h)** Time to Implement	**(i)** Local/ Political Support	**(j)** VSP/ESA Consistency	**(k)** Balance of Benefits	**(l)** Resource Consistency	**(m)** Available Stocks	**(n)** Action Taken by Others	**(o)** Other FR Species	**(p)** Adverse Effects-spp	**(q)** Adverse Effects-cult.	**Total Score**	**Norm. Total (100)**
					Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		
B-2	Phase 2 of the Battle Creek Restoration Project.	Maybe	1,250-2,500	Kier & Associates 1999	5	5	4	4	4	5	4	4	4	5	5	4	4	2	4	5	5	73	100.00
NS-64, NS-65, NS-84b, NS-83, NS-89	Adult & juvenile passage at Daguerre Point Dam, Yuba River Narrows spawning habitat w/ segregation weir, backwater, side-channel, and riparian/floodplain habitat, Deer Creek Habitat Expansion Project in the lower Yuba River.	Maybe	>= 2,000	Questionnarie	5	5	4	4	4	5	5	3	3	5	4	4	4	4	3	5	5	72	98.63
NS-5, NS-1, NS-77, NS-3, NS-10	Paynes Crossing, supplement flow, Valley Floor Channel Project, modify ag diversion to provide passage and reduce entrainment in Antelope Creek.	No	>= 500	DFG - Historical	5	4	4	4	4	4	2	3	5	4	5	5	4	4	4	5	4	70	95.89
NS-84 b	Rehabilitate Yuba River Narrows spawning habitat with segregation weir in the lower Yuba River.	Maybe	>= 2,000	Questionnarie	5	4	3	4	3	5	5	4	3	4	4	4	4	4	3	5	5	69	94.52
NS-14	Iron Canyon Fish Ladder Rehabilitation Project in Big Chico Creek.	No	1,000	DFG - Historical	5	4	4	5	4	4	2	5	5	3	4	5	4	2	2	5	5	68	93.15
NWC-6, NWC-25	Clear Creek gravel supplementation, processing tailings and restoring floodplain habitat.	Maybe	5,264	Questionnarie	5	4	3	4	2	4	5	4	4	4	4	5	4	3	3	4	5	67	91.78
NS-55	Develop dedicated instream water (Orange Cove water right purchase) in Mill Creek; lower Mill Creek Watershed Restoration Project.	No	1,900	Questionnarie	5	3	3	3	4	3	1	4	4	3	4	4	5	3	4	4	5	62	84.93
NS-35, NS-37a, NS-37b, NS-95, NS-44	Supplement flows, passage at Deer Creek Irrigation District, Cone-Kimball, and Stanford-Vina Diversions, Floodplain Project in lower Deer Creek.	No	1,000	DFG - Historical and GRANDTAB	5	3	4	3	4	3	1	3	4	3	4	4	5	3	4	4	5	62	84.93
SBW-19	Segregation weir in the Sacramento River at the Anderson-Cottonwood Irrigation District (ACID) Dam .	Maybe	7,500	Cramer Fish Sciences	5	3	3	4	3	5	4	3	2	3	4	4	4	5	1	4	5	62	84.93
NS-90	Trap-and-haul project on the North Fork Feather River.	Maybe	500-2,500	Payne & Associates 2004 (FERC)	3	4	2	1	1	5	5	2	2	4	5	3	4	5	1	4	5	56	76.71
NS-94 a	Trap-and-haul program on the North Yuba River above New Bullards Bar Reservoir with habitat restoration.	Maybe	Unknown		2	4	2	1	1	5	5	2	3	4	5	3	4	4	1	4	5	55	75.34

					EVALUATION CRITERIA																	Summary	
Reference Number	**Description of Action**	**Deal Killer (No/ Maybe)**	**Estimated HET Contribution**	**Reference for Estimated HET Contribution**	**(a)** Feasibility	**(b)** Scale	**(c)** Sustainability	**(d)** Cost Effective	**(e)** Minimal Intervention	**(f)** Separation-Genetic	**(g)** Separation-Catastrophe	**(h)** Time to Implement	**(i)** Local/ Political Support	**(j)** VSP/ESA Consistency	**(k)** Balance of Benefits	**(l)** Resource Consistency	**(m)** Available Stocks	**(n)** Action Taken by Others	**(o)** Other FR Species	**(p)** Adverse Effects-spp	**(q)** Adverse Effects-cult.	**Total Score**	**Norm. Total (100)**
					Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score		
NS-91	Trap-and-haul project on the Middle Fork Feather River.	Maybe	< 500 below natural barrier; unknown above	DWR 2007 (FERC Report)	2	3	2	1	1	5	5	2	2	4	5	3	4	5	1	4	5	54	73.97
NS-94 c	Trap-and-haul program on the Middle Yuba River in combination with increased flow releases and habitat restoration.	Maybe	>= 500	UYRSP Team 2006	2	3	2	1	1	5	5	2	3	4	5	3	4	4	1	4	5	54	73.97
B-15	Trap-and-haul program on the Sacramento River at Shasta Dam.	Maybe	Unknown		2	4	2	1	1	5	5	2	3	4	5	3	4	2	1	5	4	53	72.60
NWC-10	Trap-and-haul program in Clear Creek at Whiskeytown Dam.	Maybe	Unknown		2	2	2	1	1	5	5	2	2	4	5	3	4	5	1	4	4	52	71.23
NS-94 b	Trap-and-haul program on the North Yuba River below New Bullards Bar with habitat restoration.	Maybe	Unknown		2	2	2	1	1	5	5	2	3	3	5	3	4	4	1	4	5	52	71.23
NS-93	Trap-and-haul program on the Middle Fork (and possibly North Fork) of the American River.	Maybe	Unknown		2	4	2	1	1	5	5	2	3	4	5	3	1	2	1	4	5	50	68.49

Appendix B5

Ranked List of Viable Actions with Selection Criteria Scoring

Ranked List of Viable Actions with Selection Criteria Evaluation

				(a) Contribution	**(b)** Cost Effective	**(c)** Feasibility	**(d)** Time to Implement	Selection Criteria	Evaluation Criteria		
Reference Number	**Description of Action**	**Estimated HET Contribution[a]**	**Estimated Cost (incl. O&M)[b]**	**Score**	**Score**	**Score**	**Score**	**Score**	**Weighted Score**	**Product**	**Norm Prod**
NS-5	Paynes Crossing in Antelope Creek.	~250	1.0M	1	5	5	5	16	0.96	15.36	100.0
NS-84 b	Rehabilitate Yuba River Narrows spawning habitat with segregation weir in the lower Yuba River.	~3,250	16M	3	5	4	4	16	0.94	15.04	97.9
NS-14	Iron Canyon Fish Ladder Rehabilitation Project in Big Chico Creek.	~500	2.7M	1	5	5	5	16	0.93	14.88	96.9
NS-84b, NS-83, NS-89	Yuba River Narrows spawning habitat w/ segregation weir, backwater, side-channel, and riparian/floodplain habitat, Deer Creek Habitat Expansion Project in the lower Yuba River.	~3,450	20.6M	3	5	4	3	15	0.99	14.85	96.7
B-2	Phase 2 of the Battle Creek Restoration Project.	~1600	46.3M	1	3	4	4	12	1	12	78.1
NS-5, NS-1,NS-77, NS-3, NS-10	Paynes Crossing; supplement flow; Valley Floor Channel[c]; modify ag diversions to provide passage and reduce entrainment in Antelope Creek.	~350	8.0M	1	3	5	3	12	0.96	11.52	75.0
NS-55	Develop dedicated instream water (purchase The Nature Conservancy water rights, Orange Cove water right, & water from other willing sellers) in Mill Creek.	< 100	3.0M	1	3	4	4	12	0.85	10.2	66.4

				(a) Contribution	**(b)** Cost Effective	**(c)** Feasibility	**(d)** Time to Implement	Selection Criteria	Evaluation Criteria		
Reference Number	**Description of Action**	**Estimated HET Contribution[a]**	**Estimated Cost (incl. O&M)[b]**	**Score**	**Score**	**Score**	**Score**	**Score**	**Weighted Score**	**Product**	**Norm Prod**
NS-35, NS-37a, NS-37b, NS-44	Supplement flows in Deer Creek; improve passage at Stanford-Vina, Cone-Kimball and Deer Creek Irrigation District diversion dams; implement Floodplain Project in lower Deer Creek.	~600	32.3M	1	3	4	3	11	0.85	9.35	60.9
NS-94 a	Trap-and-haul program on the North Yuba River above New Bullards Bar Reservoir with habitat restoration.	~1,750[d]	[100M]	1	3	2	2	8	0.75	6	39.1
NS-94 c	Trap-and-haul program on the Middle Yuba River in combination with increased flow releases and habitat restoration.	~500[d]	[75M]	1	1	2	2	6	0.74	4.44	28.9
NS-94 b	Trap-and-haul program on the North Yuba River below New Bullards Bar with habitat restoration.	[500]	[75M]	1	1	2	2	6	0.71	4.26	27.7

[a]Contribution from Quantification Method (unless noted otherwise).

[b]O&M costs calculated for 50-year term.

[c]Valley Floor Channel implementation costs based on estimates from the Lower Clear Creek Restoration Project.

[d]Contribution for North Fork estimated from Ripple; Middle Fork estimated from Upper Yuba River Studies Program

Note: brackets indicate unsubstantiated estimate.

Appendix C
Outreach Activities

Appendix C
Outreach Activities

Effective November 20, 2007, Pacific Gas and Electric Company (PG&E) and the California Department of Water Resources (DWR) entered into the *Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead* (HEA) with the following parties: American Rivers, Arthur G. Baggett, Jr.[1]; California Department of Fish and Game (DFG); U.S. Department of Agriculture Forest Service (Forest Service); National Marine Fisheries Service (NMFS); U.S. Fish and Wildlife Service (USFWS); and State Water Contractors, Inc. A copy of the HEA is available on the HEA website: www.sac-basin-hea.com. DWR and PG&E (the Licensees) formed a Steering Committee, comprised of two representatives each, to execute the HEA in accordance with its terms and conditions.

The HEA allows the Licensees 2 years to jointly identify, evaluate, and select the most promising and cost-effective action(s) to expand spawning, rearing, and adult holding habitat for spring-run Chinook salmon and steelhead in the Sacramento River Basin. The Steering Committee consulted with NMFS and the HEA signatories, and requested input from directly affected and responsive third parties (herein referred to as *other stakeholders*) to identify potential actions that could qualify under the HEA. These outreach efforts assisted the Licensees with the development of the Draft and Final Habitat Expansion Plan (HEP).

The following sections describe how the Licensees, using the Steering Committee, sought input and shared information with NMFS, the HEA signatories, and other stakeholders. Table C-1 lists in chronological order the various outreach efforts by the Licensees during development of the Draft and Final HEP. The Licensees will continue their outreach efforts through completion of their responsibilities under the HEA. Chapter 5 of the Final HEP identifies the remaining phases of the HEA.

[1] Mr. Baggett, a member of the California State Water Resources Control Board (State Water Board), signed the HEA as a recommendation to the State Water Board. Neither he nor the State Water Board is a Party to the HEA. Mr. Baggett will not be participating in the State Water Board's consideration of any petition for water quality certification for any Habitat Expansion Plan pursuant to Section 401 of the federal Clean Water Act.

Table C-1. Chronological Summary of HEA Steering Committee Outreach Activities

Date	Venue	Audience	Description
2008			
Fall 2008	Website	HEA Signatories	Developed a website providing background information on the HEA
4/30/2008	Conference call	NMFS	Reviewed status of the Licensees' efforts on implementing the HEA and requested feedback from NMFS on how to solicit proposals as a means of identifying actions
7/10/2008	Symposium	Salmonid Restoration Federation's Spring-Run Chinook Salmon Symposium	Presented on the HEA and participated in a panel discussion on habitat expansion opportunities for spring–run Chinook salmon
8/20/2008	Meeting	NMFS	Reviewed the draft Work Plan for fulfilling the HEA and efforts to date, application of HEA criteria to a preliminary list of actions, and methods used to determine contribution to the HET
10/28/2008	Letter	HEA Signatories	Provided an update on implementation of the HEA and initiated contact with representatives from each signatory
12/5/2008	Meeting	Agency Partnering Meeting	Attended the 16th Partnering Session of USFWS, NMFS, Corps, EPA, and DFG; presented on the HEA
2009			
1/14/2009	Meeting	HEA Signatories	Met with signatories representing the central Sacramento River Basin watersheds to solicit information on potential habitat expansion actions
1/21/2009	Meeting	HEA Signatories	Met with signatories representing the northern Sacramento River Basin watersheds to solicit information on potential habitat expansion actions
1/28/2009	Meeting	HEA Signatories	Met with signatories representing the southern Sacramento River Basin watersheds to solicit information on potential habitat expansion actions
3/6/2009	Letter	Other Stakeholders	Solicited feedback on the development of potential habitat expansion actions for the HEP
3/10/2009	Website	HEA Signatories and Other Stakeholders	Posted a new page to the HEA website providing stakeholders with instructions on how to provide input on potential habitat expansion actions
4/2009 – 9/2009	Personal communication	RCDs, Watershed Groups	Offered information regarding the HEA and informed them on how to provide input on potential habitat expansion actions

Date	Venue	Audience	Description
4/8/2009	Meeting	NMFS	Reviewed the framework for evaluating and selecting habitat expansion actions, working definitions for HEA criteria, methodology used to determine the HET, and list of potential habitat expansion actions; also learned about NMFS' proposed Upper Yuba River actions
5/13/2009	Letter	American Rivers	Replied to a letter received from Steve Rothert of American Rivers
5/28/2009	Conference call	NMFS	Reviewed NMFS' comments received on various HEA documents, approach for applying the HEA Evaluation Criteria, Working List of Potential Actions, and recommendations for determining contribution to the HET
6/15/2009	Meeting	HEA Signatories and Other Stakeholders	Provided an update on the Working List of Potential Actions considered for the HEP and requested feedback on the approach for applying the HEA criteria and quantification methods used to determine contribution to the HET
7/7/2009	Symposium	Lower Yuba River Symposium	Attended the symposium and met with members of the RMT to discuss potential habitat expansion actions on the Lower Yuba River; also learned about other actions received via HEA questionnaires
8/12/2009	Meeting	HEA Signatories and Other Stakeholders	Reviewed revised approach for applying the HEA criteria, presented the Ranked Preliminary List of Viable Actions, and requested feedback on revised approach for applying HEA Evaluation Criteria
10/15/2009	Meeting	HEA Signatories and Other Stakeholders	Presented the List of Viable Actions, reviewed the method for determining contribution to the HET, presented actions under consideration for the Draft HEP; again requested feedback on the approach for applying the HEA criteria and quantification methods for determining contribution to the HET
11/6/2009	Conference Call	Principals from NMFS and Licensees	Discussed eligibility of actions to be recommended in the Draft HEP (Lower Yuba River Actions and Three-Creek Actions)
2010			
1/13/2010	Meeting	Lower Yuba River Landowners	Educated landowners on the HEA and informed them of potential actions under consideration in their area
2/2010	Website	All interested parties	Posted comment letters received on the Draft HEP to the HEA website
4/28/2010	Meeting	NMFS	Reviewed comments received on the Draft HEP and status of activities performed to date to begin developing the Final HEP; also received an update from NMFS on the Upper Yuba River Actions

Date	Venue	Audience	Description
5/5/2010	Meeting	Principals from NMFS and Licensees	Discussed extending the time to develop the Final HEP by 6 months
5/10/2010	Email	HEA Signatories and Other Stakeholders	Explained that comment letters received on the Draft HEP are posted to the HEA website, as well as the working spreadsheets used to determine contribution to the HET; also informed them that, as a result of comments received on the Draft HEP, the Licensees will be requesting an extension from NMFS to prepare the Final HEP
5/12/2010	Meeting	NMFS	Reviewed methodology used in the Draft HEP for estimating contribution to the HET, an update on actions recommended in the Draft HEP, and potential Upper Yuba River Actions that could fulfill the HEA
5/18/2010	Letter	NMFS	Requested 6-month extension to develop the Final HEP (NMFS responded to the Licensees' request via a letter dated June 1, 2010, granting the 6-month extension to develop the Final HEP)
5/26/2010	Conference Call	American Rivers	Reviewed planned actions to be taken during the 6-month extension and reviewed comments received from American Rivers on the Draft HEP
5/26/2010	Conference Call	State Water Contractors	Reviewed planned actions to be taken during the 6-month extension and reviewed comments received from the State Water Contractors on the Draft HEP
6/2/2010	Conference Call	DFG	Reviewed planned actions to be taken during the 6-month extension and reviewed comments received from DFG on the Draft HEP
6/23/2010	Conference Call	USFWS	Reviewed planned actions to be taken during the 6-month extension and reviewed comments received from USFWS on the Draft HEP
6/29/2010	Symposium	Lower Yuba River Symposium	Attended the RMT's 2nd annual symposium to learn about fisheries monitoring and evaluation in the Lower Yuba River
6/30/2010	Meeting	Corps	Met with representatives from the Corps to conduct a field visit of Englebright Dam, Sinoro Bar, and Daguerre Point Dam to learn about current and planned restoration activities by the Corps in the Lower Yuba River
7/16/2010	Meeting	DFG	Reviewed the proposed concept for an adaptive management plan related to the optional segregation weir component of the Lower Yuba River Actions
7/21/2010	Meeting	NMFS	Reviewed methodology used in the Draft HEP for estimating contribution to the HET and discussed potential Upper Yuba River Actions that could fulfill the HEA

Date	Venue	Audience	Description
8/17/2010	Meeting	YCWA	Provided an update on the development of potential actions in the Lower Yuba River and discussed potential actions in the Upper Yuba River
8/18/2010	Meeting	RMT	Provided an update on the development of potential actions in the Lower Yuba River and received feedback from the RMT on these actions based on ongoing studies performed by the RMT
9/8/2010	Meeting	Principals from NMFS and Licensees	Discussed progress made toward developing the Final HEP
9/27/2010	Conference Call	DFG	Reviewed comments received from DFG on the proposed concept for an adaptive management plan related to the optional segregation weir component of the Lower Yuba River Actions
11/8/2010	Letter	NMFS	Responded to letter of non-support for the Lower Yuba River Actions received from American Rivers, Trout Unlimited, South Yuba River Citizens League, and the Federation of Fly Fishers

Notes:

Corps	U.S. Army Corps of Engineers	HET	Habitat Expansion Threshold
DFG	California Department of Fish and Game	NMFS	National Marine Fisheries Service
EPA	U.S. Environmental Protection Agency	RMT	Yuba River Management Team
HEA	Habitat Expansion Agreement	USFWS	U.S. Fish and Wildlife Service
HEP	Habitat Expansion Plan	YCWA	Yuba County Water Agency

C.1 HEA Website

The Licensees established a website early in the process to share information related to the HEA. The following documents are currently available on the website:

- the HEA,
- the first annual HEA status report,
- the draft Work Plan,
- the Draft HEP,
- the Final HEP,
- worksheets used to estimate contribution to the HET for the Draft and Final HEP,
- presentations from meetings with the HEA signatories and other stakeholders, and
- correspondence and completed HEA questionnaires received from the signatories.

During development of the Draft HEP, the website also offered instructions and forms for the HEA signatories and other stakeholders to submit actions for consideration in the HEP. Specifically, a questionnaire was made available for the HEA signatories and other stakeholders to complete and submit potential habitat expansion actions to the Licensees for consideration under the HEA. The 22 questionnaires that were received by the Licensees during preparation of the Draft HEP and one questionnaire received during preparation of the Final HEP are posted on the HEA website.

The Licensees updated information on the HEA website during development of the Draft and Final HEP, and will continue to update the website during all phases of the HEA, in an effort to inform signatories to the HEA and other stakeholders of recent developments.

C.2 Outreach to Signatories to the HEA

The Licensees actively reached out to the signatories to the HEA directly and through various venues. Some of the outreach activities that the Licensees arranged or participated in are described below.

C.2.1 Consultation with NMFS

The Licensees consulted[2] with NMFS throughout the development of the Draft and Final HEP. The Licensees communicated with NMFS periodically through emails and informal phone calls to keep NMFS informed on progress toward fulfilling the HEA, and to seek guidance on various HEA-related issues and how those issues should be reflected in the HEP.

The Licensees also scheduled meetings with NMFS periodically to discuss the HEA. Meetings included

- two conference calls and five face-to-face meetings with NMFS staff, and
- three conference calls/meetings with the principals from NMFS and the Licensees.

In May 2010, the Licensees also submitted a letter to the principals from NMFS requesting to extend the time needed to develop the Final HEP. The purpose for each consultation is described below.

[2] According to the definitions presented in Section 1.1 of the HEA, “consultation” means the act of conferring and is distinct from the term “consultation” under the ESA.

C.2.1.1 Consultation with NMFS Staff

April 2008 Conference Call

On April 30, 2008, the Licensees participated in a conference call with representatives from NMFS to:

- provide NMFS with an update on the Licensees's efforts on implementing the HEA;
- identify which branch from NMFS to work with regarding the NMFS Approval Criteria identified in the HEA;
- obtain feedback from NMFS on the idea of soliciting proposals as a means of identifying potential actions;
- receive feedback from NMFS on the compilation of appropriate actions from the PG&E/California Trout, Inc. (CalTrout) effort to prioritize Central Valley anadromous salmonid recovery actions (described below), and how this process could be integrated with the NMFS *Co-Manager Review Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead* (Co-Manager Review Draft Recovery Plan); and
- obtain input on how the Licensees could integrate the HEA process with other recovery planning efforts, such as the USFWS Anadromous Fish Restoration Program (AFRP) and the CALFED Ecosystem Restoration Program.

August 2008 Meeting

On August 20, 2008, the Licensees met with NMFS and discussed the following topics:

- the Steering Committee's presentation at the July 10, 2008 Spring-Run Chinook Salmon Symposium sponsored by the Salmonid Restoration Federation,
- the draft Work Plan for fulfilling the HEA and efforts to date,
- application of the HEA criteria to the PG&E/CalTrout Prioritized Actions Contributing to Salmon and Steelhead Recovery Project list of prioritized actions,
- availability and use of the NMFS Co-Manager Review Draft Recovery Plan,
- methodologies for determining contribution of actions to the HET, and
- coordination with the HEA signatories.

April 2009 Meeting

On April 8, 2009, the Licensees met with NMFS to review:

- the framework for evaluating and selecting habitat expansion actions;
- *Working Definitions of the Evaluation, Selection, and Approval Criteria*;
- methodologies for determining contribution to the HET; and
- the list of potential habitat expansion actions.

On this day, the Licensees also first learned about NMFS' recommendation to consider the Upper Yuba River Actions.

May 2009 Conference Call

On May 28, 2009, the Licensees held a conference call with NMFS to discuss the following topics:

- NMFS review and comments on HEA documents, including the HEP timeline; HEA conceptual framework; and *Working Definitions of the Evaluation, Selection, and Approval Criteria*;
- the approach for applying the HEA Evaluation Criteria;
- the Working List of Potential Actions; and
- recommendations for determining contribution to the HET.

April 2010 Meeting

On April 28, 2010, the Licensees met with NMFS to review the following topics:

- comments received on the Draft HEP;
- update on the Draft HEP recommended actions (i.e., the Lower Yuba River Actions and Three-Creek Actions);
- strategy to develop the Final HEP;
- update from NMFS on the Upper Yuba River actions;
- terms of the HEA and identification of significant differences in interpretation of the HEA;
- objectives and goals for the next meeting of the principals from NMFS and the Licensees on May 5, 2010; and
- outreach with the HEA signatories and other stakeholders related to the 6-month extension to prepare the Final HEP.

May 2010 Meeting

On May 12, 2010, the Licensees met with NMFS. The purposes of the meeting were primarily to:

- review the methodology used in the Draft HEP for estimating contribution to the HET,
- discuss subsequent refinements to the method,
- provide an update on the actions recommended in the Draft HEP, and
- discuss potential actions in the Upper Yuba River that could fulfill the requirements of the HEA.

July 2010 Meeting

On July 21, 2010, the Licensees met with NMFS. The purposes of the meeting were primarily to:

- review again the method used in the Draft HEP for estimating contribution to the HET with an extended audience from NFMS technical staff,
- review results of a report prepared for the Steering Committee by Dr. Gregory B. Pasternack[3], in which Dr. Pasternack independently estimated the contribution to the HET from a recommended action, and
- discuss potential actions in the Upper Yuba River that could fulfill the requirements of the HEA. NMFS had submitted an HEA questionnaire on June 29, 2010, describing salmon reintroduction options in the Upper Yuba River watershed.

C.2.1.2 Consultation with NMFS Principals

November 2009 Conference Call

On November 6, 2009, the principals from NMFS (regional director) and each of the Licensees (deputy director [DWR] and vice-president [PG&E]) participated in a conference call to discuss eligibility of actions under the HEA. No decision was made during the meeting regarding eligibility of the recommended actions under the HEA.

[3] Gregory B. Pasternack, PhD, M.ASCE is a professor of watershed hydrology and geomorphology at the University of California, Davis. Dr. Pasternack has been involved with the Lower Yuba River for several years prior to the HEA; his expertise as a geomorphologist with specialized knowledge of the Lower Yuba River is broadly acknowledged. From 2003 to 2008, Dr. Pasternack was funded by the Anadromous Fish Restoration Program (AFRP) to study flow and habitat relationships, and how these relationships affect fish production processes in the stream. Dr. Pasternack presented his report *Estimate of the Number of Spring-Run Chinook Salmon That Could Be Supported by Spawning Habitat Rehabilitation at Sinoro Bar on the Lower Yuba River* to NMFS during the Steering Committee's meeting with NMFS on July 21, 2010.

May 2010 Meeting

On May 5, 2010, the principals from NMFS (regional director) and each of the Licensees (deputy director [DWR] and vice-president [PG&E]) participated in a status meeting regarding development of the Final HEP and a request to extend the time to complete the Final HEP by 6 months.

Six-Month Extension Request

On May 18, 2010, the Licensees submitted a letter to NMFS requesting a 6-month extension of time to prepare the Final HEP. NMFS had submitted extensive comments on the Draft HEP in a letter dated February 18, 2010. Comments included a recommendation for a formal time extension of 6 months to complete the Final HEP (1) to allow NMFS time to confer with the Licensees and other parties regarding its opinion that the Draft HEP was deficient; and (2) to allow NMFS to introduce new information and another alternative that NMFS believed would meet the requirements of the HEA. Section 5 of the HEA allows for the Licensees or NMFS to request an extension of time from each other to achieve the deadlines specified in the HEA. Section 5 further states that the request shall be granted if good cause exists. Although the Licensees did not agree with several comments and conclusions presented in NMFS' comment letter, the Licensees did agree that an extension of time was necessary (1) to address the comments received on the Draft HEP; and (2) to work toward developing a Final HEP that NMFS could approve.

In a letter dated June 1, 2010, NMFS confirmed that the requested extension was granted in accordance with Section 5 of the HEA.

September 2010 Meeting

On September 8, 2010, the principals from NMFS (regional director) and each of the Licensees (deputy director [DWR] and vice-president [PG&E]) participated in a meeting to discuss progress toward developing the Final HEP.

C.2.2 Consultation with HEA Signatories

The Licensees consulted with the HEA signatories throughout development of the Draft and Final HEP. The Licensees communicated with the HEA signatories periodically through letters, meetings, and conference calls. Each is described in the following sections.

C.2.2.1 Letters to HEA Signatories

On October 28, 2008, the Licensees sent a letter to the HEA signatories, to provide them with an update on implementation of the HEA and to initiate contact with staff from the various HEA parties in order to obtain additional contacts for, and information on, potential habitat expansion actions.

On May 13, 2009, the Licensees replied to a February 27, 2009 letter from Steve Rothert of American Rivers, requesting that documents in development be posted to the HEA website. The letter informed Mr. Rothert of draft work products that had been posted on the website and ongoing outreach efforts to signatories and other stakeholders.

C.2.2.2 Meetings with HEA Signatories during Development of the Draft HEP

The Steering Committee first met with the signatories to the HEA in January 2009 to solicit information on potential habitat expansion actions, identify contact persons for additional follow-up on potential actions, facilitate the receipt of completed questionnaires (see discussion below), and obtain a common understanding of the HEA criteria. Three meetings, which were divided by watersheds within the Sacramento River Basin, took place on:

- January 14, 2009, in Chico, California, focusing on potential actions in the central Sacramento River Basin watersheds;
- January 21, 2009, in Red Bluff, California, focusing on potential actions in the northern Sacramento River Basin watersheds; and
- January 28, 2009, in Sacramento, California, focusing on potential actions in the southern Sacramento River Basin watersheds.

In particular, the Steering Committee requested that the HEA signatories provide input on the Draft Working List of Potential Habitat Expansion Actions. The signatories to the HEA also were asked to submit information on actions to be considered for the HEP by completing an HEA comment form or questionnaire.

Additional meetings held in June, August, and October 2009 with the HEA signatories and other stakeholders are described below under "Communication with Both HEA Signatories and Other Stakeholders."

C.2.2.3 Conference Calls with HEA Signatories during Development of the Final HEP

In May and June 2010, the Steering Committee held conference calls with representatives of each of the HEA signatories to inform them of the planned actions to be undertaken during the 6-month extension, update them on new information received since the Draft HEP was issued, and request any available updates. The Steering Committee also reviewed the comments received on the Draft HEP from each respective party. Meetings were held with the following signatories:

- American Rivers on May 26, 2010;
- State Water Contractors on May 26, 2010;
- DFG on June 2, 2010; and
- USFWS on June 23, 2010.

The Licensees also asked each of the HEA signatories whether there was interest in meeting with all stakeholders or whether they were sufficiently informed on the plan for the extension. None of the HEA signatories expressed interest in a group meeting.

C.3 Outreach to Other Stakeholders

Stakeholder input and public support are critical to successful implementation of the actions proposed in the Final HEP. The Licensees worked closely with and sought input from other stakeholders, including local Resource Conservation Districts (RCDs) and watershed groups to identify potential actions that could qualify under the HEA.

During development of the Draft HEP, the Steering Committee contacted County Supervisors, local RCDs, and watershed groups in the Sacramento River Basin to obtain their input on potential habitat expansion actions to be considered in the Draft HEP. The various means that the Steering Committee reached out to other stakeholders are described below.

- On March 6, 2009, the Steering Committee sent a letter to stakeholders informing them about the opportunity for funding spring-run Chinook salmon and steelhead restoration actions and soliciting their feedback on the development of potential habitat expansion actions for the HEP.
- On March 10, 2009, the Steering Committee posted a new page on the HEA website providing stakeholders with instructions on how to provide input on potential habitat expansion actions by completing a questionnaire.
- During April through September 2009, the Steering Committee contacted individual RCDs and watershed groups via personal communication, offering information on the HEA and informing the stakeholders on how to provide input on potential habitat actions.

During development of the Final HEP, NMFS received a letter of non-support for the Lower Yuba River Actions presented in the Draft HEP from American Rivers, Trout Unlimited, South Yuba River Citizens League, and the Federation of Fly Fishers dated September 7, 2010. The letter claimed that the Lower Yuba River Actions did not meet at least three of the NMFS Approval Criteria identified in the HEA (Section 4.2.3[c], [d], and [e] of the HEA), especially with respect to the eligibility of the Lower Yuba River Actions under the HEA. The Licensees responded to this letter, explaining the status of the Final HEP and further development of the Lower Yuba River Actions. The letter was sent before release of the Final HEP in November 2010. The response letter also stated that the Lower Yuba River Actions as presented in the Draft HEP were eligible under the HEA and did meet the NMFS Approval Criteria.

C.4 Communication with Both HEA Signatories and Other Stakeholders

The Steering Committee held several meetings with the HEA signatories and other stakeholders to provide them with an update on the status of the HEA process throughout development of the Draft and Final HEP. The following status meetings with HEA signatories and other stakeholders took place during development of the Draft HEP:

- On June 15, 2009, to inform them about the updated Working List of Potential Actions that was being considered for the HEP. The Steering Committee asked the HEA signatories and other stakeholders to provide feedback on the approach for applying the HEA criteria and quantification methods to determine contribution to the HET. Comments were received from DFG, USFWS, and American Rivers.
- On August 12, 2009, to review the revised approach for applying the HEA criteria and to present the Ranked Preliminary List of Viable Actions. The Steering Committee asked that the HEA signatories and other stakeholders provide comments on the revised approach for applying the HEA Evaluation Criteria and on the Ranked Preliminary List of Viable Actions. No written comments were received.
- On October 15, 2009, to present the List of Viable Actions, the method for determining contribution to the HET, and the actions under consideration for the Draft HEP. The Steering Committee asked the HEA signatories and other stakeholders to provide feedback on the approach for applying the HEA criteria and quantification methods to determine contribution to the HET. Comments were received from American Rivers and NMFS.

During development of the Final HEP, the Licensees sent an email message on May 10, 2010, updating the HEA signatories and other stakeholders on the status of development of the Final HEP. The email announced that comments received on the Draft HEP were posted to the HEA website and that the spreadsheets used to estimate the contribution to the HET cited in the Draft HEP (i.e., Chapter 4 and Appendix E) were posted to the HEA website. The email informed the HEA signatories and the other stakeholders that, as a result of comments received on the Draft HEP, the Licensees would formally request an extension from NMFS to prepare the Final HEP. The Licensees also thanked the HEA signatories and other stakeholders for their participation and support throughout the HEA process.

C.5 Communication on Specific Habitat Expansion Actions

During development of the Draft and Final HEP, the Licensees coordinated with the HEA signatories regarding the various habitat expansion actions that were evaluated in the Draft HEP and recommended in the Final HEP. This coordination effort is described below.

C.5.1 Development of the Draft HEP

The Steering Committee communicated through meetings, emails, and informal phone calls with HEA signatories and other stakeholders in targeted watersheds to further develop the habitat expansion actions considered in the Draft HEP. During preparation of the Draft HEP, the Steering Committee coordinated specifically with the following groups:

- Chico State University (CSU), Chico Research Foundation, and DFG regarding rehabilitation of the Iron Canyon Fish Ladder on Big Chico Creek;
- DFG and the RMT regarding potential habitat expansion actions proposed for the Lower Yuba River;
- Deer Creek Watershed Conservancy regarding supplementing flows, improving fish passage, and rehabilitating floodplain habitat on Deer Creek;
- Mill Creek Management Team (members include Mill Creek Conservancy, DFG, DWR, and Los Molinos Mutual Water Company) regarding the development of dedicated instream flows for Mill Creek; and
- USFWS, AFRP, and DFG regarding construction of a bridge at Paynes Crossing on Antelope Creek.

C.5.2 Development of the Final HEP

During preparation of the Final HEP, the Licensees maintained communication with individuals involved with the Three-Creek Actions to remain informed about the status of funding for those actions.

In addition, the Licensees participated in the following meetings to further develop the Lower Yuba River Actions:

- Conducted a field visit on June 30, 2010, with representatives from the Corps to Englebright Dam, Sinoro Bar, and Daguerre Point Dam to obtain an overview of current and planned restoration activities by the Corps in the Lower Yuba River.
- Met with DFG on July 16 and September 27, 2010, to review a proposed concept for an adaptive management plan related to the optional segregation

weir component and to seek their input. A copy of the conceptual plan is included in Appendix J of the Final HEP.

- Met with the Yuba County Water Agency (YCWA) on August 17, 2010, to provide an update on development of potential actions in the Lower Yuba River and to discuss potential actions in the Upper Yuba River.
- Met with the RMT on August 18, 2010, to update them on the Lower Yuba River Actions. The RMT is charged with implementing a detailed study program for the Lower Yuba River, as specified in the Lower Yuba River Accord (Yuba Accord). The meeting also served as a forum for the RMT to provide feedback on the Lower Yuba River Actions based on ongoing studies by the RMT. The draft cbec, inc. eco engineering report (2010) prepared for SYRCL, *Rehabilitation Concepts for the Parks Bar to Hammon Bar Reach of the Lower Yuba River*, also was discussed at the meeting.

C.6 Coordination with Landowners

After submittal of the Draft HEP, the Licensees continued outreach efforts to other stakeholders, and especially the landowners. The Licensees sent a letter and copy of the Draft HEP to landowners in the vicinity of the Lower Yuba River Actions, informing them of the HEA and the proposed restoration efforts for spring-run Chinook salmon habitat. The letter invited the landowners to comment on the Draft HEP and informed them of a public meeting that would be held for the Lower Yuba River landowners on the actions under consideration in their area. The public meeting was held on January 13, 2010.

During preparation of the Final HEP, the Licensees solicited temporary entry permits from private landowners for the purpose of providing an option for accessing Sinoro Bar and Narrows Gateway (i.e., sites for the recommended spawning habitat expansion actions; see Chapter 3 in the Final HEP).

The Licensees also contacted Western Aggregates, owners of several parcels along the floodplain of the Yuba River downstream of the Highway 20 Bridge, to discuss partnership opportunities and access for restoration activities.

C.7 Presentations at Symposia and Meetings

C.7.1 Salmonid Restoration Federation's Spring-Run Chinook Salmon Symposium

On July 10, 2008, the Steering Committee gave a presentation on the HEA and participated in a panel discussion on habitat expansion opportunities for spring-run Chinook salmon at the Salmonid Restoration Federation's Spring-Run Chinook Salmon Symposium held in Nevada City, California. The presentation is available on the HEA website.

C.7.2 Agency Partnering Meetings

On December 5, 2008, the Steering Committee attended the 16th Partnering Session of USFWS, NMFS, the Corps, the U.S. Environmental Protection Agency, and DFG to make a presentation on the HEA. This meeting provided the opportunity to inform the managers of these agencies about the HEA and the progress made to date.

C.7.3 Lower Yuba River Symposium

On July 7, 2009, the Steering Committee attended the Lower Yuba River Symposium, which provided an update on fisheries monitoring activities being conducted by the RMT. The Steering Committee had received questionnaires for potential actions on the Lower Yuba River, and attendance at this meeting brought about a better understanding of the Lower Yuba River Accord and the monitoring being conducted on the Lower Yuba River. It also gave the members of the Steering Committee the opportunity to meet with members of the RMT to discuss potential habitat expansion actions on the Lower Yuba River.

On June 29, 2010, the Steering Committee attended the RMT's 2nd Annual Lower Yuba River Symposium on Fisheries Monitoring and Evaluation in the Lower Yuba River. The symposium was attended by representatives of the resource agencies and other stakeholders engaged in implementation of the Yuba Accord. The Yuba Accord provides for $5.5 million through 2016, primarily for monitoring and evaluation of Lower Yuba River fisheries and habitat. The symposium serves as its public review of the results of their monitoring and evaluation efforts.

C.8 Summary

Since the signing of the HEA, the Licensees have been actively reaching out to NMFS, the HEA signatories, and other stakeholders (including landowners), requesting their input throughout development of the Draft and Final HEP. The Licensees will continue coordination with the resource agencies, HEA signatories, landowners, and other stakeholders through completion of their responsibilities under the HEA.

Appendix D

Questionnaires for Actions Recommended in the Draft Habitat Expansion Plan

Habitat Expansion Agreement

for

Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead

Questionnaire Instructions

The attached questionnaire is intended to solicit information needed by the Steering Committee to review projects relative to the criteria established in the Habitat Expansion Agreement. For each proposed action (project), please complete the questionnaire to the fullest extent possible. Please provide citations where applicable and provide a full reference for each citation at the end of this questionnaire (Section X. Supporting Documents). Specific instructions follow.

I. Contact Information

Provide the name of the agency or group making the proposal as well as a contact person for the project. Include contact information such as mailing address, phone number, and email address.

II. Project Description

Provide a descriptive name for the action (project). If the action is listed in the *Working List of Potential Habitat Expansion Actions* (provided during the January 2009 meetings of HEA parties), please include the reference number associated with the action. The project location should specify the watershed or subwatershed (e.g., Deer Creek, Beegum Creek) as well as specific areas within the watershed where the project will be located and what portions of the watershed will benefit from the project. Please include geographic coordinates of the project location(s), if applicable. The project description should be a narrative that provides as much detail as possible about the project.

III. Species Limiting Factors

In this section, indicate the factors that currently limit production of spring-run Chinook salmon and/or steelhead in your watershed. The intent is that the environmental and biological objectives of your project address these limiting factors in some way. Please check one or more of the limiting factors that apply to your watershed. In the second column, describe how and where the factor limits spring-run Chinook salmon and/or steelhead. For each factor that you check, please rank its effect on spring-run Chinook salmon and/or steelhead using the drop-down box in the last column. Finally, we also ask that you describe the source of your conclusions, such as a watershed assessment or other document. Please provide enough information that we can find the document if we need it.

IV. Project Objectives—Environmental

Environmental objectives describe how the project is intended to address the limiting factors to achieve the biological objective described in the next section. Environmental objectives should be as specific and quantitative as possible (e.g., reduce gravel embeddedness in the watershed from 75% to 25% by fencing riparian areas to exclude cattle and allow riparian forest to reestablish). Describe how you think environmental objectives relate specifically to the biological objectives. In the last column, we ask you to describe the environmental objectives as either the primary or secondary focus of the project. For example, a project to plant trees might have a primary focus on riparian/floodplain function with a secondary focus on temperature or water quality.

V. Project Objectives—Biological

Biological objectives describe the anticipated biological response from the project and should be as quantitative as possible. Indicate which species and life stages are the focus of the project. Describe specifically the general condition of the target species in your watershed relative to the historical abundance. The condition of the species should be indicated using the categories in the drop-down box. Species condition categories are defined on the last page of this form. Biological objectives should include the following information: (1) an estimate of the expected contribution of the project in terms of potential adult returns, to the extent possible (and an explanation of how the estimate was developed); and (2) an explanation of how the biological objective for the species is addressed by the action relative to the environmental limiting factors (e.g., the biological objective of an action might be to increase egg incubation survival in a watershed that is currently limited by sediment levels).

VI. Project Cost

To the extent possible, estimate the capital cost of the project, the annual operating and maintenance (O&M) cost, a description of annual O&M activities, and the project lifetime (i.e., how many years O&M activities are expected, including indefinitely, and how long until you expect the project to provide benefits). Provide any confirmed or potential funding partners, or opportunities for cost sharing with other funders or between projects. Also, identify any confirmed or potential partners that might provide maintenance support for the project (funding support or labor support).

VII. Schedule

Describe the project schedule, including a potential start date, construction period, and environmental and biological response times (i.e., the expected time to realize environmental and biological benefits). The last points refer to the maturation period for the project during which time environmental conditions develop. For example, it may take 50–100 years before full environmental benefits (e.g., shading, channel stability, water quality) of planting riparian trees are realized.

VIII. Feasibility

Describe the feasibility and challenges of the project. Feasibility issues should include primarily technical issues, success of projects utilizing similar technology, and particular challenges posed by the specific project. Other issues of feasibility that may be included are challenges associated with property ownership, permitting, zoning, and other social-economic-legal issues.

IX. Project Support

Describe the support or potential conflicts associated with the project. Specifically, provide supporting and cooperating entities (e.g., agencies, non-governmental organizations). Are there cooperating agencies or groups, aside from the potential funding partners mentioned previously? Describe the degree of local support and any known opposition or conflicts with other parties.

X. Supporting Documents

Provide full references for each citation used to support the information presented in this questionnaire for your project. At a minimum, a reference should include the author(s) name; name of agency/organization (if applicable); title of the document; volume and title of journal, if the document is taken from a professional journal; and publisher, date, and location of publication.

Appendix D1

Questionnaires Received on the Lower Yuba River Actions

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

DUE: Friday, February 27, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

Name: Gary Reedy

Organization: South Yuba River Citizens League (SYRCL)

Address: 216 Main Street

City, State, Zip Code: Nevada City, CA 95959

Phone Number: (530) 265-5961 ext 208

Email Address: gary@syrcl.org

II. Project Description

Project Name: Backwater, Side-channel, and Riparian/Floodplain Habitat Restoration in the lower Yuba River

Reference No. or New: New

Project Location: Yuba River downstream of Englebright Dam

Project Description:

At present, a pre-project assessment is being conducted to inform opportunities for juvenile salmonid habitat enhancements (including a pilot riparian revegetation project) at Hammon Bar on the lower Yuba River. The pre-project assessment is addressing the geomorphic, hydrologic, and biotic factors influencing riparian recruitment, growth, and survival in the project area. Current work includes a public outreach component to inform nearby landowners, concerned stakeholders, and watershed groups about the proposed pilot project.

II. Project Description

We want to expand the current work to evaluate conditions along approximately 3 additional river miles of Western Aggregates land recently placed under conservation easement in agreement with SYRCL downstream of Hammon Bar. Using what we learn from the pre-project assessment and pilot project, we intend to implement large-scale restoration in the Yuba River by creating and restoring backwater, side-channel, and riparian/floodplain habitat in the lower Yuba River.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead in your watershed. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☒ **Channel Form**	The Yuba River in California's Central Valley was severely degraded by hydraulic and dredger mining, primarily from the mid-19th through mid-20th century. In the Yuba Goldfields reach of the Lower Yuba River, dredger tailings confine the river channel along much of its length, and shaded riverine aquatic habitat, riparian habitat, and floodplain inundation are limited. The resulting reduction in aquatic habitat complexity and diversity has been identified as a limiting factor to salmonid populations, and adversely affects rearing salmonids in particular.	High
☐ **Channel Unit Types**		Select Rank
☐ **Substrate**		Select Rank
☒ **Structure**	The Yuba River in California's Central Valley was severely degraded by hydraulic and dredger mining, primarily from the mid-19th through mid-20th century. In the Yuba Goldfields reach of the Lower Yuba River, dredger tailings confine the river channel along much of its length, and shaded riverine aquatic habitat, riparian habitat, and floodplain inundation are limited. The resulting reduction in aquatic habitat complexity and diversity has been identified as a limiting factor to salmonid populations, and adversely affects rearing salmonids in particular.	High
☐ **Flow**		Select Rank
☐ **Temperature**		Select Rank
☐ **Water Quality**		Select Rank
☐ **Passage**		Select Rank
☒ **Riparian/Floodplain**	The Yuba River in California's Central Valley was severely degraded by hydraulic and dredger mining, primarily from the mid-19th through mid-20th century. In the Yuba Goldfields reach of the Lower Yuba River, dredger tailings confine the river channel along much of its length, and shaded riverine aquatic habitat, riparian habitat, and floodplain inundation are limited. The resulting reduction in aquatic habitat complexity and diversity has	High

III. Species Limiting Factors

been identified as a limiting factor to salmonid populations, and adversely affects rearing salmonids in particular.

Source Documents:

CVPIA 10-year Implementation Plan

Additional Notes:

IV. Project Objectives—Environmental

In this section, describe how your project will affect <u>one or more</u> of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☒ **Channel Form**	Create/restore 5 acres of new backwater or side-channel habitat for rearing juvenile salmonids.	Primary
☐ **Channel Unit Types**		Select Focus
☐ **Substrate**		Select Focus
☒ **Structure**	Create/restore 5 acres of new backwater or side-channel habitat for rearing juvenile salmonids, as above. Installation of instream woody material may be used to provide structure.	Primary
☐ **Flow**		Select Focus
☐ **Temperature**		Select Focus
☐ **Water Quality**		Select Focus
☐ **Passage**		Select Focus
☒ **Riparian/Floodplain**	Create/restore 50 acres of new riparian/floodplain habitat for rearing juvenile salmonids.	Primary

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon **Population Status Specific to Watershed:** Decreasing

Target Life Stages:

☐ Spawning ☐ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration ☐ Adult Holding

Description of Project Objectives:

Increase habitat complexity (e.g., create/restore backwater and side-channel habitat, physical structure, shaded rivierine aquatic, riparian, and floodplain habitat) to provide for increased growth, protection from predators, and overall increased survival of juvenile salmonids.

Target Species: ☒ Steelhead **Population Status Specific to Watershed:** Decreasing

Target Life Stages:

☐ Spawning ☐ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration

Description of Project Objectives:

Increase habitat complexity (e.g., create/restore backwater and side-channel habitat, physical structure, shaded rivierine aquatic, riparian, and floodplain habitat) to provide for increased growth, protection from predators, and overall increased survival of juvenile salmonids.

VI. Project Cost

Capital Cost:	$2M
Annual Operation and Maintenance Cost:	$20K
Annual Operation and Maintenance Description:	Ongoing gravel/riparian augmentation and instream woody material installation
Project Lifespan:	30 years
Project Partners (Funding):	Corps of Engineers, Western Aggregates, PG&E, USFWS Anadromous Fish Restoration Program
Project Partners (Maintenance):	Corps of Engineers, South Yuba River Citizens League

VII. Schedule

Proposed Start:	2009
Expected Time to Completion:	2019
Expected Time to Realize Environmental Benefits:	2011; full environmental benefits realized in 2019
Expected Time to Realize Biological Benefits:	2011; full environmental benefits realized in 2019

VIII. Feasibility

Technical Feasibility:	Pre-project assessment is underway; pilot project soon to be underway; design plans are needed and permits will need to be obtained.
Technical Challenges:	The Yuba River can be a very active river channel
Related Projects:	Other easements and publically-owned land are likely to become available for habitat restoration projects on the Yuba River.
Ownership or Permitting Challenges:	None
Conflicts with Cultural, Zoning, or Other Issues:	None

IX. Project Support

Supporting Entities:	SYRCL, FWS
Cooperating Entities:	DFG and NMFS
Degree of Local Support:	SYRCL has been conducting outreach activities to inform the public about this project
Known Opposition:	Corps of Engineers commitment to project is unknown.

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

X. Supporting Documents

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased "flashiness," and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Never Present

The species has never been known to occur in the watershed.

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

DUE: Friday, February 27, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

Name:	Gary Reedy
Organization:	South Yuba River Citizens League (SYRCL)
Address:	216 Main Street
City, State, Zip Code:	Nevada City, CA 95959
Phone Number:	(530) 265-5961 ext 208
Email Address:	gary@syrcl.org

II. Project Description

Project Name:	Backwater, Side-channel, and Riparian/Floodplain Habitat Restoration in the lower Yuba River
Reference No. or New:	New (same as submitted by FWS)
Project Location:	Lower Yuba River in the reach from the Hwy 20 bridge down to above Daguerre Point Dam.

Project Description:

Rearing habitat for spring-run Chinook and steelhead in the Lower Yuba River is limited by a lack of habitat diversity and complexity owing to channel changes associated with past dredger mining activities. This project addresses the upper portion of the Yuba Goldfields where these habitat limitations are most conspicuous and the opportunities for restoration greatest. The project will build on a current AFRP-funded pilot restoration project and a conservation easement on Western Aggregates land to design and implement restoration of new functional

II. Project Description

floodplain habitat, off-channel rearing habitat (backwaters and side-channels), large wood structure and enhanced riparian. Habitat enhancemnets will be designed to maximize extended rearing of juvenile spring-run Chinook and steelhead. The full-phase project will require excavation of dredger material suitable in both volume and quality for use by the Army Corps of Engineers in their gravel augmentation program below Englebright Dam. Thus, this project compliments the Narrows Spawning Habitat Rehabilitation project in two ways: provision of maintenance gravels and enhanced rearing habitat for expanded populations of salmon and steelhead.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead in your watershed. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☒ **Channel Form**	The lower Yuba River is artifically straightened and narrowed due to the management of hydraulic mining debris and dredger mining activity.	High
☐ **Channel Unit Types**		Select Rank
☐ **Substrate**		Select Rank
☒ **Structure**	Large wood and riparian is conspicuously lacking in the Lower Yuba River. The technical team of fish biologists developing the Yuba Accord Fisheries Agreement identified lack of habitat complexity and diversity as one of four top stressors on Yuba River salmonid populations. This stressor is particularly important for spring-run and steelhead whose life history involves extended rearing.	High
☐ **Flow**		Select Rank
☐ **Temperature**		Select Rank
☐ **Water Quality**		Select Rank
☐ **Passage**		Select Rank
☒ **Riparian/Floodplain**	Due to artificial channel confinement and a lack of riparian vegetation, populations of rearing juvenile salmonids are limited in their ability to rear past spring flows and grow at high rates.	High

Source Documents:

Draft Implementation Plan for Lower Yuba River Fisheries Habitat Restoration, CVPIA 10-year Implementation Plan

Additional Notes:

The Yuba Accord provides flow schedules and temperature management which promises to minimize or adaptively manage the other top stressors identified for salmon and steelhead. In addition, the River Management Team is spending $0.5M annually in monitoring salmonid populations and habitat in a way that could provide evaluation for the proposed project.

IV. Project Objectives—Environmental

In this section, describe how your project will affect one or more of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☒ **Channel Form**	Create/restore a minimum of 5 acres of new backwater or side-channel habitat for rearing juvenile salmonids.	Primary
☐ **Channel Unit Types**		Select Focus
☐ **Substrate**		Select Focus
☒ **Structure**	Install woody instream material and boulders within newly created backwater or side-channel habitat and at other locations in reach..	Primary
☐ **Flow**		Select Focus
☐ **Temperature**		Select Focus
☐ **Water Quality**		Select Focus
☐ **Passage**		Select Focus
☒ **Riparian/Floodplain**	Create/restore 50 acres of new functional floodplain with enhanced riparian habitat for rearing juvenile salmonids.	Primary

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon **Population Status Specific to Watershed:** Decreasing

Target Life Stages:

☐ Spawning ☐ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration ☐ Adult Holding

Description of Project Objectives:

Enhance rearing habitat by constructing backwater and side-channels, placing wood, planting riparian and engineering restored functional floodplains. High quality rearing habitat will provide for increased growth, protection from predators, and overall increased survival of juvenile salmonids.

V. Project Objectives—Biological

Target Species: ☒ Steelhead

Population Status Specific to Watershed: Decreasing

Target Life Stages:

☐ Spawning ☐ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration

Description of Project Objectives:

Enhance rearing habitat by constructing backwater and side-channels, placing wood, planting riparian and engineering restored functional floodplains. High quality rearing habitat will provide for increased growth, protection from predators, and overall increased survival of juvenile salmonids.

VI. Project Cost

Capital Cost:	$2M
Annual Operation and Maintenance Cost:	$30K
Annual Operation and Maintenance Description:	Riparian enhancement and monitoring will be the primary maintenance cost to the project. The Corps is required to implement by 2012 a program of large wood supply to the lower Yuba River (NMFS 2007)
Project Lifespan:	30 years
Project Partners (Funding):	Corps of Engineers, Western Aggregates, BLM, PG&E, USFWS Anadromous Fish Restoration Program
Project Partners (Maintenance):	Corps of Engineers, South Yuba River Citizens League

VII. Schedule

Proposed Start:	2009
Expected Time to Completion:	2019
Expected Time to Realize Environmental Benefits:	2011; full environmental benefits realized in 2019
Expected Time to Realize Biological Benefits:	2011; full environmental benefits realized in 2019

VIII. Feasibility

Technical Feasibility:	Pre-project assessment is underway, and conceptual designs available. Design plans alternatives and permits will need to be obtained. This type of restoration has occurred on other large Central Valley rivers.
Technical Challenges:	The Yuba River is an active channel with limitied flood management. The factors limiting recruitment and survival of riparian are still undergoing local investigation and unnatural summer hydrographs may prove problematic.
Related Projects:	Other easements and publically-owned land are likely to become available for habitat restoration projects on the Yuba River. This project compliments the Yuba Narrows Rehabilitation project by addressing limiting factors for juvenile rearing and providing a source for the maintenance of gravels.
Ownership or Permitting Challenges:	Western Aggregates has made 3 miles of the south bank a conservation easement for the purpose of habitat restoration. BLM manages the Hammon tract and is an cooperative partner. A small tract of Army Corps land exists between. Corps permits will be needed.
Conflicts with Cultural, Zoning, or Other Issues:	None determined

IX. Project Support

Supporting Entities:	SYRCL, FWS, BLM, Western Aggregates
Cooperating Entities:	DFG and NMFS
Degree of Local Support:	SYRCL has been conducting outreach activities to inform the public about this project and encountered a high degree of support
Known Opposition:	None determined.

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

SYRCL (2008) A Framework for Restoration in the Lower Yuba River

Draft Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration. October 2005. Lower Yuba River Fisheries Technical Working Group. CD Distribution

NMFS BiOp on Englebright and Daguerre Dams (2007)

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased "flashiness," and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Never Present

The species has never been known to occur in the watershed.

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

DUE: Friday, February 27, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

Name: Beth Campbell

Organization: USFWS

Address: Stockton FWO
4001 North Wilson Way

City, State, Zip Code: Stockton, CA 95205

Phone Number: (209) 334-2968 ext 402

Email Address: elizabeth_campbell@fws.gov

II. Project Description

Project Name: Yuba River Narrows Habitat Enhancement

Reference No. or New: New

Project Location: Yuba River (Narrows Reach is about 10 miles upstream from Daguerre Point Dam)

Project Description:

Spawning gravel is abundant in much of the lower Yuba River due to continual inputs from historical mine tailings. In the Narrows reach where spring-run Chinook salmon hold, however, gravel augmentation is needed. Spring-run chinook salmon in fact have been observed attempting to spawn on bedrock. This project would provide for the removal of undesirable "shot rock" and install spawning gravel usable by spring-run Chinook salmon and steelhead.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead in your watershed. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☐ **Channel Form**		Select Rank
☐ **Channel Unit Types**		Select Rank
☒ **Substrate**	Insufficent gravel for spawning is available in the Narrows reach of the Yuba River where many spring-run Chinook salmon hold and attempt to spawn.	High
☐ **Structure**		Select Rank
☐ **Flow**		Select Rank
☐ **Temperature**		Select Rank
☐ **Water Quality**		Select Rank
☐ **Passage**		Select Rank
☐ **Riparian/Floodplain**		Select Rank

Source Documents:

CVPIA 10-year Implementation Plan

Additional Notes:

IV. Project Objectives—Environmental

In this section, describe how your project will affect one or more of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☐ **Channel Form**		Select Focus
☐ **Channel Unit Types**		Select Focus
☒ **Substrate**	Restore 1 acre of salmonid spawning habitat in the Narrows reach of the Yuba River.	Primary
☐ **Structure**		Select Focus
☐ **Flow**		Select Focus
☐ **Temperature**		Select Focus
☐ **Water Quality**		Select Focus
☐ **Passage**		Select Focus

IV. Project Objectives—Environmental

☐ **Riparian/Floodplain** Select Focus

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon **Population Status Specific to Watershed:** Decreasing

Target Life Stages:

☒ Spawning ☐ Egg Incubation ☐ Summer Rearing ☐ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration ☐ Adult Holding

Description of Project Objectives:

Increase the availability of suitable spawning habitat in the Narrows reach of the Yuba River, to provide for increased spawning success of spring-run Chinook salmon.

Target Species: ☒ Steelhead **Population Status Specific to Watershed:** Decreasing

Target Life Stages:

☒ Spawning ☐ Egg Incubation ☐ Summer Rearing ☐ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration

Description of Project Objectives:

Increase the availability of suitable spawning habitat in the Narrows reach of the Yuba River, to provide for increased spawning success of steelhead.

VI. Project Cost

Capital Cost:	$300K
Annual Operation and Maintenance Cost:	$30K
Annual Operation and Maintenance Description:	Ongoing gravel augmentation.
Project Lifespan:	30 years
Project Partners (Funding):	Corps of Engineers, PG&E
Project Partners	Corps of Engineers

VI. Project Cost

(Maintenance):

VII. Schedule

Proposed Start:	2010
Expected Time to Completion:	2012
Expected Time to Realize Environmental Benefits:	2012
Expected Time to Realize Biological Benefits:	2012

VIII. Feasibility

Technical Feasibility:	Design plans are needed and permits will need to be obtained.
Technical Challenges:	The Yuba River can be a very active river channel
Related Projects:	The Corps of Engineers is required to do this as part of the NMFS (2002) BO. The Corps funding requirement should be clearly identified, before being supplemented with HEA funds.
Ownership or Permitting Challenges:	Easiest access to a likely site (PG&E mitigation land) is across private land, and landowner support has been inconsistent. DFG is not a proponent of allowing heavy equipment into the stream channel.
Conflicts with Cultural, Zoning, or Other Issues:	None

IX. Project Support

Supporting Entities:	FWS and NMFS
Cooperating Entities:	DFG
Degree of Local Support:	Yuba County Resource Conservation District is a proponent of this project.
Known Opposition:	See ownership or permitting challenges, above.

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased "flashiness," and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Never Present

The species has never been known to occur in the watershed.

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

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DUE: Thursday, April 30, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

Name:	Duane Massa
Organization:	CA. Dept. of Fish and Game
Address:	2545 Zanella Wy. Suite F
City, State, Zip Code:	Chico, CA 95928
Phone Number:	(530) 895-5005
Email Address:	dmassa@dfg.ca.gov

II. Project Description

Project Name:	Lower Yuba River Narrows Gravel Rehabilitation Project
Reference No. or New:	
Project Location:	The Narrows reach is an approximately a six-mile span of potentially high quality spring-run Chinook salmon spawning habitat located on the lower Yuba River from Englebright Dam to the State Route 20 Bridge in Yuba County, CA.

Project Description:

Englebright Dam was constructed in 1941 on the lower Yuba River to trap hyrdaulic mining debris left from the gold rush in California. The dam has been blocking the natural recruitment of spawning gravels in the Narrows reach for over 65 years. In many areas of this reach, the spawning gravels are completely absent and have been replaced by a bedrock substrate. Spring-run Chinook salmon have been observed to migrate and hold in this area of river, but spawning success has been largely impacted by a lack of suitable spawning substrate as a result of gravel impoundment at Englebright Dam. Gravel injection at this site is expected to expand available spawning habitat primarily for spring-run Chinook salmon, as suitable flow regimes already exist. A pilot gravel injection project

II. Project Description

was successfully completed in the Narrows reach during November 2007. Approximately 361 cubic yards of spawning gravels were injected below the Narrows II powerhouse. Aerial redd surveys conducted in 2008 positively identified spring-run Chinook salmon utilizing the pockets of gravel created by this pilot project. However, additional gravels are needed to fully rehabilitate this reach. This can be accomplished through the injection of approximately 54,000 cubic yards of gravel in the Narrows reach (Englebright-SR20) over several years. Preliminary estimates of this river section indicate that this activity can provide additional spawning habitat for over 4,850 spring-run Chinook salmon.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead <u>in your watershed</u>. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☒ **Channel Form**	Channel incision and slope have been affected by land use, hydraulic mining and hydropower practices.	High
☒ **Channel Unit Types**	Natural channel morphological units have been altered by land use, hydraulic mining and hydropower practices.	High
☒ **Substrate**	Spawning gravel substrate has been completely lost in many sections of the lower Yuba River due to impoundment by Englebright Dam.	Critical
☒ **Structure**	Natural channel form and unit types synonomous with spawning habitat values (i.e. pool, riffle, bank structure, LWD retention, etc.) have been altered by land use, hydraulic mining and hydropower practices.	High
☐ **Flow**		Select Rank
☐ **Temperature**		Select Rank
☐ **Water Quality**		Select Rank
☒ **Passage**	Englebright Dam blocks access to the majority of historic spring-run Chinook salmon spawning habitat. Daguerre Point Dam creates passage difficulties for both adult and juvenile salmonids.	High
☐ **Riparian/Floodplain**		Select Rank

Source Documents:

Pasternack, Greg. 2009. SHIRA-based river analysis and field-based manipulative sediment transport experiments to balance habitat and geomorphic goals on the lower Yuba River. Final Report. U.C. Davis Cooperative Ecosystems Studies Unit

Available from http://pasternack.ucdavis.edu/LYR3_Pasternack_FINAL.pdf

Additional Notes:

III. Species Limiting Factors

IV. Project Objectives—Environmental

In this section, describe how your project will affect one or more of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☒ **Channel Form**	Gravel injection will decrease channel incision and restore natural slope, thus serving to self-regulate additional gravel loss.	Secondary
☒ **Channel Unit Types**	Gravel injection will improve spawning habitat by restoring natual channel morphological units.	Secondary
☒ **Substrate**	Gravel injection will restore natural spawning substrate absent in this reach.	Primary
☒ **Structure**	Gravel injection will restore natural channel form and unit types synonomous with spawning habitat values (i.e. pool, riffle, bank structure, LWD retention, etc.).	Primary
☐ **Flow**		Select Focus
☐ **Temperature**		Select Focus
☐ **Water Quality**		Select Focus
☐ **Passage**		Select Focus
☐ **Riparian/Floodplain**		Select Focus

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon **Population Status Specific to Watershed:** Stable

Target Life Stages:

☒ Spawning ☒ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration ☒ Adult Holding

Description of Project Objectives:

The objective of this project is to restore gravel recruitment below Englebright Dam. This process is a critical step to restoring historic spring-run Chinook salmon populations on the lower Yuba River. Gravel injection will serve to restore historic spawning areas currently under-utilized. This process will also serve to restore several other natural river channel unit, form and structural functions; including a reduction of channel incision, restoration of natural

V. Project Objectives—Biological

slope for gravel retention, and restoration of natural pool/run/riffle mesohabitat interactions.

Target Species: ☒ Steelhead

Population Status Specific to Watershed: Stable

Target Life Stages:

☒ Spawning ☒ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration

Description of Project Objectives:

Steelhead escapement to the lower Yuba River is currently unknown, but monitoring activities have observed adult and juvenile steelhead to be present. Adult spawning activity and yearly emigrations have been observed. Restoration of historic spawning areas will likely improve habitat conditions for this species.

VI. Project Cost

Capital Cost:	$3,000,000 (estimated) for initial 54,000 cu yards
Annual Operation and Maintenance Cost:	Unknown
Annual Operation and Maintenance Description:	Annual replentishment of gravel substrate will be necessary for the period that Englebright Dam blocks natural downstream gravel movement.
Project Lifespan:	The project would have a lifespan corresponding with the continued operation of Englebright Dam.
Project Partners (Funding):	Unknown
Project Partners (Maintenance):	Unknown

VII. Schedule

Proposed Start:	Once permits and funding are secured (possibly November 2009).
Expected Time to Completion:	One month
Expected Time to Realize Environmental Benefits:	Immediate
Expected Time to Realize Biological Benefits:	Immediate

VIII. Feasibility

Technical Feasibility:	A pilot gravel injection project was successfully completed in November 2007.
Technical Challenges:	None. All were addressed during pilot project activities.
Related Projects:	A number of restoration projects are in various stages of completion to address passage, spawning and rearing components of a complete river rehabilitation.
Ownership or Permitting Challenges:	The property is owned jointly by PGE, YCWA and USACE. Permits were successfully acquired for the pilot project. No significant challenges forseen.
Conflicts with Cultural, Zoning, or Other Issues:	None identified at this time.

IX. Project Support

Supporting Entities:	U.C. Davis, NMFS, USFWS, USACE, CDFG, PGEYCWA, Yuba River Accord Management Team, Yuba River Technical Working Group, South Yuba River Citizens League
Cooperating Entities:	U.C. Davis, NMFS, USFWS, USACE, CDFG, PGE, YCWA
Degree of Local Support:	High at this time.
Known Opposition:	None identified at this time.

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

Pasternack, Greg. 2009. SHIRA-based river analysis and field-based manipulative sediment transport experiments to balance habitat and geomorphic goals on the lower Yuba River. Final Report. U.C. Davis Cooperative Ecosystems Studies Unit

Available from http://pasternack.ucdavis.edu/LYR3_Pasternack_FINAL.pdf.

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased “flashiness,” and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Never Present

The species has never been known to occur in the watershed.

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

DUE: Thursday, April 30, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

Name:	Gary Reedy
Organization:	South Yuba River Citizens League
Address:	217 Main Street
City, State, Zip Code:	Nevada City, Ca 95959
Phone Number:	530.265.5961 x208
Email Address:	gary@syrcl.org

II. Project Description

Project Name:	Yuba River Narrows Spawning Habitat Rehabilitation
Reference No. or New:	Basically, same as "Narrows Rehabilitation" project submitted by CDFG and FWS
Project Location:	Yuba River (0.8 miles below Englebright and immediately upstream of Deer Creek) 39deg 13' 50 N 121deg 16' 37 W

Project Description:

Compared to historic conditions, spring-run Chinook and steelhead populations of the Yuba River are severely limited by blockage from Englebright Dam. The spring-run Chinook population of the Yuba River is at high risk of extinction due to average annual abundance <500 fish, strays from the Feather River Hatchery and inadequate spawning segregation from the fall-run population. This project would restore habitat in the reach below Englebright Dam where spring-run Chinook are known to hold and attempt spawning despite a lack of suitable spawning habitat. This project may also involve a segregation weir approximately 6 miles below Englebright to provide spawning segregation from non-natal and fall-run salmon. The need and benefits for the segregation weir

II. Project Description

component of the project can be more completely evaluated following results from ongoing studies by the Yuba Accord RMT involving tagging, tracking, redd mapping and genetic analysis. Dr. Greg Pasternak of UC Davis has thoroughly described the physical situation in the Englebright Dam Reach (EDR). Although the Armcy Corps of Engineers is required to implement a gravel augmentation program, no such program will provide benefits to salmon and steelhead until the channel is rehabilitated from instream gravel mining and deposition of shot rock. With rehabilitation and the provision of 100,000 tons of gravel, the Englebright Dam Reach could support at least 2000 spawning spring-run Chinook. Gravel supply would then be maintained as per requirements of the Corps. The benefits of this project, for steelhead in particular, would be expanded with gravel augmentation in Deer Creek which enters the reach near the location of highest potential for spawning habitat enhancement.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead <u>in your watershed</u>. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☒ **Channel Form**	Instream gravel mining and deposition of shot rock has made the channel at the project location unsuitable for spawning, even with restoration of annual gravel supply. More generally, the channel form in the lower Yuba is affected by lack of gravel supply in upper reach (i.e. downcutting) and artificial confinement from RM 7 to RM 21 (goldfields) resulting from walls of mine tailings.	High
☐ **Channel Unit Types**		Select Rank
☒ **Substrate**	Englebright Dam blocks transport of all gravels into the channel below. Spawning habitat exists beginning two miles below the dam as material becomes entrained from historic terraces and mine tailings	High
☒ **Structure**	see note below	Medium
☐ **Flow**		Select Rank
☐ **Temperature**		Select Rank
☐ **Water Quality**		Select Rank
☒ **Passage**	Englebright Dam blocks access to the majority of spawning habitat in the watershed for spring-run and steelhead; No segregation provided for spawning of spring-run.	High
☒ **Riparian/Floodplain**	see note below	Medium

Source Documents:

Pasternack Manuscript on Englebright Dam Reach, Draft Implemention Plan for Lower Yuba River Anadromous Fish Restoration, Recovery Plan for Central Valley Spring-run Chinook and Steelhead (Co-manager Draft).

Additional Notes:

For description and sources for structure and riparian/floodplain as limiting factors in the lower Yuba River, see submitted information for Yuba River Rearing Habitat Enhancement

IV. Project Objectives—Environmental

In this section, describe how your project will affect one or more of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☒ **Channel Form**	Rehabilitation of channel form by shot rock removal and regrading as necessitated following final analysis of alternatives	Primary
☐ **Channel Unit Types**		Select Focus
☒ **Substrate**	Placement of 100,000 tons of spawning gravel to be followed by program of gravel augmentation/maintenance by the Army Corps	Primary
☒ **Structure**	Through association with Yuba River Rearing Enhancement Project	Secondary
☐ **Flow**		Select Focus
☐ **Temperature**		Select Focus
☐ **Water Quality**		Select Focus
☒ **Passage**	Through association with Deer Creek Gravel Augmentation and Passage Project submitted by Friends of Deer Creek	Secondary
☒ **Riparian/Floodplain**	Through association with Yuba River Rearing Enhancement Project	Secondary

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon **Population Status Specific to Watershed:** Decreasing

Target Life Stages:

☒ Spawning ☒ Egg Incubation ☒ Summer Rearing ☐ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration ☐ Adult Holding

Description of Project Objectives:

Provide spawning habitat in the Englebright Dam Reach of the Yuba River to support 2000 or more spring-run Chinook salmon and enhance juvenile productivity. Also, to provide spatial segregation during spawning from summer immigrants and fall-run Chinook as needed to protect phenotypically or genetically distinct spring-run Chinook. Note: Based on results from gravel placement in Mokelumne River (Joe Merz, personal communication), 100,000 tons of gravel could be sufficient to support this spawning population and greatly enhance production of macroinvertebrates representing food sources for juvenile salmonids.

V. Project Objectives—Biological

Target Species: ☒ Steelhead

Population Status Specific to Watershed: Decreasing

Target Life Stages:

☒ Spawning ☒ Egg Incubation ☐ Summer Rearing ☐ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration

Description of Project Objectives:

Increase the availability of suitable spawning and incubation habitat in the Narrows reach of the Yuba River, to provide for increased spawning success and juvenile productivity for steelhead. Also, this project is complimentary with gravel augmentation in Deer Creek (as proposed by Friends of Deer Creek) which could provide additional benefits in the confluence area for both species and more than 4 miles of expanded spawning and rearing for steelhead.

VI. Project Cost

Capital Cost:	$3.1M for habitat rehabilitation (based on $30/ton placed gravel plus engineering and design), plus $ 219,000 for weir
Annual Operation and Maintenance Cost:	$52,000 annually for weir operation and monitoring
Annual Operation and Maintenance Description:	The Corps is obligated to provide sufficient gravel to channel below Englebright to maintain habitat at no cost to project (estimated by Pasternak to be 10,000 tons). Segregation weir would involve full-time staff for 3.5 months/year plus assembly and disassembly.
Project Lifespan:	30 years
Project Partners (Funding):	PG&E (tbd per Narrows Mitigation Fund), FWS (AFRP)
Project Partners (Maintenance):	Army Corps (tbd for gravel augmentation/maintenance); Yuba County Water Agency (tbd for support of weir and monitoring)

VII. Schedule

Proposed Start:	2010
Expected Time to Completion:	2 months for construction period
Expected Time to Realize Environmental Benefits:	2011
Expected Time to Realize Biological Benefits:	2011

VIII. Feasibility

Technical Feasibility:	Similar spawning habitat rehabilitation has been conducted in the Central Valley, including on the Mokelumne and Tuolomne Rivers. Resistance board segregation weirs are versatile and used by fisheries managers throughout the region. Cramer Fish Sciences staff, who pioneered the use the technology in California, has provided reconnaissance and confirmed feasibility on the Yuba River. For more information, see their resistance board weir website at http://weir.fishsciences.net.
Technical Challenges:	The Yuba River has limited flood control above Englebright and constructed spawning channels will be subject to scouring forces. Additional analysis is required to determine appropriate site rehabilitation techniques before gravel placement. For example, complete shot rock removal may not be required. Also, shot rock near the dam must be stabilized to prevent future impacts.
Related Projects:	Gravel augmentation proposed by Friends of Deer Creek would add substantially to the amount of expanded steelhead habitat in this area. Restoration of off-channel rearing habitat in the Parks Bar to Hammon reach of the Yuba River (as proposed by USFWS and SYRCL) would address a limiting factor for spring-run Chinook and steelhead juveniles. The Corps of Engineers is required by a NMFS BiOp to implement a program of gravel augmentation by the fall of 2012. However, this program is not likely to start before site rehabilitation for which no entity has been made responsible. Nevertheless, the Corps program should be solidified before completion of this project.
Ownership or Permitting Challenges:	Access to rehabilitation site requires either permission from two private landowners so far offering less than consistent support, or construction of road on steep slopes of PG&E mitigation land. CDFG has expressed concerns about the new road and immediate impacts of the project on holding spring-run salmon.
Conflicts with Cultural, Zoning, or Other Issues:	None determined

IX. Project Support

Supporting Entities:	FWS, CDFG, NMFS, SYRCL; PG&E support to be determined.
Cooperating Entities:	Friends of Deer Creek, UC Field Station; Yuba County Water Agency cooperation to be determined.
Degree of Local Support:	Yuba County Resource Conservation District has proposed a pilot phase of this project for funding by the Sierra Nevada Conservancy. This project is expected to have a high degree of local support because it recovers spring-run and steelhead populations without altering water management, recreation or access. If used, a segregation weir would block only the relatively small portion of salmon attempting to migrate into the upper reach from July 1 to October 15.
Known Opposition:	The segregation weir component will have opposition without data to demonstrate lack of sufficient natural segregation. One of two immediate landowners in the rehab location may prove oppositional.

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

Pasternack and others, Manuscript 2009, Historical Analysis of the Englebright Dam Reach of the Lower Yuba River, CA to Aid Spring-run Chinook Salmon Habitat Rehabilitation.

Shira-based river analysis and field-based manipulative sediment transport experiments to balance habitat and geomorphic goals on the Lower Yuba River. http://pasternack.ucdavis.edu/LYR3_Pasternack_FINAL.pdf

NMFS, Central Valley Spring-run and steelhead recovery plan (co-manager draft)

Draft Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration. October 2005. Lower Yuba River Fisheries Technical Working Group. CD Distribution

Merz JE, Ochikubo Chan LK. 2005. Effects of gravel augmentation on macroinvertebrate assemblages in a regulated California river. River Research and Applications 21: 61–74. DOI: 10.1002/rra.819

Merz JE, Setka JD, Pasternack GB, Wheaton JM. 2004. Predicting benefits of spawning habitat rehabilitation to salmonid fry production in a regulated California river. Canadian Journal of Fisheries and Aquatic Science 61: 1433–1446. DOI: 10.1577/M03-038.1

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased “flashiness,” and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Never Present

The species has never been known to occur in the watershed.

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

DUE: Thursday, April 30, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

Name: Joanne Hild

Organization: Friends of Deer Creek

Address: 132 Main Street

City, State, Zip Code: Nevada City, CA 95959

Phone Number: 530-265-6090

Email Address: joanne@friendsofdeercreek.org

II. Project Description

Project Name: Deer Creek Salmon and Steelhead Spawning Habitat Expansion Project

Reference No. or New:

Project Location: Deer Creek between Lake Wildwood and the confluence with the Yuba River. 39.2358 deg N; 121.2190 deg W at the Lake Wildwood dam.

Project Description:

The Deer Creek Salmon and Steelhead Habitat Expansion Project is an effort to restore critical habitat for Spring-run Chinook salmon and steelhead through a combination of targeted gravel augmentation, barrier removal, invasive species removal, riparian revegetation, and collaboration with affected stakeholders, especially Lake Wildwood. In August 2008 the California Department of Fish and Game included Deer Creek on its list of 22 priority streams for future instream work. The list was compiled and ranked based on input from Regional DFG staff, staff from the State Water Board, U.S. Fish and Wildlife Service, and the National Marine Fisheries Service, using the following criteria: 1) Presence of anadromous species; 2) likelihood that DFG flow recommendations would provide a high level of improvement; 3) availability of recent flow studies or other relevant data; and 4) the possibility of

II. Project Description

partners/willing landowners. This proposal is offered in conjunction with the Yuba River Narrows Spawning Habitat Rehabilitation Project proposed by South Yuba River Citizens League.

The mouth of Deer Creek was once an exceptionally rich salmon and steelhead habitat for the Yuba River. Salmon and steelhead were present on Deer Creek and Squirrel Creek, a tributary of Deer Creek, in large numbers in the early part of the 20th century. Steelhead were observed in the 1960's in the first quarter mile of Deer Creek, until the impassible falls, and salmon were observed in large numbers in the 1920's (Yoshiyama, Gerstung, Fisher, and Moyle).

Lake Wildwood reservoir dam on Deer Creek, constructed in 1970, blocks the downstream movement of gravel that is essential for fish spawning habitat, and causes severe impacts to all elements of Deer Creek's riverine function, especially temperature, flow, and nutrient loads. Friends of Deer Creek has worked for the past several years with the Lake Wildwood Lake Committee to make changes to their recreational management of the reservoir that take into account the impacts to the creek. Much work remains if Deer Creek's salmon and steelhead spawning habitat is to be restored and expanded. This proposal is an effort to mitigate the impacts to the creek and make permanent changes in the management of the system that prevent the impacts from recurring.

Assessment, planning and design can begin immediately, with implementation beginning in September 2009. All necessary permits for the implementation of this project have been submitted.

The project elements are as follows:

1. Gravel Augmentation: Lake Wildwood dam is located four and a quarter miles above the confluence with the Yuba, where it has a detrimental impact on Deer Creek's remaining salmon and steelhead spawning habitat. The primary objective of this project is to work with Lake Wildwood to recover the gravel that is prevented by the dam from passing downstream, and to place it along with purchased gravel as needed in the gravel-starved lower reaches of Deer Creek that are critical spawning habitat. While mercury-laden fines are able to cross the dam during storm and dewatering events, larger gravel and pebbles are prevented from passing. Replacement of gravel below the dam will restore a critical ingredient of salmonid spawning habitat as well as a vital but poorly understood element in the overall function of the stream, with beneficial impacts to temperature, flow, oxygenation, and fish and other wildlife populations.

2. Revegetation: We propose a revegetation effort for the four and a quarter mile stretch of creek from the Lake Wildwood dam to the confluence. The effort will focus on the riparian zone, meadow/floodplain areas and upland zones. Like most of the watershed, this area is infested with invasive non-native species that outcompete beneficial native species and interact with the climatic conditions to create parched, tinder-dry conditions in the long hot summers. Of particular concern are Himalayan Blackberry (Rubus discolor), Black Locust trees (Robinia pseudoacacia) and non-native grasses in the riparian zone, Scotch Broom (Cytisus scoparius) and Yellow Star Thistle (Centaurea solstitialis) in the meadow areas, and Ripgut grass in the upland areas. Revegetation from the native palette would restore the capacity to uptake nutrients, thereby reducing the extent of algae blooms that have severely impacted lower Deer Creek. Algae blooms cause large diurnal swings in pH, creating conditions that are lethal to native aquatic organisms. These algae blooms and resulting pH increases have caused the State Board to include Deer Creek as an impaired watershed for pH on the 303(d) list. Revegetation will increase tree cover in the riparian zone, thereby reducing direct solar radiation available as energy for algae. Invasive Himalayan blackberry, prevalent throughout the riparian zone, provides little shade and blocks access to the creek for larger animal species. Blackberry also contributes to erosion as the stream flows around the rootball, undermining the soil. By contrast, native willows overhang the water, remain lush and green all summer long, hold the soil in their roots, and provide copious shade that keeps the water cool. Their roots provide habitat and protection from predators for a variety of animal species. Revegetation of denuded sections of the riparian zone will also help control sediment loads in the creek that result from erosion. This stretch of creek is dominated by a single highly pollution-tolerant macroinvertebrate family, indicating overall ecological degradation. Improved riparian habitat is likely to result in increased macroinvertebrate diversity in addition to providing numerous habitat and water quality benefits for the target species and other riverine and riparian dependent species.

3. Barrier Removal: The third project element is the assessment and removal of barriers to anadromous fish passage. Salmon and steelhead were once present for several miles along Deer Creek and its tributaries, but their range is now limited to the first quarter mile of stream. At this point, a large and impassible waterfall, known as Basher

II. Project Description

Falls, prevents their passage. Salmon were once able to ascend these falls because the presence of gravels in the creek maintained the height of the stream bed and prevented the creek from incising, and large woody debris acted as natural fish ladders to facilitate fish passage. Gravel loads upstream of the falls will restore stream elevation, and targeted gravel placement at the falls will focus on restoring passibility. Native trees, once established, will provide the necessary large woody debris. In addition, we will explore and implement other options for restoring passibility to the falls as indicated. We will also survey any additional barriers to fish passage that lie between the confluence and Lake Wildwood, in an effort to expand habitat range to the entire 4.25 mile stretch of creek, and up to 2.5 additional miles of Squirrel Creek, a tributary of Deer Creek below Lake Wildwood.

4. Collaborative Management of Lake Wildwood and Wastewater Treatment Plant: Lower Deer Creek's potential salmon and steelhead spawning habitat is gravely compromised by the presence of Lake Wildwood dam and wastewater treatment plant, with water temperatures in the fall that are lethal to fish, severe lack of suitable gravels, and an extreme excess of nutrients that contribute to rampant algae blooms. Restoration of viable habitat in this creek, the last tributary spawning grounds for the Yuba River before fish passage is blocked by Englebright Dam, depends on Lake Wildwood's and the Wastewater Treatment Plant's adoption of management practices that reduce impacts to the downstream ecosystem. Necessary changes include increasing the summer flow in order to reduce downstream temperature; releasing from cooler deep waters; collecting gravel during dredge operations for downstream placement; reducing the high flows during the periodic release by further lengthening the duration of the release; and reducing the input of nutrients from the Wastewater treatment plant. Central Valley Regional Water Quality Control Board is in the process of imposing stricter limits on nitrates and phosphates in effluent in order to meet their regional targets. Lake Wildwood has chosen Friends of Deer Creek to implement salmon habitat restoration improvements as a mitigation for their excessive nutrient loads, and that project will complement the current proposal. New technology exists that will result in reduced nutrient loads when implemented. Friends of Deer Creek has established a good working relationship with the Lake Wildwood Lake Committee over the course of several years, in the interest of preserving our shared environment. The fruits of this collaboration are already evident in changes that the Lake Committee has implemented in lengthening the duration of the periodic release, thereby reducing the high flows; posting signs that warn anglers of the dangers of mercury in fish; developing a joint water quality monitoring program at four sites in and below the reservoir; creating an inspection station for boats to prevent the spread of invasive non native species including quagga mussels; and collaborating in a study of mercury-laden sediment that is transported over the dam during storms. Friends of Deer Creek's board of directors includes John Norton, a Lake Wildwood resident, member of the Lake Committee, and retired program director at the California State Water Resources Control Board, who has been instrumental in establishing a partnership.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead in your watershed. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☒ **Channel Form**	Lake Wildwood Dam's construction in 1970 has resulted in drastic changes to the channel form below the dam in the critical salmon spawning reach. While the presence of the dam has not essentially changed the peak flow, the dam prevents the passage of gravels that modulate flow. The fact that there is flow capable of transporting and depositing gravel without a supply of gravel has resulted in the creek incising into its bedrock and alluvium below Lake Wildwood to the confluence. The availability of flow but not of gravel and cobbles has also had the effect of incising the creek at the falls and steepening the gradient, transforming the falls into an impassible obstacle and limiting salmon and steelhead habitat range to the quarter mile stretch between the falls and the confluence. A further	Critical

	consequence of the combination of high flow and gravel starvation is bed armoring, particularly in reaches from Lake Wildwood to Squirrel Creek. Bed armoring is a particular problem in alluvial reaches, resulting in a reduction in habitat diversity. Finally, there is a large amount of angular sediment below the dam due to local erosion caused by construction at Lake Wildwood. Source data: Friends of Deer Creek Geomorphic Assessment, based on protocols developed by Montgomery and Buffington 1997.	
☒ **Channel Unit Types**	The lack of sediment has contributed to a reduction in riffle frequency caused by changes to the substrate. The stretch of creek below Lake Wildwood to the confluence with Squirrel Creek is particularly impacted by infrequency of riffles. The reduction in riffle habitat has the potential to raise temperatures, lower dissolved oxygen concentrations, and reduce habitat suitability. The lack of sediment also causes the creek to incise into alluvial step pools, reducing turbulent flows and dissolved oxygen concentrations. The reduction in gravel has also led to the deepening of pools, making them less suitable for spawning because of the loss of oxygenated flow. Deep pools can reduce the hyporheic flows needed to buffer daily temperature swings. Deep pools also reduce dissolved oxygen concentrations and contribute to algae blooms. Finally, the dam blocks large woody debris which can provide side channel pool habitat and help with gravel retention, thereby creating riffles and increasing the suitability of pools for spawning. The lack of woody debris decreases the diversity of channel units. Source data: Friends of Deer Creek Geomorphic Assessment, based on protocols developed by Montgomery and Buffington 1997.	High
☒ **Substrate**	Lake Wildwood dam blocks gravel and cobbles which would provide habitat to lower Deer Creek. The reach between Lake Wildwood and Squirrel Creek is particularly impacted, with only localized sediment inputs. The composition of the streambed below Lake Wildwood has been fundamentally altered since the construction of the dam because the reduction of the sediment supply has led to bed armoring, and a large median substrate diameter unsuitable for spawning salmonids. Fine sediment however is able to pass downstream, leading to a disproportionate amount of fine substrate too small for spawning habitat. Localized gravel recruitment leads to uneroded, angular gravels. The entire system is starved of suitable gravel supply because of the presence of the dam. Source data: Wolman Pebble Counts done in conjunction with Geomorphic Assessment.	Critical
☒ **Structure**	The presence of two dams (Lake Wildwood and Scotts Flat) has interrupted the continuous system that would bring large woody debris from upland forests. The lack of woody debris affects the distribution and spacing of riffles, runs, and pools. Debris creates unique and diverse habitat types including side channel pools, lateral pools, mid channel pools, and riffles.Source data: Friends of Deer Creek Geomorphic Assessment, based on protocols developed by Montgomery and Buffington 1997; Physical Habitat Assessments conducted in 2007 and 2008 in accordance with SWAMP Stream Habitat Characterization Form; Desktop analysis	High

	using Google Earth to assess canopy cover.	
☒ **Flow**	Lake Wildwood has a severe impact on flow, with inadequate flow in the summer months and unseasonal high flows during the annual dewatering. The dewatering event mimics a storm event, triggering salmon and steelhead to begin their upstream journey to spawn, where the eggs then dry up when the waters recede. The high flows also scour the vegetation and macroinvertbrates from the downstream section of the creek, causing severe impacts to riparian vegetation and habitat. The area is dominated by a single macroinvertebrate family, blackflies (Simulidae), and suffers from a critical lack of the macroinvertebrate diversity needed by salmonids. The entire Deer Creek watershed functions as a water management system. The natural flow regime would allow snowmelt to pass all the way into lower Deer Creek. Snow melt is now blocked and diverted at numerous places. Winter high flows are similar to historic highs, but data collected since 1934 reveals a significant reduction in summer flows resulting from Lake Wildwood's flow management (USGS). Below Lake Wildwood, less flow results in more pronounced diurnal temperature swing, and more severe environmental stresses on organisms. Source data: Flow regime analysis using USGS gauge data and Army Corps of Engineers Hydrologic Engineering Center Statistical Software Package.	Critical
☒ **Temperature**	Temperature is an urgent limiting factor in Lower Deer Creek. Temperature increases caused by human actions are a severe problem in lower Deer Creek. Temperatures of 24 degs C are lethal to salmonids, with 23 degs C being the LT50 (Baker). Ten years of temperature data on Deer Creek in the salmonid spawning reach reveal lethally high temperatures in the summer and fall spawning season, with peaks of 30 degs C (Friends of Deer Creek). Management activities on private land such as grazing, logging, gravel mining, and agriculture have led to degradation of the riparian corridor, reduction in riparian habitat and invasion by non-native plant species that bring reduced shade and habitat benefits. The lack of gravel and cobble in the streambed has led to a deepening of pools and a reduction in turbulent riffle flow and riffle spacing, all of which factors can lead to temperature increases (Grant et al, 2006). Managed flow from Lake Wildwood has significant impacts on downstream temperature caused by several factors: summer release of warm water from surface waters of the reservoir; extremely low outflows in summer in order to conserve reservoir depth; and a lack of natural variation in both flow and temperature, reducing the potential for hyporheic exchange to act as a temperature buffer (Poole & Berman). Source data: Friends of Deer Creek monthly water quality data; Onset HOBO data logger data during Lake Wildwood dewatering.	Critical
☒ **Water Quality**	The primary impacts to the water quality are nutrient loads, algae, and large diurnal swings in pH and temperatures.The wastewater treatment plant at Lake Wildwood releases significant quantities of nutrients into lower Deer Creek, which have contributed to excessive algae blooms. Algae take in oxygen and release carbon	Critical

	dioxide, leading to large diurnal swings in pH and dissolved oxygen, with severe impacts on stream organisms. Deer Creek below Lake Wildwood is 303(d) listed for pH as a result of excessive nutrient loads (http://www.waterboards.ca.gov). The impact of nutrient-laden effluent from the wastewater treatment plant is especially pronounced in summer when the low flows prevent effluent dilution. The lack of riparian canopy also increases the availability of solar radiation to the streambed, contributing to algae blooms. Denuded riparian areas do not uptake nutrients, leaving the nutrients available for algae growth. Source data: Friends of Deer Creek monthly monitoring data.	
☒ **Passage**	Fish passage is completely blocked by a waterfall located a quarter mile above the confluence with the Yuba River. Salmon and steelhead were historically able to scale these falls, but the lack of gravel, cobbles and large woody debris to act as natural fish ladders, has caused the creek to become deeply incised and the falls to become too steep to pass. Source data: Visual and Geomorphic Assessment based on protocols developed by Montgomery and Buffington 1997.	Critical
☒ **Riparian/Floodplain**	The riparian vegetation is significantly compromised both by the spread of invasive non-natives, and by private land management including grazing, logging, mining, and residential development, that has caused the banks to become denuded in places. Aerial photography reveals severely degraded vegetation in more than half of Deer Creek's riparian zone between Lake Wildwood and the Yuba confluence, and even more of Squirrel Creek's riparian zone in 3.2 miles above the confluence with Deer Creek.These impacts result in temperature increases, a reduction in nutrient uptake capacity, and the loss of fish and macroinvertebrate habitat. Riparian vegetation has been found by many studies to be critical in regulating stream temperature (Johnson & Jones, 2000). Riparian areas with higher plant density and basal area have temperatures up to 11% lower than areas with significantly lower plant density and basal area (Opperman & Merenlender, 2004). Non natives such as blackberry outcompete native species such as willow, alder, and cottonwood that provide suitable habitat including canopy, shading, root mats and root wads. The composition of the riparian vegetation zone is crucial to stream temperature regulation, and must include tree species that provide canopy (Broadmeadow & Nisbet, 2004). The riparian zone at the site is currently dominated primarily by shrub-like Himalayan blackberry and Scotch broom, which do not provide the necessary canopy cover to effectively regulate the stream temperature. Non natives such as scotch broom are more susceptible to wildfire, which in turn increases fine sediment load to the creek. Grazing animals cause further impact to native vegetation by spreading non-native seeds and by trampling and compacting soil, making it less hospitable to native species that require specific soil characteristics in order to be successful. The lack of large native riparian trees reduces the availability of large woody debris in the creek necessary for habitat and for fish passage. The lack of gravel has caused the creek to become incised, particularly in the alluvial reaches, and unable to access its	Critical

III. Species Limiting Factors

	floodplain. Source data:Physical Habitat Assessments conducted in 2007 and 2008 per SWAMP Stream Habitat Characterization Form; Habitat Assessment conducted in conjunction with Friends of Deer Creek twice yearly Macroinvertebrate Bioassessment since 2000; streamwalk visual assessment, May 2008.

Source Documents:

Baker, P.F., Speed, T.P., and F.K. Ligon. 1995. Estimating the influence of temperature on the survival of chinook salmon smolts (Oncorhynchus tshawytscha) migrating through the Sacramento - San Joaquin River Delta of California. Can. J. Fish. Aquatic. Sci 52:855-863.

Broadmeadow, S. & Nisbet, T.R. 2004. The effects of riparian forest management on the freshwater environment: a literature review of best management practice. Hydrology and Earth System Sciences 8(3), 286–305.

California Water Resources Control Board http://www.waterboards.ca.gov/tmdl/docs/303dlists2006/approved/BAK_Aug13thruOct30/state_06_303dlist.pdf

Friends of Deer Creek. www.friendsofdeercreek.org/data.html

Grant, Gordon et al. Potential effects of gravel augmentation on temperature in the Clackamas River, Oregon. A report prepared for Portland General Electric. 1 June, 2006

Johnson, S.L. & Jones, J.A. 2000. Stream temperature responses to forest harvest and debris flows in western Cascades, Oregon. Canadian Journal of Fisheries and Aquatic Sciences 57, 30–39.

Opperman, J.J. & Merenlender, A.M. 2004. The effectiveness of riparian restoration for improving instream fish habitat in four hardwood-dominated California streams. North American Journal of Fisheries Management 24, 822–834.

Poole, Geoffrey C. and Cara H. Berman. An Ecological Perspective on In-Stream Temperature: Natural Heat Dynamics and Mechanisms of Human-Caused Thermal Degradation. http://waterdata.usgs.gov/nwis/uv?11418500

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 2001. Historical and present distribution of chinook salmon in the Central Valley. Pages 71-176 in R. Brown, ed. Contributions to the biology of Central Valley salmonids. Fish Bulletin 179. http://wfcb.ucdavis.edu/www/Faculty/Peter/petermoyle/publications/CentralValleyChinook.pdf

Additional Notes:

IV. Project Objectives—Environmental

In this section, describe how your project will affect <u>one or more</u> of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☒ **Channel Form**	The gravel augmentation effort will affect the channel form by reducing the rate of channel incision into the streambed and bedrock. The armoring of the streambed that prevails in the reach between Lake Wildwood and Squirrel Creek will be mitigated by providing a	Primary

	more natural and diverse substrate regime, balancing out the large boulders and bedrock with smaller gravel, and reducing the incision rate. The project objective is to reduce the median substrate diameter by 25%.	
☒ **Channel Unit Types**	The project will place gravel in the sediment-starved reach of Deer Creek below Lake Wildwood, creating riffles and side pools that are necessary to decrease temperature and increase dissolved oxygen. Replacement of gravel will also prevent the creek from incising and developing deep stagnant pools. The revegetation project will provide sources of large woody debris that help to create diverse channel unit types. The project objective is to increase riffle habitat by 30%.	Primary
☒ **Substrate**	The addition of gravel recovered from Lake Wildwood and from Yuba River sources will reduce the median substrate diameter to a diameter more suitable for salmon spawning. Diverse substrate will reduce incision and create more spawning bed habitat. The presence of large quantities of angular sediment from local sources will be mitigated by a combination of removal of angular gravel where practical and increased abundance of rounded pebbles more suitable for spawning habitat. Finally, the addition of diverse substrate will create more hyporheic flow by creating riffles and raising the bed elevation, resulting in reduced temperature and increased dissolved oxygen levels. The project objective is to reduce median substrate diameter by 25%.	Primary
☒ **Structure**	The proposed revegetation effort in the riparian zone below Lake Wildwood and along Squirrel Creek will replace low-lying invasive shrubs with native trees, resulting in local sources of large woody debris. Woody debris facilitates the creation of riffles and pools, and acts as a natural fish ladder. The project objective is to increase woody debris biomass by 100%.	Primary
☒ **Flow**	The gravel augmentation will affect the flow regime by raising the bed elevation, decreasing surface flow and increasing subsurface hyporheic flow. The revegetation will affect flow by providing a source of large woody debris which will create diverse channel unit types and an increase in riffles and sidepools. We will negotiate with Lake Wildwood and Nevada Irrigation District (NID) to make changes to their future management strategies that may include releasing colder water, reducing flow during the periodic dewatering by lengthening the timeframe, and ensuring that the summer release meets the minimum flow levels required under the terms of their permit. The project objective is to ensure that Lake Wildwood's spring, summer and fall flows meet their permitted requirements 100% of the time.	Primary
☒ **Temperature**	The project will realize significant improvements to temperature. We plan to import gravel recovered from Lake Wildwood and from the Yuba River, to create riffles that have the capacity to reduce temperature and increase dissolved oxygen. We will work with Lake Wildwood to manage the summer release of water from a lower depth, so that colder water is entering the stream. We will work with landowners to fence grazing animals out of the riparian zone so that	Primary

	native vegetation can become established, and will focus revegetation efforts on increasing the supply of native shade trees. The project objective is to reduce instances of lethal temperature peaks to zero.	
☒ **Water Quality**	Water quality impacts are interconnected, with the lack of riparian vegetation and canopy contributing to high temperatures and the growth of excessive algae blooms, which in turn leads to large diurnal swings in pH and temperature. The proposed revegetation will increase canopy and overall biomass, thereby increasing the capacity to uptake the nutrients that feed algae blooms and reducing temperature and solar radiation, further reducing algae blooms. The reduction of algae blooms in turn will reduce pH and dissolved oxygen concentration swings. The gravel augmentation will raise bed elevation and create riffle habitat, with increased turbulence that increases dissolved oxygen concentrations. The gravel will also increase subsurface flow to provide a buffer against temperature spikes. We will reduce algal biomass by 25%, and nutrients by 25%.	Primary
☒ **Passage**	The project will include an effort to restore passibility to the falls a quarter mile from the Yuba confluence in order to regain four miles of salmon habitat on Deer Creek and up to 2.5 miles on Squirrel Creek. It is hypothesized that the falls have become excessively steep for a combination of human-caused reasons, including the lack of gravel that causes the creek to incise, and the geomorphological changes to the creek that were caused by intensive gold mining in the creek beginning in the Gold Rush. We plan to restore passibility by a combination of gravel augmentation to raise the streambed height and fall height reduction, by removing accumulated debris at the top of the falls. The project objective is to increase habitat range by 4 miles on Deer Creek and 2.5 miles on Squirrel Creek.	Primary
☒ **Riparian/Floodplain**	The project includes an extensive revegetation effort along 4.25 miles of Deer Creek and an additional 3.2 miles of Squirrel Creek. The denuded areas will be replanted with native trees; invasive non-natives will be removed and replaced with native vegetation; and grazing animals that compact the soil and eat the seedlings will be fenced away from the riparian zone. The gravel augmentation effort will prevent the creek from incising and will allow it to access its floodplain. Friends of Deer Creek's wide volunteer network and relationships with private landowners make us uniquely positioned to implement revegetation efforts on private land and to work with landowners to make beneficial changes to private land management practices. We will reduce the total denuded area of the riparian zone from 33% to 15%.	Primary

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon **Population Status Specific to Watershed:** Intermittent

Target Life Stages:

☒ Spawning ☒ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☒ Adult Immigration ☐ Adult Holding

Description of Project Objectives:

The objective of the project is to increase the proportion of Yuba River salmon found on Deer Creek by 5-10%. The habitat requirements for spring-run Chinook salmon will be addressed in the following manner by the proposed project:

Adult Immigration: High temperatures deter adult salmon from entering their natal streams, and are a problem in Deer Creek for the reasons stated in III above. Our monthly monitoring data, available on our website, indicates that the temperature range in the creek is just above the upper limit of tolerable temperature range. High temperature peaks and extreme temperature swings will be addressed by revegetating to increase shade; by adding gravel to increase riffle habitat and hyporheic flows; and by working with Lake Wildwood management to release water in summer from lower and colder depths of the reservoir. Migrating salmon avoid streams with excessive turbidity. Deer Creek's turbidity is not excessive, but the revegetation project will address sediment loads by vegetating denuded banks to reduce erosion. We will also work with landowners to fence grazing animals away from the riparian zone, where they contribute to erosion by compacting the soil and eating seedlings. In order to expand the available habitat on Deer Creek beyond the current 1/4 mile, it is necessary to address the impassibility of Basher Falls and determine whether it can be made passible. A survey of the falls will examine pool depth to falls height ratio, vertical and horizontal distance, and whether an alternate route under the falls can be developed to facilitate fish passage.

Spawning: The most significant variables affecting spawning habitat are substrate composition, cover, water quality and water quantity. In terms of water quantity, flow is impacted in Deer Creek by Lake Wildwood dam, with low summer flows and unnaturally high flows during the periodic dewatering. Suitable salmon spawning habitat requires sufficient but not excessive flow, and our work with Lake Wildwood will focus on ensuring that minimum summer flows are observed and that the duration of the dewatering is extended to allow a lower flow rate. Temperature provides an important cue for spawning salmon, with the ideal temperature range being 5.6-13.9 deg C. Timing of spawning must take into account the seasonal temperatures that affect subsequent incubation success rates - successful spawning requires suitable temperatures at just the right time. As outlined above in Adult Immigration, temperature impacts will be addressed by a combination of revegetation efforts, reservoir management strategies, and gravel augmentation. Of critical importance to spawning habitat is suitably-sized substrate, with salmon requiring gravel in the range of 1.3 to 10.2 cm. Up to 80% of the gravel should be in the range of 1.3 to 3.8 cm, with the remainder up to 10.2cm. As outlined above, the targeted stretch of creek is gravel-starved as a result of the dam at Lake Wildwood that prevents the passage of gravel downstream. The gravel augmentation effort in this project will recover gravel from the reservoir and augment with purchased gravel from a Yuba River source in order to increase the ratio of suitable substrate. Finally, spawning salmon require adequate cover for shade and for protection from predators. Cover may be provided by overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water, turbulence, and turbidity. The project will include an extensive revegetation of the riparian zone focused on increasing native shade cover and providing a supply of large woody debris.

Incubation: While spawning habitat is also incubation habitat, the needs of embryos during incubation differ from those of adults. Of particular importance is the quantity of fine sediment that can block oxygenated flow in the redds and restrict alevin movement. The revegetation will reduce fine sediment loads by restoring erosion-prone denuded

V. Project Objectives—Biological

areas. Dissolved oxygen concentrations also have an impact on incubating salmon, with low and medium DO levels corresponding to smaller, weaker and fewer alevins. DO concentrations are impacted by temperature, surface and intragravel water interchange, substrate permeability, and oxygen demand of organic material in the redd. The project will result in increases in dissolved oxygen levels by reducing water temperature through a combination of revegetation, gravel augmentation, and changes to reservoir management; reducing algae blooms by increasing riparian vegetation that will uptake nutrients and provide shade; increasing the proportion of gravels to fine sediment; and increasing riffle habitat and thereby increasing hyporheic flow. Incubation success is influenced strongly by temperature, with temperatures in the higher end of the ideal range greatly reducing the number of days until embryos hatch. Proposed temperature mitigations are as described under "Adult Immigration", above.

Rearing: Abundance of juvenile salmon is impacted by a range of variables including vegetative cover, protection from predators, abundance of food sources, flow, water quality including DO concentrations and pH, temperature, competition, depth, velocity, and substrate. Project impacts to temperature, water quality, flow, substrate, and vegetative cover/protection from predators have been discussed in the above sections. The project will have a significant impact on macroinvertebrate habitat, with habitat improvements resulting from the revegetation and substrate improvements. Macroinvertebrates constitute the major food source for salmonids. Both suitably-sized substrate and large native trees and their woody debris are crucial in increasing macrinvertebrate populations and in providing protective cover to juvenile salmon.

Target Species: ☒ Steelhead

Population Status Specific to Watershed: Extirpated

Target Life Stages:

☒ Spawning ☒ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☒ Adult Immigration

Description of Project Objectives:

The project objective is to return steelhead to Deer Creek. While steelhead were historically present in the watershed, it is thought they are no longer found here. The project impacts for spring-run chinook habitat will yield comparable benefits for steelhead. The temperature range for spawning steelhead is 3.9-9.4 deg C. There is considerable overlap in the ideal range for all habitat variables for salmon and steelhead, and the project will yield benefits that will accrue to both species. While steelhead are not currently present in Deer Creek because of habitat degradation, they are still present in the Yuba River in the vicinity of Deer Creek, and it is hoped that the project will restore Deer Creek's habitat to viability.

VI. Project Cost

Capital Cost: $75,000 for equipment

Annual Operation and Maintenance Cost:

$174,000 annual operation costs for the project term of 3.25 years

$275,000 annual maintenance costs

Annual Operation and Maintenance Description:

For the 3.25 year term of the project, the project will salvage gravel from Lake Wildwood and purchase additional Yuba River gravel as needed; deposit the gravel below Lake Wildwood dam and at the falls annually; remove non-native riparian vegetation; revegetate with native vegetation; irrigate as needed; monitor and remove non-native vegetation; conduct meetings with Lake Wildwood Lake Committee to implement management changes; survey barriers to fish passage and remediate; implement monitoring program.

VI. Project Cost

Project Lifespan:	Funding is requested for the 3.25 year project term. Operating and maintenance activities are expected to be required indefinitely, as long as the dam at Lake Wildwood is present. Immediate benefits are expected in macroinvertebrate populations, as soon as suitable gravel is restored, with salmon and steelhead numbers showing an improvement within three years. Long term benefits in riparian vegetation will continue to accrue for the next ten years.
Project Partners (Funding):	Nevada County Sanitation District #1, a compensatory mitigation imposed by California Department of Fish and Game.
Project Partners (Maintenance):	Lake Wildwood Association will be maintenance project partners, providing salvaged gravel and other remedial actions in their management plan as developed in the scope of the project.

VII. Schedule

Proposed Start:	September 2009
Expected Time to Completion:	December 2012
Expected Time to Realize Environmental Benefits:	2019
Expected Time to Realize Biological Benefits:	December 2012

VIII. Feasibility

Technical Feasibility:

The technical elements of the project include gravel augmentation, riparian revegetation, and barrier removal.

The gravel augmentation element is feasible because we have convenient access for depositing gravel loads at Lake Wildwood dam, as well as a cooperative relationship with Lake Wildwood Lake Association who have granted us permission to access their land for this purpose. Lake Wildwood Association has been seeking solutions to the issue of gravel starvation in the lower reach, and is strongly supportive of efforts to recover gravel from the lake and place it below the dam. If the recovered gravel proves to be unsuitable or insufficient, we have identified an alternative source of gravel from the Yuba River, which can be trucked in to the site.

The riparian revegetation effort is feasible because of our strong relationships developed over many years with landowners along the creek, some of whom are volunteers and monitors for our organization. We have secured formal consent to implement revegetation efforts from landowners of approximately one third of the land area along Deer Creek between Lake Wildwood and the Yuba confluence, and will continue working to secure additional permissions. Friends of Deer Creek has already completed a similar revegetation effort that involves the removal of non-natives and replacement with native trees and plants in an upstream reach, and has developed a method of incremental removal of

VIII. Feasibility

invasives to avoid exacerbating the erosion problem; revegetation in targeted sections that can outcompete the invasive vegetation; and gathering of native seedlings and cuttings from a variety of specimens in the project area in order to ensure genetic diversity and suitability.

Barrier removal will consist primarily of a feasibility study to determine the best method of bypassing Basher Falls and implementation as appropriate. The effort to restore passibility by targeting gravel placement to elevate streambed height is made possible by good access at the falls, that will allow us to focus a specific "gardening"-style gravel placement at the site. The introduction of large numbers of native trees will restore the supply of large woody debris that in the past acted as a natural fishladder to facilitate fish passage.

Technical Challenges:

Technical challenges remain in the restoration of passibility to the falls. Anecdotal evidence suggests that historically, salmon and steelhead were able to scale these falls and were found in the upper reaches of Deer Creek, but the falls are known to have been impassible since at least the 1920's, before the construction of Lake Wildwood dam. An initial study of the falls has shown that there is an access point at the bottom of the falls approximately 10" in diameter, and that it is possible that fish passage could be occur via this route instead of up the face of the falls. If fish passage cannot be restored, the habitat range will be limited to the first quarter mile of stream above the Yuba confluence, but riparian revegetation and gravel augmentation efforts would be implemented in the entire 4.25 mile stretch of the creek between Lake Wildwood and the confluence in order to realize greater temperature and pH improvements.

The temperature peaks in the creek currently are lethal to spawning fish, and a primary goal of all elements of the project is to reduce temperature peaks and swings. The related projects below reveal that improvements in temperature suitability result from each planned remediation strategy, and taken together we believe that the project in its entirety will restore habitability.

Related Projects:

All elements of the project have been successfully implemented in other waterways:

Barrier Removal: In Puget Sound, when access to 145 rkm in the upper Skykomish River above Sunset Falls (a natural barrier) was provided, chinook and pink salmon penetrated the upper reaches of the basin, and their populations peaked in 15 and 25 years, respectively (Seiler 1991).

Nutrient Uptake: The plan to plant native plants in denuded areas and as a replacement for non-native shrubs has been shown to result in a significant reduction in nutrient loads in the creek, with willows being extremely efficient at nutrient uptake (Byrd & Kelly 2006).

Native Revegetion Benefits: A revegetation project in Mendocino County targeted at steelhead habitat restoration yielded significant temperature benefits, beneficial changes in channel morphology, and a supply of large woody debris within 10-20 years that was equal to that found on similar streams in mature forest (Opperman & Merenlender 2004).

Gravel Augmentation: East Bay Municipal Utility District has implemented a series of gravel augmentation activities over several years in the Mokelumne River just below Comanche Dam. The augmentation has yielded multiple

VIII. Feasibility

benefits, including the immediate return of spawning Chinook salmon to two sites; a 12% increase in the quantity of suitably-sized gravels; increased dissolved oxygen and decreased temperatures; and macroinvertebrate populations in the new gravel that are equal to those found in established gravel (Bjornn & Reiser, Mokelumne).

Ownership or Permitting Challenges:

We are fortunate to have developed harmonious relationships with several landowners along the creek and with Lake Wildwood. Therefore, it is not anticipated that land ownership issues will be a significant obstacle.

We have applied for the following permits for this project:

Army Corps of Engineers, Section 404 Permit

Department of Fish and Game, Lake and Streambed Alteration Permit

Central Valley Regional Water Quality Control Board, Water Quality Certification Section 401 Permit

Conflicts with Cultural, Zoning, or Other Issues:

There are no known conflicts with cultural, zoning, or other issues. On the contrary, our close collaboration with the Tsi-Akim Maidu has revealed to us that the return of the salmon people to their ancestral lands is their highest priority, as indicated by their revival of the "Calling Back the Salmon" ceremony for the past few years in the fall. Efforts to restore salmon habitat are of paramount cultural importance.

IX. Project Support

Supporting Entities:

The Tsi-Akim Maidu Tribe is supportive of the goals of this project.

Support for elements of this project is implicit in the fact that in August 2008 the California Department of Fish and Game included Deer Creek on its list of 22 priority streams for future instream work. The list was compiled and ranked based on input from Regional DFG staff, staff from the State Water Board, U.S. Fish and Wildlife Service, and the National Marine Fisheries Service, using the following criteria: 1) Presence of anadromous species; 2) likelihood that DFG flow recommendations would provide a high level of improvement; 3) availability of recent flow studies or other relevant data; and 4) the possibility of partners/willing landowners. T

Cooperating Entities:

Lake Wildwood, Nevada County Sanitation District #1, and private property owners along the affected stretch of creek have all offered their formal cooperation, and support letters are available.

Degree of Local Support:

Friends of Deer Creek enjoys a high degree of local support and places a priority on building cooperative relationships with all affected parties, private and public. Several homeowners along the creek have become volunteers and monitors; the city of Nevada City is currently partnering with us on an EPA-funded Brownfield Assessment of abandoned mines on city-owned land, and has provided us with low-rent office and lab space for the past decade; Lake Wildwood has collaborated with us on mulitple projects and, as a result of our collaboration, has modifed its management practices of the reservoir to take into account impacts to the creek; and we are developing an eight mile community trail along the creek, in partnership with several local groups, which promises to

IX. Project Support

be a highly valued local resource and which has engendered much support and volunteer hours from a broad spectrum of the community. These relationships make it possible for us to accomplish many things that would be hard for a state agency to do, especially when access to private property is required as it is in this project.

Known Opposition: There is no known opposition to this project.

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

Baker, P.F., Speed, T.P., and F.K. Ligon. 1995. Estimating the influence of temperature on the survival of chinook salmon smolts (Oncorhynchus tshawytscha) migrating through the Sacramento - San Joaquin River Delta of California. Can. J. Fish. Aquatic. Sci 52:855-863.

Bjornn, T.C. and D.W. Reiser. "Mokelumne River Spawning Habitat Improvement Project Monitoring". American Fisheries Society Special Publication, 1991. http://www.delta.dfg.ca.gov/AFRP/

Bjornn, T.C and D.W. Reiser. "Habitat Requirements of Salmonids in Streams." Influences of forest and rangeland management on salmonid fisheries and their habitats. W. Meehan (ed). American Fisheries Society Special Publication 19, 1991. 83-138.

Broadmeadow, S. & Nisbet, T.R. 2004. The effects of riparian forest management on the freshwater environment: a literature review of best management practice. Hydrology and Earth System Sciences 8(3), 286–305.

Byrd, Kristin B. and Maggi Kelly. Salt Marsh Vegetation Response To Edaphic And Topographic Changes From Upland Sedimentation In A Pacific Estuary. Department of Environmental Science Policy, and Management, University of California, Berkeley. Wetlands, Vol. 26, No. 3, September 2006, pp. 813–829.

California Water Resources Control Board http://www.waterboards.ca.gov/tmdl/docs/303dlists2006/approved/BAK_Aug13thruOct30/state_06_303dlist.pdf

Friends of Deer Creek. www.friendsofdeercreek.org/data.html

Grant, Gordon et al. Potential effects of gravel augmentation on temperature in the Clackamas River, Oregon. A report prepared for Portland General Electric. 1 June, 2006

Johnson, S.L. & Jones, J.A. 2000. Stream temperature responses to forest harvest and debris flows in western Cascades, Oregon. Canadian Journal of Fisheries and Aquatic Sciences 57, 30–39.

Opperman, J.J. & Merenlender, A.M. 2004. The effectiveness of riparian restoration for improving instream fish habitat in four hardwood-dominated California streams. North American Journal of Fisheries Management 24, 822–834.

Poole, Geoffrey C. and Cara H. Berman. An Ecological Perspective on In-Stream Temperature: Natural Heat Dynamics and Mechanisms of Human-Caused Thermal Degradation. http://waterdata.usgs.gov/nwis/uv?11418500

Seiler, D. 1991. Coho production potential above Snoqualmie Falls. Open File Report, 15 January 1991. Planning, Research, and Harvest Management Division. Washington Department of Fisheries, Olympia,WA.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 2001. Historical and present distribution of chinook salmon in the Central Valley. Pages 71-176 in R. Brown, ed. Contributions to the biology of Central Valley salmonids. Fish Bulletin 179. http://wfcb.ucdavis.edu/www/Faculty/Peter/petermoyle/publications/CentralValleyChinook.pdf

X. Supporting Documents

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased “flashiness,” and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Never Present

The species has never been known to occur in the watershed.

Appendix D2

Questionnaire Received on the Antelope Creek Action

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

DUE: Friday, February 27, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

Name:	Brenda Olson
Organization:	U.S. Fish and Wildlife Service
Address:	Red Bluff Fish & Wildlife Office, 10950 Tyler Road
City, State, Zip Code:	Red Bluff, CA 96080
Phone Number:	530-527-3043 x227
Email Address:	Brenda_Olson@fws.gov

II. Project Description

Project Name:	Antelope Creek Tehama Wildlife Area Paynes Crossing (fish passage)
Reference No. or New:	NS-5
Project Location:	CDFG Tehama Wildlife Area, Paynes (or Middle Slab) crossing, Ishi Road. lat 40.231639, long -121.885691. Approximate elevation, 1290 ft.

Project Description:

The current road crossing is made of grate metal. The stream bed on the downstream side of the structure has downcut. Large boulders have been placed in the past to break up the velocity but that also filled in pools that spring Chinook may have used to get up and over the structure during low water years. In addition, the substrate that once filled in the grate is being washed out so juveniles moving out of the system get strained through the structure. This structure is a partial barrier, in that adults can navigate above it during high flows.

This project will build a bridge to replace the current structure. This will allow natural stream function in passage of fish, bedload, and localized narrowing of the channel where it has been impacted from the crossing impounding

II. Project Description

water/flow.

The AFRP funded environmental compliance, permitting, and engineered design in 2008. This project will be complete in 2009. Construction could begin as early as 2010. As part of the analysis, several different alternatives were looked at, however a bridge was the best option for fish, stream function, and human safety.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead in your watershed. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☒ **Channel Form**	Below Edwards dam, Antelope Creek divides into many different channels. The water is divided into these channels, thereby stranding juvenile salmonids, and possibly delaying migration of adults, in low water years. When Antelope Creek overflows into New Creek at the Edwards diversion dam, the water drains into another stream, Salt Creek. This multi-channel issue is identified in the 2001 Final AFRP Restoration Plan as an Evaluation needing to be completed.	Critical
☐ **Channel Unit Types**		Select Rank
☐ **Substrate**		Select Rank
☐ **Structure**		Select Rank
☒ **Flow**	Flow is an issue downstream of the Edwards dam. In low water years the stream can be dry spring through fall. What additional water rights occur downstream of the Edwards dam is unknown.	Critical
☒ **Temperature**	The temperature limiting factor is related to flow. Temperatures become lethal in the valley floor once the air temperature rises and flow is diverted.	High
☐ **Water Quality**		Select Rank
☒ **Passage**	Adult passage is affected by the multiple channels in the lower section, the amount of flow diverted at Edwards dam, and the partial barrier in the CDFG Tehama Wildlife Area. In addition, juvenile passage is affected by the current crossing structure in the Tehama Wildlife Area, the lack of a bypass from the two diversion canals at Edwards dam, and the multiple channels below Edwards dam.	Critical
☐ **Riparian/Floodplain**		Select Rank

Source Documents:

Additional Notes:

IV. Project Objectives—Environmental

In this section, describe how your project will affect one or more of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☒ **Channel Form**	By removing the current structure, and allowing natural bedload movement and the thalweg to establish, the channel will become narrower through the section just upstream of the structure. Currently the channel is relatively wide and slow moving during low flow.	Secondary
☐ **Channel Unit Types**		Select Focus
☐ **Substrate**		Select Focus
☐ **Structure**		Select Focus
☐ **Flow**		Select Focus
☐ **Temperature**		Select Focus
☐ **Water Quality**		Select Focus
☒ **Passage**	Removing the current structure and replacing the crossing with a bridge will allow passage at all flows and natural stream function. Adults will be able to access suitable holding and spawning habitat, increasing their survival. Depending on water year, the crossing delays or prevents upstream passage of adult spring chinook, and also entrains juvenile outmigrants. The past two spring Chinook salmon surveys (2007 & 2008) have found most, if not all, below this crossing.	Primary
☐ **Riparian/Floodplain**		Select Focus

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon **Population Status Specific to Watershed:** Decreasing

Target Life Stages:

☐ Spawning ☐ Egg Incubation ☐ Summer Rearing ☐ Winter Rearing

☒ Juvenile Emigration ☒ Adult Immigration ☐ Adult Holding

Description of Project Objectives:

The objective is to remove the partial passage impediment and allow free passage of adult and juvenile spring Chinook salmon at all flows. This will allow the adults to access suitable holding and spawning habitat which will

V. Project Objectives—Biological

increase their survival.

Target Species: ☐ Steelhead

Population Status Specific to Watershed: Relative to Historical

Target Life Stages:

☐ Spawning ☐ Egg Incubation ☐ Summer Rearing ☐ Winter Rearing

☐ Juvenile Emigration ☐ Adult Immigration

Description of Project Objectives:

VI. Project Cost

Capital Cost:	It is estimated that the total construction cost will be around $700,000. Due to the remote location, mobilization costs may be high. In addition, finding a suitable borrow pit for bridge approaches may be spendy if material needs to be hauled any distance. Currently, there is no suitable borrow pit identified.
Annual Operation and Maintenance Cost:	
Annual Operation and Maintenance Description:	
Project Lifespan:	50+ years
Project Partners (Funding):	USFWS - AFRP has funded the environmental documentation, permitting, and engineered design - $98,000.
Project Partners (Maintenance):	CDFG

VII. Schedule

Proposed Start:	2010
Expected Time to Completion:	2010, one work season
Expected Time to Realize Environmental Benefits:	immediately
Expected Time to Realize Biological Benefits:	immediately

VIII. Feasibility

Technical Feasibility:	Nothing has been identified to date that would preclude building a bridge.
Technical Challenges:	Remote location, depending on bridge dimensions some road work may need to occur (widening a few curves).
Related Projects:	There is a project downstream that is addressing non-existant juvenile bypasses on 2 currently screened diversions.
Ownership or Permitting Challenges:	Ownership is CDFG, fully supportive of the project.
Conflicts with Cultural, Zoning, or Other Issues:	None identified at this point.

IX. Project Support

Supporting Entities:	USFWS-AFRP, CDFG, NMFS
Cooperating Entities:	CDFG, USFWS, NMFS
Degree of Local Support:	High
Known Opposition:	None

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

Environmental documents, permits, and designs should be done by late summer/early fall. Available upon request.

USFWS. 2008. Internal document of Limiting Factors developed for 10 year CVPIA Implementation Strategy.

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased "flashiness," and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Never Present

The species has never been known to occur in the watershed.

Appendix D3

Questionnaires Received on the Big Chico Creek Action

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

DUE: Thursday, April 30, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

Name:	Tracy McReynolds
Organization:	CA. Dept. of Fish and Game
Address:	2545 Zanella Wy. Suite F
City, State, Zip Code:	Chico, CA 95928
Phone Number:	(530) 895-5111
Email Address:	tmcreynolds@dfg.ca.gov

II. Project Description

Project Name:	Iron Canyon Fish Ladder Rehabilitation Project
Reference No. or New:	NS-13
Project Location:	The Iron Canyon Fish Ladder is located in Iron Canyon, Upper Bidwell Park, on Big Chico Creek, northeast of Chico, CA, in Butte County. The site is located near the Salmon Hole and Parking Lot P areas of Upper Bidwell Park, accessible from Upper Park Road, a gravel road that roughly parallels the creek, in T22N, R2E, and undesignated section of Arroyo Chico Land Grant.

Project Description:

A massive landslide in the early 1900's blocked spring-run Chinook and steelhead access to holding and spawning habitat above Iron Canyon. In 1958 the California Department of Fish and Game (DFG) constructed the Iron Canyon Fish Ladder to provide access through the blocked area to the nine miles of habitat above Iron Canyon. The ladder is now 50 years old and damage has made fish passage at low flows extremely difficult or impossible.

II. Project Description

The proposed project would repair existing weirs, expand and modify existing weirs, and install 6 new weirs at the Iron Canyon Fish Ladder (CSU, Chico Research Foundation 2008). The specific construction involves:

• Pool deepening, at minimum of 0.1 feet to 2.1 feet. Excavation of pool sidewalls will be necessary, with large boulder-sized blocks potentially requiring partial or complete removal. Jack-hammer and/or drilling may be necessary for the large block removal. Excavated material does not require removal from the site and may be disposed of in adjacent, non-fishway pools.

• Partial demolition of 18 existing weirs (Weirs 1 through 6, 6B, and 7 through 17). These weirs will then be encased in new reinforced concrete.

• At the contractor's discretion, existing weirs may also be entirely demolished and replaced with new weir design, rather than encased.

• Installation of 6 new weirs (Weirs 1B, 5B, 7B, 8B, 8C, and 11B) constructed with reinforced concrete.

• Installation of fabricated aluminum flashboards into finished weir slots.

The purpose of the project is to improve adult spring-run Chinook and steelhead passage to holding and spawning habitat above Iron Canyon over a broader range of flows.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead in your watershed. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☐ **Channel Form**		Select Rank
☐ **Channel Unit Types**		Select Rank
☐ **Substrate**		Select Rank
☐ **Structure**		Select Rank
☒ **Flow**	Agricultural diversions in the Valley reach reduce flows impeding both upstream and downstream passage.	High
☒ **Temperature**	Reduced flows in the Valley reach increase water temperatures and can impact juvenile rearing conditions.	High
☐ **Water Quality**		Select Rank
☒ **Passage**	The lower reaches have flood control structures and diversions that impede upstream passage when flow is low.	High
☒ **Riparian/Floodplain**	Flood control measures and land use (agricultural and urban) have degraded riperian habitats in the lower reaches	High

Source Documents:

Big Chico Creek Watershed Alliance. Big Chico Creek Existing Conditions Report. Publication date unknown.

Available from http://www.bigchicocreek.org.

Additional Notes:

IV. Project Objectives—Environmental

In this section, describe how your project will affect one or more of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☐ **Channel Form**		Select Focus
☐ **Channel Unit Types**		Select Focus
☐ **Substrate**		Select Focus
☐ **Structure**		Select Focus
☐ **Flow**		Select Focus
☐ **Temperature**		Select Focus
☐ **Water Quality**		Select Focus
☒ **Passage**	The modification will allow the Iron Canyon Fish Ladder to function effectively at flows >= 100cfs. The objective is to improve flow through the fish ladder to facilitate the upstream passage of spring-run Chinook and steelhead over a broader range of flows (HDR and SAGE 2006).	Primary
☐ **Riparian/Floodplain**		Select Focus

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon

Population Status Specific to Watershed: Relative to Historical

Target Life Stages:

☒ Spawning ☐ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☒ Adult Immigration ☒ Adult Holding

Description of Project Objectives:

In recent years, the estimated escapement of spring-run Chinook has been less than 200 however past estimates by DFG suggest that Big Chico Creek could support 1000 spring-run Chinook. Repairing the fish ladder would improve spring-run Chinook access to the existing habitat over a broader range of flows thereby increasing escapement in more years. Therefore, one purpose of this project is to increase escapement of spring-run Chinook in Big Chico Creek by improving upstream passage to summer holding, spawning and rearing habitat.

V. Project Objectives—Biological

Target Species: ☒ Steelhead

Population Status Specific to Watershed: Relative to Historical

Target Life Stages:

☒ Spawning ☐ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☒ Adult Immigration

Description of Project Objectives:

Steelhead escapement to Big Chico Creek is currently unknown but historically steelhead were observed in Big Chico Creek. Improvements to the fish ladder would improve access to spawning and juvenile rearing habitat. Therefore another purpose of this project is to increase escapement of steelhead in Big Chico Creek by improving upstream passage to spawning and rearing habitat.

VI. Project Cost

Capital Cost: $1,727,151 (HDR 2007)

Annual Operation and Maintenance Cost: Unknown

Annual Operation and Maintenance Description: Removing accumulated debris and sediment from pools, installing/uninstalling flashboards, and monitoring movement or deterioration (HDR and SAGE 2006).

Project Lifespan: The estimated lifespan of the ladder is 50 years (HDR and SAGE 2006).

Project Partners (Funding): USFWS-AFRP (design and environmental compliance).

Project Partners (Maintenance): DFG (for basic O&M only).

VII. Schedule

Proposed Start: Once permits and funding are secured (possibly June 2010).

Expected Time to Completion: One work season (June-September)

Expected Time to Realize Environmental Benefits: Immediate

Expected Time to Realize Biological Benefits: Immediate

VIII. Feasibility

Technical Feasibility:	An evaluation of Iron Canyon for the USFWS was conducted in 2006. Based on the results there was nothing identified geologically, seismically, structurally, or hydraulically to preclude construction of the ladder (HDR and SAGE 2006).
Technical Challenges:	The work site is located in a steep-walled canyon so site access poses a challenge. There is also a low to moderate risk of a block topple or slide and/or compression failure of sections of the canyon walls. These challenges were addressed in the 2006 evaluation of Iron Canyon.
Related Projects:	There are numerous restoration project on-going in Big Chico Creek to address passage issues with agricultural diversions and flood control stuctures in the lower portion of the watershed. In addition, a portion of the habitat upstream of Iron Canyon is protected by the Big Chico Creek Ecological Reserve owned by the California State University, Chico Research Foundation.
Ownership or Permitting Challenges:	The property is owned by the City of Chico. The City of Chico intends to adopt a Mitigated Negative Declaration for the project. No permitting challenges are identified at this time.
Conflicts with Cultural, Zoning, or Other Issues:	None identified at this time. There are some culutral concerns with cumulative impacts of projects within Big Chico Creek that are expected to be resolved.

IX. Project Support

Supporting Entities:	Big Chico Creek Watershed Alliance (BCCWA) and CSU Chico Research Foundation.
Cooperating Entities:	USFWS, DFG, and City of Chico.
Degree of Local Support:	High at this time.
Known Opposition:	None identified at this time.

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

CSU, Chico Research Foundation (2008). Iron Canyon Fish Ladder Rehabilitation Initial study/Mitigated Negative Declaration. SCH No. Pending. Prepared for CSU, Chico Research Foundation, USFWS, and City of Chico. August 4, 2008. Chico, CA.

HDR (2007). USFWS - Iron Canyon Fish Ladder Project Construction Documents Project Manual. Prepared for USFWS. June 2007. Folsom, CA.

HDR and SAGE (2006). Evaluation of Iron Canyon for Proposed Fish Ladder Structure Repair and Construction Final Report. Prepared for USFWS Chico, CA. May 2006.

X. Supporting Documents

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased "flashiness," and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Never Present

The species has never been known to occur in the watershed.

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

DUE: Thursday, April 30, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

Name:	Susan Strachan
Organization:	CSU, Chico Research Foundtion
Address:	Bldg 25, CSU Chico
City, State, Zip Code:	Chico, CA 95928-0870
Phone Number:	530-894-1308
Email Address:	sstrachan@csuchico.edu

II. Project Description

Project Name:	Iron Can yon Fish Ladder Rehabilitation
Reference No. or New:	New
Project Location:	Iron Canyo, Big Chico Creek, Chico, Butte County

Project Description:

Rehabilitate existing weirs and install new weirs to provide consistent access to holding and spawning habitat at low to moderate flows.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead in your watershed. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☐ **Channel Form**		Select Rank
☐ **Channel Unit Types**		Select Rank
☐ **Substrate**		Select Rank
☐ **Structure**		Select Rank
☐ **Flow**		Select Rank
☒ **Temperature**	Temperature below Iron Canyon lethal.	High
☐ **Water Quality**		Select Rank
☒ **Passage**	Iron Canyon boulders obstruct adult passage in low to moderate flow years. Flood control structures can affect adult and juvenile passage.	High
☒ **Riparian/Floodplain**	Urban land use, agricultural land use and flood control modifications have degraded riparian habitat in valley reaches.	Medium

Source Documents:

Big Chico Creek Watershed Alliance, undated.

Additional Notes:

IV. Project Objectives—Environmental

In this section, describe how your project will affect one or more of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☐ **Channel Form**		Select Focus
☐ **Channel Unit Types**		Select Focus
☐ **Substrate**		Select Focus
☐ **Structure**		Select Focus
☐ **Flow**		Select Focus
☐ **Temperature**		Select Focus
☐ **Water Quality**		Select Focus
☒ **Passage**	Project will restore adult passage at low and moderate flows to reach	Primary

IV. Project Objectives—Environmental

holding, spawning and rearing habitat.

☐ **Riparian/Floodplain** Select Focus

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon **Population Status Specific to Watershed:** Intermittent

Target Life Stages:

☒ Spawning ☐ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☒ Adult Immigration ☒ Adult Holding

Description of Project Objectives:

The estimated escapement of spring-run Chinook is highly variable, ranging from 0 in low flow years to almost 400 in high flow years. Repairing the fish ladder would improve spring-run Chinook access to the existing habitat over a broader range of flows thereby increasing escapement in more years. Therefore one purpose of this project is to increase escapement of spring-run Chinook in Big Chico Creek by improving upstream passage to summer holding, spawning and rearing habitat.

Target Species: ☒ Steelhead **Population Status Specific to Watershed:** Intermittent

Target Life Stages:

☒ Spawning ☐ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☐ Juvenile Emigration ☒ Adult Immigration

Description of Project Objectives:

Steelhead escapement to Big Chico Creek is currently unknown but historically steelhead were observed in Big Chico Creek. Improvements to the fish ladder would improve access to spawning and juvenile rearing habitat. Therefore another purpose of this project is to increase escapement of steelhead in Big Chico Creek by improving upstream passage to spawning and rearing habitat.

VI. Project Cost

Capital Cost:	$2,114,218 (HDR, 2007, adjusted for 2010 construction costs, grant administration, public outreach and extended construction period for concrete curing)
Annual Operation and Maintenance Cost:	unknown

VI. Project Cost

Annual Operation and Maintenance Description:	Routine operation and maintenance will include inspection, removal of debris, adjustment of flow where possible and small repair such as patching walls where broken or damaged, and other minor repairs necessary to keep fish moving through the ladder (DFG, personal communication)
Project Lifespan:	50 years (HDR and Sage, 2006)
Project Partners (Funding):	USFWS-AFRP (design and environmental compliance)
Project Partners (Maintenance):	DFG (routine operation and maintenance as described above)

VII. Schedule

Proposed Start:	Bid package fall, 2009, award April 2010, mobilize June 1, 2010
Expected Time to Completion:	Complete in channel October 15, 2010, site restoration and contract complete Decemer, 2010
Expected Time to Realize Environmental Benefits:	Spring, 2011
Expected Time to Realize Biological Benefits:	Spring, 2011

VIII. Feasibility

Technical Feasibility:	Project selected by agency technical team as preferred alternative (Department of Water Resources, 2002). An evaluation of Iron Canyon for the USFWS was conducted in 2006. Based on the results there was nothing identified geologically, seismically, structurally, or hydraulically to preclude construction of the ladder (HDR and SAGE, 2006).
Technical Challenges:	The work site is located in a steep-walled canyon so site access poses a challenge. There is also a low to moderate risk of a block topple or slide and/or compression failure of sections of the canyon walls. These challenges were addressed in the 2006 evaluation of Iron Canyon.
Related Projects:	Agricultural pumps were moved from mouth of Big Chico to Sacramento River to protect juvenile outmigration. Inflatable dam installed at 1-Mile on Big Chico Creek that can be adjusted to improve passage for spring run and steelhead. Ecological Reserve established that protects 4,000 acres of watershed and 4.5 miles of spring run stream habitat.
Ownership or Permitting Challenges:	CEQA complete. Permitting underway, expected to be complete by fall, 2009.
Conflicts with Cultural, Zoning, or Other Issues:	Cultural resources survey documented no cultural conflicts. Project is consistent with City of Chico planning documents.

IX. Project Support

Supporting Entities:	City of Chico, CSU, Chico Research Foundation, Big Chico Creek Watershed Alliance
Cooperating Entities:	DFG, USFWS, NMFS
Degree of Local Support:	High
Known Opposition:	None

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

All documents except construction specifications can be found at http://www.bigchicocreek.org/nodes/aboutwatershed/projectsprograms/iron_canyon_fish_ladder.htm

Big Chico Creek Watershed Alliance, undated. Existing Conditions Report. Chico, CA. Undated.

Department of Water Resources (2002). Iron Canyon and Bear Hole Fish Passage Project on Big Chico Creek, Preliminary Engineering Technical Report. Sacramento, CA. April 2002.

HDR (2007). USFWS - Iron Canyon Fish Ladder Project Construction Documents Project Manual. Prepared for USFWS. June 2007. Folsom, CA.

HDR and SAGE (2006). Evaluation of Iron Canyon for Proposed Fish Ladder Structure Repair and Construction Final Report. Prepared for USFWS Chico, CA. May 2006.

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased “flashiness,” and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Never Present

The species has never been known to occur in the watershed.

Appendix D4

Questionnaire Received on the Battle Creek Actions

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

DUE: Friday, February 13, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

Name:	Mike Berry
Organization:	California Department of Fish and Game
Address:	601 Locust Street
City, State, Zip Code:	Redding, CA 96001
Phone Number:	530-225-2131
Email Address:	mberry@dfg.ca.gov

II. Project Description

Project Name:	Battle Creek Restoration Project
Reference No. or New:	B-1 and B-2.
Project Location:	Tehama County, approximately 2 miles South of the town of Manton

Project Description:

Financial support of implementation of Phase 1(b) of the Battle Creek Restoration Project. Phase 1(b) includes a new tailrace connector from Inskip powerhouse to Coleman Canal and a water bypass channel near Inskip Powerhouse. This phase potentially includes removal of Coleman Diversion Dam, depending on the timing of the completion of Phase 2. The project also includes financial support of implementation of Phase 2 of the Battle Creek Restoration Project. Phase 2 includes removing Coleman Diversion Dam (if not completed in Phase1(b)), South, Lower Ripley Creek Feeder, and Soap Creek Feeder Diversion Dams; installing screens and ladders on Inskip Diversion Dam; a tailrace connector from South Powerhouse to Inskip Canal and decommisioning South Canal.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead in your watershed. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☐ **Channel Form**		Select Rank
☐ **Channel Unit Types**		Select Rank
☐ **Substrate**		Select Rank
☐ **Structure**		Select Rank
☒ **Flow**	The flow in South Fork Battle Creek is reduced to 3-5 cubic feet per second (cfs) due to diversions for hydro-power, thus severely limiting habitat for all life stages of spring-run Chinook salmon and steelhead.	Critical
☒ **Temperature**	Because of the reduced flow, water temperatures increase to levels lethal to all life stages of spring-run Chinook salmon and steelhead	High
☐ **Water Quality**		Select Rank
☒ **Passage**	The diversion dams have ladders that are to small or are in poor condition and therefore block spring-run Chinook salmon and steelhead access to approximately 16.3 miles of prime habitat.	Critical
☐ **Riparian/Floodplain**		Select Rank

Source Documents:

Battle Creek Restoration Project EIS/EIR (2005), Battle Creek Salmon and Steelhead Restoration Plan (1999).

Additional Notes:

IV. Project Objectives—Environmental

In this section, describe how your project will affect one or more of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☐ **Channel Form**		Select Focus
☐ **Channel Unit Types**		Select Focus
☐ **Substrate**		Select Focus
☐ **Structure**		Select Focus
☒ **Flow**	When the project is completed flow will be increased downstream of Inskip Diversion Dam from the current 3-5 cfs up to 35-40 cfs. Upstream of Inskip Diversion Dam the flows will increase to natural	Primary

IV. Project Objectives—Environmental

	flows because South Diversion Dam will have been removed.	
☒ **Temperature**	The increased flow will lower the temperatures in Battle Creek to levels capable of supporting all life stages of spring-run Chinook salmon and steelhead, including incubation of eggs.	Primary
☐ **Water Quality**		Select Focus
☒ **Passage**	Removal of two dams and a new fish ladder at Inskip Diversion Dam will allow access to 16.3 miles of prime spring-run Chinook and steelhead habitat that has not been used since the early 1900's when the hydro-electric projects were first built. Construction of a State and federally approved fish screen will allow safe passage of emmigrating juveniles passed the diversion canal.	Primary
☒ **Riparian/Floodplain**	The increased flow and additional nutrients from decaying salmon carcasses will likely result in healthier riparian forest/vegetation.	Secondary

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon **Population Status Specific to Watershed:** Extirpated

Target Life Stages:

☒ Spawning ☒ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☒ Juvenile Emigration ☒ Adult Immigration ☒ Adult Holding

Description of Project Objectives:

In the early 1900's several dams were built on Battle Creek as part of a hydro-electric power production project. The dams on South Fork Battle Creek diverted a majority of the water out of this tributary and blocked passage of adult spring-run Chinook salmon. Completing Phase 1(b) and Phase 2 of the project will restore water flow, temperature, and spring-run Chinook salmon access to16.3 miles of prime historic spring-run Chinook salmon habitat. Additionally the project will restore optimum water temperatures for egg incubation, juvenile rearing, and outmigrating smolts while screening the diversion will prevent emegrating juveniles from being drawn into the canal.

Target Species: ☒ Steelhead **Population Status Specific to Watershed:** Intermittent

Target Life Stages:

☒ Spawning ☒ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☒ Juvenile Emigration ☒ Adult Immigration

Description of Project Objectives:

[Same as Above for Spring-Run Chinook Salmon]

VI. Project Cost

Capital Cost:	Phase 1(b) cost estimate is $26 million, Phase 2 cost estimate is $47 million, we are recommending approximately $30 million of HEA money that will be matched with other funds.
Annual Operation and Maintenance Cost:	Not estimated
Annual Operation and Maintenance Description:	Not estimated
Project Lifespan:	Perpetuity
Project Partners (Funding):	Possibly California Department of Fish and Game (CDFG), California Wildlife Conservation Board (WCB), California Department of Water Resources (DWR), Pacific Gas and Electric Company (PG&E), and/or Bureau of Reclamation (Reclamation).
Project Partners (Maintenance):	PG&E will own and maintain all of the improvements and related hydro-power facilities, and have agreed to maintain them in working order.

VII. Schedule

Proposed Start:	Summer 2010
Expected Time to Completion:	2-4 years
Expected Time to Realize Environmental Benefits:	Immediately after completion.
Expected Time to Realize Biological Benefits:	First winter and spring after completion, full benefit after a few generations of returning Chinook salmon and steelhead. Spring-run Chinook salmon and steelhead are present in the drainage downstream of the dam, and are expected to occupy the newly opened habitat during their first adult migration event after completion.

VIII. Feasibility

Technical Feasibility:	This project is very feasable, the feasability studies are complete, engineering and design is complete and the various environmental documents are complete.
Technical Challenges:	None that have not been identified and adequately addressed.
Related Projects:	North Fork Battle Creek restoration is scheduled to start in the Summer of 2009 (Phase 1(a)) and will provide access and suitable habitat for spring-run Chinook salmon and steelhead to 11 miles of North Fork Battle Creek.
Ownership or Permitting Challenges:	There is one landowner near Inskip Dam that is unhappy with various aspects of the project. PG&E continues to work with them to resolve the issues.

VIII. Feasibility

Conflicts with Cultural, Zoning, or Other Issues:	None known

IX. Project Support

Supporting Entities:	DWR, Regional Water Quality Control Board, State Water Resources Control Board, The Nature Conservancy, Metropolitan Water District, Battle Creek Watershed Conservancy, Nor-Cal Fishing Guides and Sportsman Assn., U.S. Forest Service, Lassen National Forest
Cooperating Entities:	CDFG, PG&E, Reclamation, U.S. Fish and Wildlife Service, NOAA Fisheries.
Degree of Local Support:	High
Known Opposition:	Oasis Springs Lodge

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

Kier Associates. 1999. Battle Creek Salmon and Steelhead Restoration Plan. Prepared for the Greater Battle Creek Watershed Working Group. January. Sausalito, CA.

Jones and Stokes. 2005. Battle Creek Salmon and Steelhead Restoration Project Final Environmental Impact Statement/Environmental Report. July. Sacramento, CA.

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased "flashiness," and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Appendix E

Central Valley Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin Background Report

STATE OF CALIFORNIA
THE NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF ENVIRONMENTAL SERVICES

CENTRAL VALLEY SPRING-RUN CHINOOK SALMON AND STEELHEAD IN THE SACRAMENTO RIVER BASIN BACKGROUND REPORT

November 2009

Arnold Schwarzenegger **Governor** **State of California**	**Mike Chrisman** **Secretary for Resources** **The Natural Resources Agency**	**Lester A. Snow** **Director** **Department of Water Resources**

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Table of Contents

List of Tables and Figures

List of Acronyms

AFRP	Anadromous Fish Restoration Program
AROG	American River Operations Work Group
BCWC	Butte Creek Watershed Conservancy
CCWG	Cottonwood Creek Watershed Group
CCWMP	Cow Creek Watershed Management Program
CDFG	California Department of Fish and Game
CNFH	Coleman National Fish Hatchery
CSU	California State University
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DCID	Deer Creek Irrigation District
DCWC	Deer Creek Watershed Conservancy
Delta	Sacramento-San Joaquin Delta
DIDSON	dual-frequency identification sonar
DWR	California Department of Water Resources
ERP	Ecosystem Restoration Program
ESA	federal Endangered Species Act
ESU	environmentally significant unit
EWP	Environmental Water Program
FERC	Federal Energy Regulatory Commission
FERC Project 2100	Pacific Gas and Electric Company's Oroville Facilities Project
FERC Project 2105	Pacific Gas and Electric Company's Upper North Fork Feather River Project
FERC Project 2107	Pacific Gas and Electric Company's Poe Project
FISH	Fisheries and Instream Habitat
Forest Service	U. S. Department of Agriculture Forest Service
GCID	Glenn-Colusa Irrigation District

GIS	geographic information systems
HEA	Habitat Expansion Agreement
IFIM	instream flow incremental methodology
km	kilometer(s)
LMMWC	Los Molinos Mutual Water Company
MOU	Memorandum of Understanding
NMFS	U. S. Department of Commerce, National Marine Fisheries Service
PG&E	Pacific Gas and Electric Company
PVA	population viability assessment
RCMP	River Corridor Management Plan
Reclamation	U. S. Bureau of Reclamation
Restoration Project	Battle Creek Salmon and Steelhead Restoration Project
RM	River Mile
State Water Board	California State Water Resources Control Board
Study Team	Upper Yuba River Studies Program Study Team
SVRIC	Stanford-Vina Ranch Irrigation Company
USACE	U. S. Army Corps of Engineers
USFWS	U. S. Fish and Wildlife Service
VSP	viable salmonid population
WUA	weighted usable area
YOY	young of the year
Yuba Accord	Lower Yuba River Accord

Central Valley Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin Background Report

Introduction

Effective November 20, 2007, Pacific Gas and Electric Company (PG&E) and the California Department of Water Resources (DWR) entered into the Habitat Expansion Agreement (HEA) with the following parties: American Rivers, Arthur G. Baggett, Jr. (signing as a recommendation to the California State Water Resources Control Board [State Water Board]), California Department of Fish and Game (CDFG), U.S. Department of Agriculture Forest Service (Forest Service), U.S. Department of Commerce National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and State Water Contractors, Inc. Under the agreement, PG&E and DWR have 2 years to jointly identify, evaluate, and select the most promising and cost-effective action(s) to expand spawning, rearing, and adult holding habitat for spring-run Chinook salmon and steelhead in the Sacramento River basin, as an alternative to the Resource Agencies and other parties seeking project-specific fish passage prescriptions or license conditions in the New Project Licenses for PG&E's Upper North Fork Feather River Project (Federal Energy Regulatory Commission [FERC] Project No. 2105) and Poe Project (FERC Project No. 2107) and DWR's Oroville Facilities Project (FERC Project No. 2100).

The purpose of this *Central Valley Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin Background Report* (Background Report) is to provide background information on the status of spring-run Chinook salmon and Central Valley steelhead populations throughout watersheds in the Sacramento River basin. The information synthesized in the report will be used to support PG&E and DWR in identifying, evaluating, and selecting potential habitat expansion actions, to fulfill their obligations under the HEA.

Central Valley Spring-Run Chinook Salmon

Listing Status

In 1999, NMFS listed the Central Valley spring-run Chinook salmon evolutionarily significant unit (ESU) as threatened under the federal Endangered Species Act (ESA) (NMFS 1999). The Central Valley ESU includes all naturally spawned populations in the Sacramento River, tributaries of the Sacramento River, and the Feather River (DWR 2007). In 2005, NMFS published a final listing determination for Central Valley spring-run that added Feather River Hatchery spring-run to the designation (DWR 2007). In 2005, NMFS published the final designation of critical habitat, which includes the Sacramento, lower Feather, and Yuba Rivers; and Beegum, Battle, Clear, Cottonwood, Antelope, Mill, Deer, Butte, and Big Chico Creeks (DWR 2007).

General Life History

Central Valley spring-run Chinook salmon generally leave the ocean and enter the Sacramento River from March to July as immature fish. Once they arrive at the spawning grounds, spring-run adults mature over the summer and spawn between late August and early October (NMFS 2002). Historically, spring-run adults ascended to higher elevation reaches to avoid excessive summer temperatures during this holding period (Healey 1991). Spring-run Chinook spawn in gravel beds located at the tails of holding pools (USFWS 1995). The eggs are deposited in the gravel, where incubation, hatching, and emergence occur.

The emergence of spring-run fry occurs from November to March, depending on water temperatures (CDFG 1998). Central Valley spring-run Chinook exhibit both of the freshwater life history types described by Healey (1991). The *stream-type* Chinook reside in freshwater for a year or more following emergence, and the *ocean-type* Chinook salmon migrate to the ocean within their first year. The fry use shallow, nearshore areas with slow current and good cover (CDFG 1998).

Higher elevation streams such as Mill and Deer Creeks generally have a higher proportion of spring-run exhibiting the stream-type life history. The proportion varies annually depending on stream conditions (Harvey-Arrison pers. comm.). These juveniles spend 9 to 10 months in their natal streams and up to 18 months in freshwater (USFWS 1995, CDFG 1998). In lower elevation streams such as Butte Creek, the juveniles exhibit more of an ocean-type life history with a higher proportion of the production leaving the tributaries from December to February (CDFG 2000). These young-of-the-year (YOY) Chinook may rear in the bypasses, the lower Sacramento River, and the Sacramento-San Joaquin River Delta (Delta) until ready to enter the ocean. CDFG conducted a life history investigation on Butte Creek from 1995 to 2003 and found that spring-run that emigrated from the creek as yearlings contributed greatly to the ocean harvest rate, suggesting that yearlings survive at higher rates than YOY (CDFG 2004b).

In general, Chinook salmon spend between 1 and 4 years in the ocean before returning to spawn (Myers et al. 1998). Fisher (1994) estimated that 87% of spring-run Chinook return as 3-year-olds based on data collected at Red Bluff Diversion Dam. In another study, Cramer and Demko (1997) estimated that 80 to 90% of the spring-run smolts from the Feather River Hatchery matured at age 4 and that 85% of those fish were harvested by the time they reached age 4. Based on data from the life history investigation, CDFG found that age 4 fish can make up a high percentage of the escapement in some years, ranging from 44 to 89% (CDFG 2004a). These numbers were calculated using coded-wire tag data that were standardized for release size.

Historical Distribution

Yoshiyama et al. (2001) provided a narrative description of the historical distributional limits and abundances of Chinook within the Central Valley watersheds. Schick et al. (2005) expanded on this work using a geographic information system (GIS) to add more explicit spatial information. They grouped spring-run into four diversity units: (1) upper Sacramento spring-fed (Little Sacramento, Pit, Fall, Hat, McCloud, Battle, Mill, and Deer Creeks); (2) upper Sacramento rain driven (Butte, Big Chico, Antelope, Clear, Cottonwood/Beegum, Thomes, and Stony Creeks); (3) lower Sacramento-San Joaquin northern Sierra (Feather, Yuba, and American Rivers); and (4) lower Sacramento-San Joaquin southern Sierra (Mokelumne, Stanislaus, Tuolumne, Merced, San Joaquin, and Kings Rivers).

Lindley et al. (2007) divided spring-run into slightly different diversity units: (1) basalt and porous lava (Little Sacramento, Pit, Fall, Hat, McCloud and Battle Creeks); (2) Northern Sierra Nevada (Mill, Deer, Antelope, Butte, and Big Chico creeks and Feather, Yuba, American, and Mokelumne Rivers; (3) Northwestern California (Clear, Cottonwood/ Beegum, Thomes, and Stony Creeks); and (4) Southern Sierra Nevada (Stanislaus, Tuolumne, Merced, San Joaquin, and Kings Rivers).

This Background Report relies heavily on the historical distribution of spring-run and steelhead information presented in Yoshiyama et al. (2001) and Schick et al. (2005). Because the HEA specifies that the target of habitat expansion actions is the Sacramento River basin, this report addresses only the first three diversity units described by Schick et al. (2005).

In the upper Sacramento spring-fed unit, spring-run Chinook could have accessed approximately 43 kilometers (km) (27 miles) of habitat in the Pit River, 11.5 km (7 miles) in the Fall River, 3.5 km (2 miles) in Hat Creek, and 25 km (15.5 miles) in the McCloud River prior to the construction of Shasta Dam (Schick et al. 2005). The Pit River was a “noted salmon stream” in the late 1800s, but a substantial decline occurred prior to 1929 (Yoshiyama et al. 2001). Both the Fall River and Hat Creek are tributaries of the Pit River and were noted to support spring-run spawning, but not to the same extent as Pit River (Yoshiyama et al. 2001). Yoshiyama et al. (2001) noted that access to all of the tributaries was impeded by gold mining and irrigation activities prior to the construction of Shasta Dam.

For the tributaries below Shasta Dam, spring-run Chinook could have accessed approximately 26 km (16 miles) of habitat in Battle Creek (including both the North and South Forks), 25 km (15.5 miles) in Mill Creek, and 20.5 km (13 miles) in Deer Creek (Schick et al. 2005). All three of these tributaries naturally provided spatial separation between spring-run and fall-run (Yoshiyama et al. 2001). Reynolds et al. (1993) noted that surveys conducted prior to the construction of Shasta Dam indicated that Battle Creek could support 1,800 spawning pairs in the reaches above the Coleman National Fish Hatchery. By the 1920s, spawning reaches on both the North and South Forks were blocked by diversion dams associated with hydroelectric projects, which also altered streamflows. Clark (1929) noted that a small spring run still existed above the U.S. Bureau of Fisheries egg-collecting station and hatchery. By the 1980s, however, very few if any spring-run Chinook were observed in Battle Creek (Campbell and Moyle 1990). Spring-run Chinook have been observed in both Cow Creek and Bear Creek in low numbers (CH2M Hill 1998). Both creeks are predominantly rain fed and were probably used by spring-run only in years with above-normal rainfall (CH2M Hill 1998).

Mill Creek supported rather “large” runs of spring-run Chinook with few human-made obstacles, mainly diversion dams near the valley floor (Yoshiyama et al. 2001). Escapement ranged from <500 to 3,000 fish between 1947 and 1959 (Fry 1961). Overall, the trend was downward between the 1940s and the 1980s, from an annual average of 2,000 to about 300 fish (CDFG 1990).

Deer Creek also had a strong population of spring-run until diversion dams were built and reduced instream flows (Clark 1929). Habitat in Deer Creek was expanded by about 5 miles above Lower Deer Creek Falls in the early 1940s to mitigate for the construction of Shasta Dam (Needham et al. 1941). Deer Creek has adequate habitat to support a sustainable population of 4,000 spring-run but insufficient flows can impede or prevent upstream passage (Reynolds et al. 1993). Like Mill Creek, escapement ranged from <500 to 4,000 fish between 1940 and 1956 (Fry 1961). The escapement decreased between the 1940s and the 1990s from an average annual of 2,200 to 660 fish (Yoshiyama et al. 2001).

For the east side tributaries in the upper Sacramento rain-fed unit, spring-run Chinook had access to approximately 14.5 km (9 miles) of habitat in Antelope Creek, 29 km (18 miles) in Butte Creek, and 11 km (7 miles) in Big Chico Creek (Schick et al. 2005). Access and use of these tributaries have been limited by water diversions since the 1920s (Yoshiyama et al. 2001).

Antelope Creek historically supported a low number of spring-run Chinook with an estimated escapement of approximately 500 fish (Reynolds et al. 1993). Reynolds et al. (1993) noted that operations of two water diversions during the irrigation season impede or prevent the upstream migration of spring-run in most years. Big Chico Creek also supported low numbers of spring-run and was primarily used opportunistically (Reynolds et al. 1993). Reynolds et al. reported that the population was <500 during the 1950s and 1960s, and dropped to <200 fish in the 1990s. Butte Creek historically supported the largest population of the three tributaries but was heavily impacted by water diversions, dams, and weirs by the 1920s (Clark 1929). CDFG (1960) reported adults still being lost to unscreened diversions as late as 1958 to 1960. Extensive mining and hydroelectric development also reduced the amount of suitable habitat in the watershed (Hanson et al. 1940). Escapement ranged from <500 to 3,000 fish in the 1950s but dropped to 100 to 700 fish by the early 1990s (Fry 1961, CDFG 1998).

The west-side tributaries of the Sacramento River, including Clear Creek, Cottonwood/Beegum Creek, Thomes Creek, and Stony Creek, also provided some suitable habitat for spring-run (Yoshiyama et al. 2001). Clear Creek provided approximately 15 km (9 miles) of suitable habitat while Cottonwood Creek provided 10 km (6 miles) and Stony Creek 28 km (17 miles) (Schick et al. 2005). These creeks, along with a dozen other small tributaries, occasionally supported small runs of <500 fish (Fry 1961). Low flows associated with irrigation noticeably affected both passage and water temperatures for spring-run by the late 1920s (Clark 1929).

Three river systems in the lower Sacramento-San Joaquin Northern Sierra unit drain into the Sacramento River: the Feather, Yuba, and American Rivers. All three river drainages historically supported a substantial number of spring-run Chinook in their upper watersheds (Yoshiyama et al. 2001). Extensive mining, irrigation, and the development of hydroelectric dams significantly reduced the amount of suitable habitat in all three drainages (Yoshiyama et al. 2001). Schick et al. (2005) estimated approximately 114 km (71 miles) of suitable habitat for spring-run in the Feather River. Spring-run used all four major tributaries of the Feather River but primarily used the Middle Fork for spawning (CDFG 1952, Fry 1961, DWR 2007). Hydropower dams and other structures blocked much of the historical habitat prior to the construction of Oroville Dam in 1967, which formed a complete barrier for migration into the upper watershed.

The Yuba River contributed 19.5 km (12 miles) of habitat. Much of this habitat was seriously impacted by both diversion dams and mining activities starting in the late 1800s (Schick et al. 2005, Reynolds et al. 1993). Most of the available habitat was found on the North Fork, but the Middle and South Forks also were used by spring-run (Yoshiyama et al. 2001). Yoshiyama et al. (2001) noted that access to all forks was greatly impeded by Daguerre Point Dam around 1910 and was blocked completely with the completion of Englebright Dam in the late 1930s.

The American River contributed an additional 80.5 km (50 miles) of suitable habitat historically, but access to this habitat was impeded by construction of diversion dams and was completely blocked in 1955 by completion of Folsom and Nimbus Dams. Prior to completion of these dams, spring-run used all three forks of the American River. Spring-run likely used the North Fork up to the falls at

Royal Gorge, the Middle Fork up to the confluence with the Rubicon River, and the South Fork up to the waterfall at Eagle Rock (Yoshiyama et al. 1996).

Current Distribution

In the upper Sacramento spring-fed unit, spring-run Chinook no longer have access to the Pit River, the Fall River, Hat Creek, the McCloud River, or the Little Sacramento River due to construction of Shasta Dam (Schick et al. 2005). For the tributaries below Shasta Dam, spring-run Chinook access to Deer and Mill creeks remains essentially unchanged. However, much of the historical habitat on Battle Creek is no longer accessible (Schick et al. 2005). Approximately 2.9 km (2 miles) of habitat on the mainstem remains accessible, but access is blocked on both the North and South Forks.

For both the east-side and west-side tributaries of the Sacramento River in the upper Sacramento rain-fed unit, the amount of available habitat for spring-run Chinook remains essentially the same (Schick et al. 2005). However, access and use of these tributaries are limited by water diversions. Spring-run habitat on Stony Creek was blocked due to construction of Black Butte Reservoir and is no longer used by spring-run Chinook (Reynolds et al. 1993). In all of the other tributaries, except Butte Creek, only remnant spring-run populations remain (Yoshiyama et al. 2001). The Butte Creek population has been increasing over the last decade due to passage improvements made in the late 1990s (CDFG 2004b).

In the lower Sacramento-San Joaquin Northern Sierra unit, much of the historical habitat is blocked by dams. On the Feather River, only 35 km (22 miles) of habitat on the mainstem below Oroville Dam remains, and there is no spatial or temporal separation between spring-run and fall-run Chinook (Schick et al. 2005). This has resulted in the hybridization of the two runs from in-river spawning and past hatchery operations (Yoshiyama et al. 2001). However, an early-returning population persists within both the Feather and Yuba Rivers and is supported by Feather River Hatchery operations (Yoshiyama et al. 2001, DWR 2007, Lindley et al. 2007). On the Yuba River, most of the historical habitat was blocked by construction of Daguerre Point and Englebright Dams. Access to the North Yuba, Middle Yuba, and South Yuba Rivers is blocked, leaving about 12 km (7.5 miles) of spawning habitat on the lower Yuba River below Englebright Dam (Schick et al. 2005). The Yuba River has experienced the same problem with hybridization between spring-run and fall-run due to the lack of spatial and temporal separation (Yoshiyama et al. 2001). There is no suitable habitat for spring-run on the American River below Nimbus Dam.

Population Viability Assessment

In 2000, NMFS published a technical memo describing the viable salmonid population (VSP) concept and providing guidance for determining the conservation status of populations (McElhany et al. 2000). Lindley et al. (2007) built upon that work and developed a more quantitative framework for assessing the viability of Chinook and steelhead ESUs in the Central Valley.

McElhany et al. (2000) defined a viable salmonid population as an independent population that has a negligible risk of extinction over a 100-year time frame, where an independent population has one or more local breeding units whose dynamics are not substantially altered by exchanges of individuals with other populations. McElhany et al. used four parameters (abundance, population growth rate, population spatial structure, and diversity) to evaluate population viability status. The following discussion of the four parameters is drawn from their report.

According to the abundance VSP guidelines, a viable population size would meet the following criteria: (1) large enough to have a high probability of surviving environmental variation comparable to what has been observed in the past and expected in the future; (2) large enough for compensatory processes to provide resilience; (3) large enough to maintain genetic diversity over the long term; (4) large enough to provide important ecological functions throughout its life cycle; and (5) population estimates on average are above the population targets over a period of time. If the population size meets any of the following critical size guidelines, it cannot be considered viable: (1) depensatory processes are likely to reduce it below replacement; (2) risk of inbreeding or fixation of deleterious mutations; (3) high risk of productivity variation due to demographic stochasticity (population highly unpredictable); or (4) population estimates on average are below the population targets over a short period of time.

When estimates of population growth rates indicate that a population is consistently failing to replace, the risk of extinction is increased regardless of the cause. McElhany et al. (2000) focused on the population growth rate over the entire life cycle but noted that it is also important to estimate stage-specific productivity when evaluating population viability. Even if stage-specific declines do not result in a reduction in the total population, they may indicate a lack of resilience to variation. On the other hand, a viable population would meet the following population growth rate VSP guidelines: (1) natural productivity is sufficient to maintain abundance above the viable level (cohort-replacement rate ≥ 1); (2) if the population includes naturally spawning hatchery fish, the productivity of the naturally produced spawners is sufficient to maintain abundance at or above viability thresholds without the hatchery subsidy; (3) productivity is sufficient during freshwater life history to maintain a viable abundance even during poor ocean conditions; (4) does not exhibit sustained declines that span multiple generations and multiple brood-year cycles; (5) does not exhibit trends or shift in traits (i.e., the size and age of spawners) that portend declines in the growth rate; and (6) has an adequate time series of abundance to detect ecologically significant trends before substantial changes to abundance have occurred.

The spatial structure guidelines address both the geographic distribution of individuals and the processes that generate that distribution. Because a population's structure depends on habitat quality, spatial configuration, dynamics, and the dispersal characteristics of the individuals the VSP guidelines include (1) habitat patches that are not destroyed faster than they are naturally created; (2) natural straying rates among subpopulations is not be substantially increased or decreased by human actions; (3) some suitable or marginally suitable habitat patches that currently contain no fish are maintained; (4) source subpopulations are maintained; and (5) historical spatial processes are preserved as a default goal.

Diversity (i.e., variation in traits) within and among populations is important for population viability. Salmon traits such as anadromy, morphology, fecundity, run timing, spawn timing and behavior, juvenile behavior, age at smolting and maturity, egg size, developmental rate, ocean distribution, and genetic characteristics allow for considerable diversity. Nevertheless, any actions that affect basic demographic and evolutionary processes can affect a population's diversity. Diversity guidelines for a viable population include (1) variation in traits such as run timing, age structure, size, fecundity, morphology, behavior, and molecular genetic characteristics that are not substantially altered by human-caused factors; (2) natural processes of dispersal are maintained and human-caused factors do not substantially change the gene flow rate among populations; (3) natural processes that cause ecological variation are maintained; and (4) historical phenotypic diversity is used as a default goal in maintaining viable populations.

McElhany et al. (2000) also developed guidelines for assessing the viability of ESUs. The guidelines are (1) the ESU has multiple populations; (2) some populations are geographically widespread; (3) some populations are geographically close; (4) populations do not all share common catastrophic risks; (5) populations display diverse life histories and phenotypes; (6) some populations exceed VSP guidelines; and (7) historical number and distribution of populations are used as a default goal for maintaining viable ESUs.

Using a criteria-based assessment, Lindley et al. (2007) found that the Central Valley spring-run ESU is not viable because only a small portion of the historical ESU is represented and the remaining populations are vulnerable to catastrophic disturbance. However, those existing populations are at low risk of extinction. Lindley et al. (2007) identified four ecoregions within the ESU historically: (1) basalt and porous lava region; (2) northern Sierra Nevada region; (3) southern Sierra Nevada region; and (4) Northwestern California region. The only viable spring-run Chinook populations remaining are in the northern Sierra Nevada region (Butte, Mill, and Deer Creeks). This current distribution leaves the ESU vulnerable to catastrophic disturbances from volcanic activity (Mt. Lassen), drought, and wildfires.

Butte Creek and Deer Creek spring-run populations satisfied both the population viability assessment (PVA) and other viability criteria putting them at low risk of extinction while Mill Creek is at moderate risk of extinction based on the PVA but satisfies other viability criteria (Lindley et al. 2007). Some uncertainty remains about whether Mill and Deer Creek populations are independent or if they belong to a single larger population (Lindley et al. 2004). Lindley et al. (2007) also noted the presence of ephemeral or dependent populations in the Northwestern California region. Due to insufficient data, they were not able to assess the status of the early-returning Chinook within the Feather River Hatchery population that spawn in both the Feather and Yuba Rivers.

Viability assessments use conditions from the recent past to address whether a population will persist in the future. Future conditions are unlikely to be similar to the recent past, however, because of expected climatic changes. Lindley et al. (2007) noted that the criteria they proposed may not offer sufficient protection if a prolonged period of unfavorable climatic conditions occurs. Regional-scale climate models for California broadly agree that future temperatures will be warmer and that total precipitation may decline with a significant decline in snowfall. Given these changes, all Central Valley salmonids are likely to be negatively affected, especially those using freshwater in summer (Lindley et al. 2007). Lindley et al. noted that habitat availability will decrease as the lower distributional limit rises, given the current upper distributional limits due to dams.

Lindley et al. (2007) assessed three different scenarios for the potential increase in mean summer temperature by 2100 and its effect on the availability of historical habitat above the 25 °C isotherm. Under the most conservative increase of 2 °C, the loss of historical habitat would be low except for in the southern Sierra eco-region and in Butte Creek (Lindley et al. 2007). With a more likely increase of 5 °C, historical habitat loss would be significant with some remnant habitat in the upper reaches of the basalt and porous lava (Pit and McCloud Rivers) and the northern Sierra ecoregions (Battle and Mill Creeks, and Feather and Yuba Rivers). Under this scenario, most of the remaining habitat would be found on the Feather and Yuba Rivers. Lindley et al. (2007) also estimated that, under an 8 °C increase, spring-run habitat would be found only in the uppermost reaches of the North Fork Feather River, Battle Creek, and Mill Creek. Changes in hydrology are also are expected to impact Central Valley salmonids by reducing the quantity and quality of freshwater habitat.

Central Valley Steelhead

Listing Status

As noted, in 1998, NMFS listed the Central Valley steelhead ESU as threatened under the federal ESA (NMFS 1998). This ESU includes all naturally spawned populations of steelhead in the Sacramento and San Joaquin Rivers and their tributaries (NMFS 1998 as cited in DWR 2007). The original critical habitat designation was withdrawn, and NMFS published a final designation of critical habitat in 2005 (DWR 2007). The critical habitat designation includes the Sacramento, lower Feather, and Yuba Rivers; Battle, Cottonwood, Antelope, Mill, Deer, Butte, and Big Chico Creeks; and the Cosumnes, Mokelumne, Calaveras, and San Joaquin Rivers and tributaries to the San Joaquin (NMFS 2004).

General Life History

The life history of steelhead is more complex than other Pacific salmonids; steelhead exhibit both anadromous and freshwater resident traits. The freshwater residents are referred to as rainbow trout. Steelhead are divided into two basic reproductive ecotypes. Stream-maturing steelhead, also referred to as *summer steelhead*, are sexually immature upon freshwater entry and mature in the river over the summer (Busby et al. 1996). The ocean-maturing steelhead, or winter steelhead, enter freshwater with well developed gonads and spawn soon after reaching the spawning grounds. Unlike Chinook, steelhead are iteroparous (capable of spawning more than once), but they rarely spawn more than twice (Busby et al. 1996). Historically, both summer and winter steelhead were found in the Central Valley (Needham et al. 1941). Currently, only winter steelhead have been identified in the Central Valley (McEwan 2001).

Winter steelhead enter freshwater between August and April, and spawning occurs from December to May (Busby et al. 1996, NMFS 2002). In the Sacramento River basin, spawning generally peaks between January and March (NMFS 2002). Steelhead use cool, well oxygenated water with velocities ranging from 1 to 3.6 feet per second for spawning (McEwan 2001). The incubation time depends on water temperature, dissolved oxygen concentration, and substrate; fry generally emerge in late spring (NMFS 2002). The fry use shallow water along perennial streambanks, where they establish and defend feeding stations (Nickelson et al. 1992, McEwan 2001).

YOY steelhead primarily use higher velocity areas in pools for rearing but are also known to use glides and riffles (NMFS 2002). Juveniles use a wider range of habitat types but prefer areas with large and small woody debris and overhead cover (McEwan 2001, NMFS 2002). Older juveniles can also move downstream to rear in larger tributaries or rivers (Nickelson et al. 1992). The juveniles will reside in freshwater from 1 to 4 years and typically emigrate between February and April (NMFS 2002). Central Valley steelhead generally spend 1 to 2 years in the ocean before returning to spawn (Busby et al. 1996).

Recent studies have shown that Central Valley steelhead and rainbow trout are polymorphic, finding that anadromous females can produce non-anadromous progeny and non-anadromous females can produce anadromous progeny (McEwan 2001, Zimmerman et al. 2008). Research by Zimmerman et al. (2008) suggests that the portion of steelhead progeny may differ between location and years.

Historical Distribution

Information on the historical distribution of Central Valley steelhead is limited and not as well documented as for Central Valley Chinook salmon. McEwan (2001) provides evidence supporting the conclusion that steelhead distribution can be inferred from Chinook salmon distribution, especially spring-run Chinook salmon which has many of the same requirements for spawning and rearing. Yoshiyama et al. (1996) concluded that steelhead distribution was probably broader than Chinook salmon:

> *[Steelhead were] undoubtedly more extensively distributed [than Chinook salmon in the Central Valley]. Due to their superior jumping ability, the timing of their upstream migration, which coincided with the winter rainy season, and their less restrictive preferences for spawning gravels, steelhead could have used at least hundreds of miles of smaller tributaries not accessible to the earlier-spawning salmon.*

The available information indicates that steelhead used both the Sacramento River and San Joaquin River basins from the Pit River south to the Kings River (McEwan 2001). Like Chinook salmon, extensive mining, dams, and low flows impacted the distribution of steelhead starting in the late 1800s.

Lindley et al. (2006) reconstructed the historical distribution and population structure using models to predict the spatial location of stream locations and identifying suitable habitats within stream segments. They identified 81 independent populations of steelhead within four major subdivisions in the Central Valley ESU. The four subdivisions are (1) Sacramento River basin; (2) Suisun Bay area tributaries; (3) San Joaquin tributaries draining the Sierra Nevada; and (4) streams that drained to the Buena Vista and Tulare basins. Like McEwan (2001) and Yoshiyama et al. (1996) they found that *O. mykiss* was probably more abundant in the Sacramento basin than in the San Joaquin basin. The San Joaquin tributaries have steeper gradients and sometimes lower flow and therefore have more natural barriers to migration (Lindley et al. 2006).

This report focuses on the distribution of steelhead in the Sacramento River basin.

Current Distribution

The current distribution is limited in most areas due to impassable dams in the Central Valley. Reynolds et al. (1993) reported that approximately 95% of the historical habitat has been lost due to both mining and water development activities.

Because of limited steelhead monitoring efforts, the current distribution is not clearly known (McEwan 2001). Based on Chinook monitoring data collected by CDFG and USFWS, steelhead are still found in several upper Sacramento tributaries, including Clear, Antelope, Deer, Mill, Butte, and Battle Creeks (Busby 1996, Low et al. 2007). Lindley et al. (2006) reported that historical habitat may still be accessible in a few streams including Mill, Deer, Butte, and Cottonwood Creeks. Naturally spawning steelhead are also found on the American, Feather, Yuba, Mokelumne, and mainstem Sacramento Rivers; but the hatchery influence on these fish remains unknown (Busby et al. 1996). Changes to the thermal regime and food web structure (Lieberman et al. 2001) on these regulated rivers may be more beneficial for the resident forms, thus altering the proportion of anadromous to resident forms in these larger rivers.

Population Viability Assessment

Lindley et al. (2007) were not able to quantitatively assess the viability of Central Valley steelhead due to data deficiencies. Although they did not find any evidence of a low extinction risk for the ESU, the significant loss of historical habitat, habitat fragmentation, and degradation are likely adversely affecting both the anadromous and resident *O. mykiss* populations. Based on qualitative data and assessment of hatchery-supported populations, Lindley et al. (2007) determined that the existing populations are not viable and that the Central Valley ESU has a moderate to high risk of extinction.

Like spring-run Chinook, Central Valley steelhead populations are susceptible to the impacts of the predicted climate changes addressed by Lindley et al. (2007). Because spring-run and steelhead currently use much of the same habitat in the Sacramento River basin, steelhead will probably be affected much to the same extent in the tributaries as described for spring-run.

Restoration Activities in the Sacramento River Basin

Central Valley Project Improvement Act

In the mid-1990s, several state and federal restoration programs were developed to protect and restore anadromous salmonid populations within the Central Valley. The Central Valley Project Improvement Act (CVPIA) was amended to assign equal priority to fish and wildlife protection, restoration, and mitigation as to other Central Valley Project (CVP) projects (Reclamation and USFWS 2001). Under Section 3406 of the CVPIA, the Department of Interior was required to implement the Anadromous Fish Restoration Program (AFRP) which includes reoperation of the CVP to achieve the goals outlined in the AFRP Final Restoration Plan, implementing a Habitat Restoration Program, and dedicating 800,000 acre-feet of CVP yield annually for fish and wildlife (known as *(b)(2) water*) on CVP-operated rivers and streams (Reclamation and USFWS 2001). The CVP yield is used to improve upstream flows, meet water quality standards set forth in State Water Board Decision D-1641, and reduce entrainment at the CVP pumping facility in Tracy. The CVPIA also requires implementation of a supplemental water acquisition program, anadromous fish flow pulses, elimination of flow fluctuations, Clear Creek restoration, gravel replenishment, a Comprehensive Assessment and Monitoring Program, and an Anadromous Fish Screen Program (Reclamation and USFWS 2001).

The CVPIA required the Secretary of the Interior to develop and implement the AFRP, which was to make all reasonable efforts to ensure that by 2002 the natural production of anadromous fish in the Central Valley rivers and streams be self-sustaining at levels at least double the average levels from 1967 to 1991 (USFWS 2001). In 1995, the AFRP Core Group prepared a Working Paper on Restoration Needs; in 2001, they completed the Final Restoration Plan for the AFRP. Since the mid-1990s, USFWS has implemented AFRP restoration activities on several tributaries in the upper Sacramento River basin, including Mill, Deer, Butte, Clear, and Battle Creeks, to support these restoration goals.

As the amended CVPIA was being implemented, other programs were being developed, including CALFED and the Trinity River Mainstem Fishery Restoration Program (Reclamation and USFWS 2001). In light of that, many CVPIA efforts were coordinated with CALFED efforts in the Central Valley, especially the CALFED Ecosystem Restoration Program (ERP), as described below.

CALFED

In 1994, state and federal agencies joined with stakeholders and agreed to the Bay-Delta Accord, an agreement to develop a long-term comprehensive plan to restore the Bay-Delta for all beneficial uses. The Bay-Delta Accord led to the formation of CALFED, a cooperative effort to restore the ecological health of the Bay-Delta, improve water supply reliability, protect drinking water quality, and protect Delta levees (Reclamation and USFWS 2001). One of the several programs created through this process was the ERP.

The ERP was designed to maintain, improve, and increase both aquatic and terrestrial habitats in the Bay-Delta through the restoration of ecological processes (CALFED 2001). The ERP also was designed to recover at-risk species, such as anadromous salmonids, that are dependent on the Delta. The ERP is implemented using an ecosystem-based adaptive management approach with defined goals and objectives for ecosystem habitat and species rehabilitation projects (CALFED 2001). Three types of management actions (targeted research, pilot or demonstration projects, and full-scale implementation projects) are funded through the ERP (CALFED 2001). Since 1997, the ERP has funded numerous restoration projects in the upper Sacramento River basin.

NMFS is currently preparing a recovery plan for winter and spring-run Chinook and Central Valley steelhead. A co-manager review draft of the recovery plan was released in May 2008 that identified numerous recovery actions for the Sacramento River basin tributaries to benefit spring-run Chinook and steelhead. These actions include identifying and implementing projects to improve water temperature (reduce fire risk, restore meadows, and increase riparian shade), conduct fish passage evaluations at agricultural diversions, evaluate and dedicate instream flows to facilitate passage, implement gravel augmentation projects, fortify streambanks to reduce fine sediments, monitor water quality, and modify sport fishing regulations (NMFS 2008).

Sacramento River Basin Tributaries: Status of Spring-Run Chinook Salmon and Steelhead

Table 1 displays the historical estimates of spring-run Chinook salmon escapement in the Sacramento River basin tributaries along with the range of escapement estimates for the period from 1960 to 2007. Figures 1 through 3 display the estimated adult spring-run populations from 1960 to 2007 in tributaries where estimates are available.

Data acquired from CDFG GrandTab. Data for 2005 to 2007 are preliminary and subject to revision.

The Feather River estimate includes both in-river and hatchery counts. Data acquired from CDFG GrandTab. Data for 2005 to 2007 are preliminary and subject to revision.

Data acquired from CDFG GrandTab. Data for 2005 to 2007 are preliminary and subject to revision.

For this report, monitoring information was taken from the Central Valley Salmon and Steelhead Monitoring Program Summary (Low et al. 2007) unless otherwise stated. This report focuses on the monitoring activities for adult salmonids and does not include information on juvenile salmonid monitoring in the Central Valley.

The following sections describe the spawning/holding habitat, rearing habitat, monitoring activities, limiting factors, and restoration activities for tributaries that are known to support spring-run Chinook or steelhead in the upper Sacramento River basin.

Table 1. Escapement Estimates for Spring-Run Chinook in the Sacramento River Basin Tributaries from Historical Records and Monitoring Data (1960–2007)

Tributary	Historical Abundance	Source	CDFG GrandTab Estimate 1960–2007 (min–max)
Battle Creek	1,700–2,200; 1,800	CDFG (1998); Reynolds et al. (1993)	2–291
Cow Creek	unknown		No survey for spring-run
Bear Creek	unknown		No survey for spring-run
Clear Creek	< 500	Fry (1961)	0–194
Antelope Creek	<= 500	Reynolds et al. (1993)	0–154
Mill Creek	300–3,000; <= 3,500; 3,000–4,000	Fry (1961) & CDFG (1990); CH2M Hill (1998); CDFG (1998)	61–3,500
Deer Creek	500–4,000	Fry (1961) & Yoshiyama et al. (2001)	84–8,500
Butte Creek	100–3,000	Fry (1961) & CDFG (1998)	10–20,259
Big Chico Creek	< 200–500; 1,000	Reynolds et al. (1993); CH2M Hill (1998)	0–500
Cottonwood Creek	<= 500	Fry (1961)	0–477
Thomes Creek	< 500	Fry (1961)	0–2
Stony Creek	< 500	Fry (1961)	(Extirpated)
Feather River (in-river)	1,700; 500–4,000; 8,000–20,000	CH2M Hill (1998); CDFG (1998) & Fry (1961); Moyle (2002)	2–2,908
Yuba River	unknown; 6,000–10,000	no early CDFG records; Moyle (2002)	108–200
American River	unknown; >= 10,000	no early CDFG records; Moyle (2002)	(Extirpated)

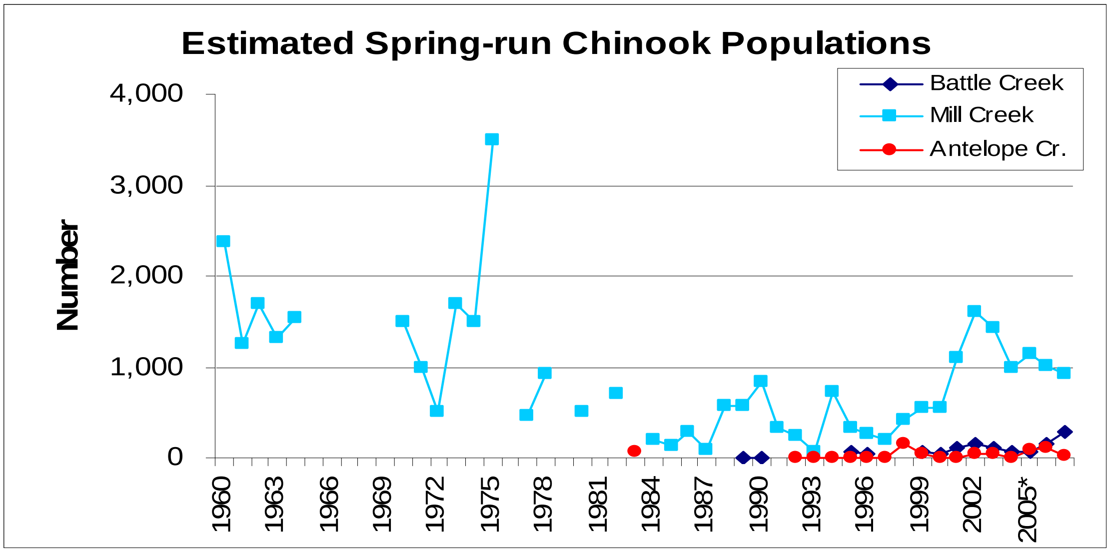

Figure 1. Estimated Adult Spring-Run Chinook Populations for Battle, Mill, and Antelope Creeks (1960–2007)

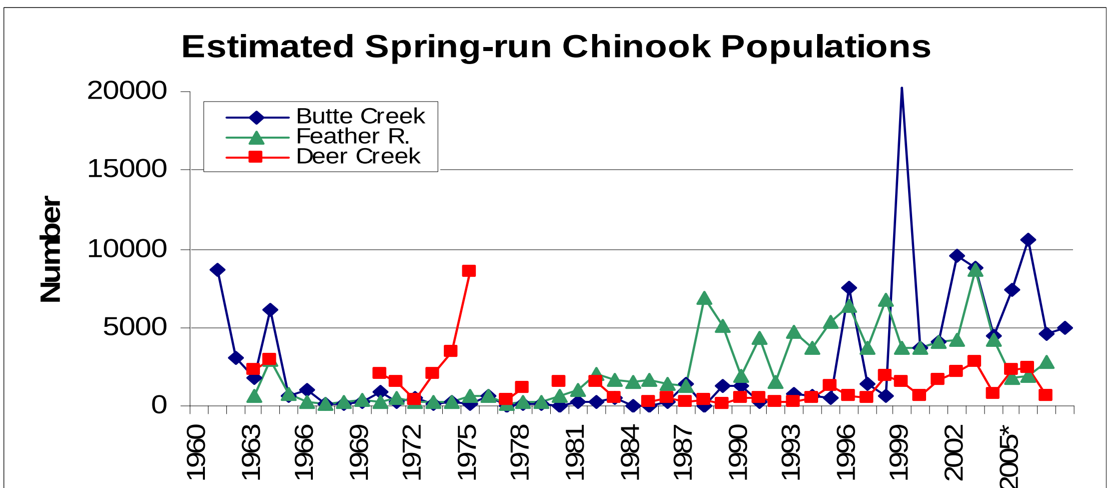

Figure 2. Estimated Adult Spring-Run Chinook Populations for Butte Creek, Deer Creek, and Feather River (1960–2007)

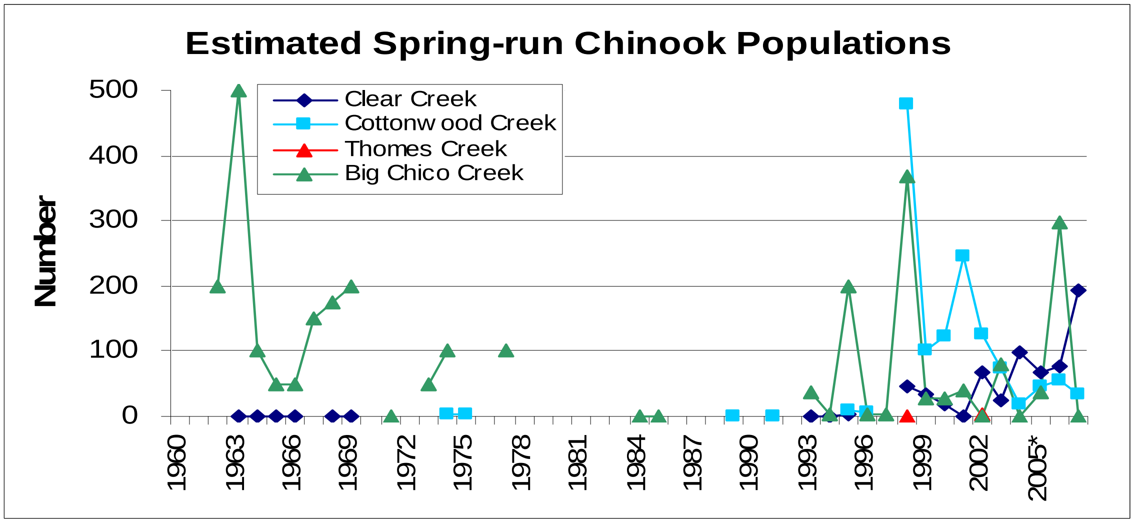

Figure 3. Estimated Adult Spring-Run Populations for Clear, Cottonwood, Thomes, and Big Chico Creeks (1960–2007)

Clear Creek

Spawning/Holding Habitat

Clear Creek is approximately 18.1 miles long between the confluence with the Sacramento River and Whiskeytown Dam. Whiskeytown Dam is a total barrier to salmonid migration in Clear Creek. The elevation for this reach drops from 1,000 feet to 400 feet above mean sea level (Newton and Brown 2004). USFWS identified two predominant stream channel types in Clear Creek. The upper reaches from Whiskeytown Dam down to Clear Creek Road Bridge (River Mile [RM] 8.5) have steep canyon walls with falls, high-gradient riffles, and deep pools. Below Clear Creek Road Bridge, the stream channel widens into an alluvial reach with a much lower gradient.

Since 2001, the Dedicated Project Yield Program—authorized by Section 3406(b)2 of the CVPIA—has provided additional water year-round to increase streamflow. The increased flows and resulting lower water temperatures improve passage, holding, spawning, and rearing conditions for both spring-run Chinook and steelhead (Giovannetti and Brown 2007). The goal of the flow targets is to provide access to 90% of the maximum possible weighted usable area (Reclamation and USFWS 2007).

The additional streamflows to manage water temperature also allow fall-run Chinook to access the reaches above Gorge Cascade (RM 6.5). Because USFWS was concerned about the effects of hybridization and redd superimposition between spring-run and fall-run Chinook, they installed a temporary picket weir at RM 8.09 in 2003 (Newton and Brown 2005). The weir limits spring-run Chinook to approximately 10 miles of spawning and holding habitat but ensures spatial separation of the two runs. The weir is installed in late August and removed in early November to allow steelhead access to the entire creek.

Water temperatures are managed to support spring-run spawning and egg incubation. Water temperature is maintained at <56 °F at the Igo gage (RM 10.8) for spring-run spawning from

September 15 through October 30 under the biological opinion for the operation of the CVP and the State Water Project (NMFS 2002).

Gravel augmentation has substantially increased the amount of spawning habitat for both Chinook and steelhead in Clear Creek (Giovannetti and Brown 2007). Smaller gravel has been injected below Whiskeytown Dam specifically to improve steelhead spawning. Giovannetti and Brown (2007) found that 30 to 40% of the steelhead redds had injection gravel in them between 2001 and 2007, suggesting that habitat is still limiting spawning or that the gravel injection is providing more suitable spawning habitat for steelhead.

Rearing Habitat

Brown (1996) calculated the change in percent of optimum habitat at various instream flows and estimated a 15% increase in rearing habitat when flows were increased from 50 to 150 cubic feet per second (cfs). Currently, flows are maintained at 200 cfs from mid-September through mid-June to support juvenile salmonid rearing and emigration.

USFWS and the CALFED Environmental Water Program (EWP) are currently working with the U.S. Bureau of Reclamation (Reclamation) to reoperate Whiskeytown Dam in spring to reactivate fluvial processes within Clear Creek (Reclamation and USFWS 2007). The reoperation would involve producing a 1-day flow of 3,250 cfs three times in a 10-year period. The process would help support juvenile salmonid rearing by re-creating and maintaining diverse instream and floodplain habitat in Clear Creek. In addition, ongoing floodplain and channel reconstruction projects have helped restore the natural form and functions to rearing habitat in the lower watershed (Giovannetti and Brown 2007).

Monitoring Activities

USFWS staff conducts a snorkel survey monthly from late April through August and twice a month from September to early November to determine the relative abundance of adult spring-run Chinook in Clear Creek. Nearly the entire length of Clear Creek is surveyed starting near the mouth at RM 1.7 up to Whiskeytown Dam. The survey is also used to evaluate the distribution of immigrating and spawning Chinook. USFWS has conducted this survey annually since 1999. No long-term annual spring-run escapement surveys were conducted prior to 1999 in Clear Creek.

As part of the spring-run snorkel survey, USFWS staff counts live steelhead/ rainbow trout. USFWS also conducts a late-fall Chinook and steelhead redd survey by kayaking essentially the entire length of Clear Creek monthly from December through April. USFWS has conducted the survey since 1999, providing data on the number of steelhead/rainbow trout redds and the temporal and spatial spawning distribution within Clear Creek.

Limiting Factors

Whiskeytown Dam remains a total barrier limiting habitat access and gravel transportation. Flow and water temperature are controlled by dam operations and could be affected by climate change. The stable flows also modify fluvial processes that can affect the quality of juvenile rearing habitat. There is also no permanent spatial separation of fall and spring-run Chinook in Clear Creek.

Restoration Activities

Built in 1903, McCormick Saeltzer Dam (RM 6.5) was a total barrier to spring-run Chinook migration. A fish passage structure was added in 1958, but it was unsuccessful. In 1992, the structure was modified to improve fish passage. Passage increased slightly, but debris commonly blocked access through the structure (Newton and Brown 2004). The McCormick Saeltzer Dam was completely removed in 2000, providing access to the full length of Clear Creek up to Whiskeytown Dam.

The current flow schedule to increase flows and lower water temperature was developed based on an instream flow incremental methodology (IFIM) study conducted in the 1980s. The schedule may be revised based on a new IFIM study being developed by USFWS (Reclamation and USFWS 2007).

Gravel augmentation below Whiskeytown Dam started in 1995; since then, approximately 110,000 tons of gravel has been injected into the creek (Reclamation and USFWS 2007). The goal of the project is to replace the amount of spawning habitat that existed before construction of the dam by 2020. Meeting this goal will provide approximately 347,000 square feet of spawning habitat (Reclamation and USFWS 2007).

A 2-mile section in the lower portion of the creek that was significantly degraded by mining is currently being restored. Phases 1, 2A, and 2B of the Stream Channel Restoration Project were completed between 1998 and 2001. Gravel extraction pits were filled in to reduce stranding and predation and to restore floodplain function. Phase 3A was completed in 2002 by relocating a section of stream channel along with continued restoration of the floodplain. Monitoring in the new channel documented more than a 400% increase in spawning area use for fall Chinook (Reclamation and USFWS 2007). Geomorphic monitoring associated with the Stream Channel Restoration Project indicated that the stream channel and floodplain are functioning as intended and juvenile Chinook rearing was higher than expected (Reclamation and USFWS 2007). Phase 3B was completed in 2008 and involved creating spawning riffles and continuing revegetation efforts. The final phase (Phase 3C), currently in the design and permitting phase, involves realigning the stream channel and rebuilding the floodplain in the lowest reach of the restoration project to improve rearing habitat.

The extensive restoration efforts and flow supplementation have improved conditions in Clear Creek for both spring-run Chinook and steelhead. This restoration has allowed for the successful re-establishment of spring-run Chinook into the watershed and has increased the steelhead population.

Cow Creek

Spawning/ Holding Habitat

The Cow Creek watershed contains six major tributaries, for a combined length of 164.4 river miles (WSRCD and Cow Creek Watershed Management Group 2005). CDFG does not consider Cow Creek suitable for spring-run due to low flows, high water temperatures, and lack of holding pools (CH2M Hill 1998). However spring-run have been documented using Cow Creek and may use the watershed in above-normal water years.

The mainstem of Cow Creek does support fall-run, late fall-run, and limited steelhead spawning (<200); but the lack of summer holding pools makes it unsuitable for spring-run Chinook (SHN Consulting 2001). On Little Cow Creek, Diddy Wells Falls creates a barrier to upstream migration, except possibly in above-normal flow years. Clover Creek provides spawning habitat up to Clover Creek Falls for fall-run and steelhead. The falls are a total barrier to upstream migration. Upper Whitmore Falls on Old Cow Creek creates a barrier to upstream migration during normal water years (SHN Consulting 2001). The available habitat, above and below the Upper Whitmore Falls, lacks holding pools and adequate spawning gravel for spring-run Chinook; but it does provide some spawning habitat for steelhead (SHN Consulting 2001).

South Cow Creek supports the most anadromous fish use in the Cow Creek watershed; spring-run Chinook have been observed below the PG&E Mill Creek Diversion Dam (SHN Consulting 2001). Adequate spawning grounds are identified above and below the diversion dam for both spring-run and steelhead. This section of the creek also has dense riparian vegetation to help moderate water temperatures (SHN Consulting 2001). Access to spawning areas can be limited in some years due to low flows.

Rearing Habitat

Cow Creek currently provides some habitat for non-natal spring-run Chinook and steelhead rearing but is limited in most years by low flows and high water temperatures (WSRCD and Cow Creek Watershed Management Group 2005).

Monitoring Activities

No systematic monitoring is conducted on Cow Creek for spring-run Chinook or steelhead.

Limiting Factors

WSRCD and Cow Creek Watershed Management Group (2005) identified several factors limiting Chinook populations in Cow Creek, including flows, water temperature, and the lack of fish ladders and screens on diversions. Low flows are caused by numerous irrigation and hydroelectric diversions, and currently Cow Creek is fully adjudicated. Predation of juvenile Chinook by Sacramento pikeminnow, smallmouth bass, and largemouth bass also may be a limiting factor in the lower portions of Cow Creek (SHN Consulting 2001) Grazing, habitat conversion, non-native plants, and land management have altered the vegetation (WRSCD and Cow Creek Watershed Management Group 2005). In addition, fire suppression management has resulted in higher potential for catastrophic wildfires. SHN Consulting (2001) noted that Cow Creek does not have a major storage dam, allowing a more natural hydrograph. Because many diversions do not have minimum flow requirements, flow is limited in most years.

Restoration Activities

The Cow Creek Watershed Management Group worked in partnership with the Western Shasta Resource Conservation District (RCD) to develop the Cow Creek Watershed Management Plan (CCWMP). The CCWMP outlines specific steps to enhance the watershed in each of five categories: water quality and quantity, fisheries, botanical and wildlife resources, fire prevention and fuel management, and education and outreach (WSRCD and Cow Creek Watershed Management Group 2005). The CCWMP objectives for anadromous fish include addressing monitoring needs, developing programs to install screens and ladders, and implementing actions to increase instream flows. The CCWMP also identifies objectives for monitoring water quality, improving water quality and quantity, protecting and enhancing riparian corridors, and fuel management to avoid catastrophic fires within the watershed.

In March 2009, PG&E filed a License to Surrender Application with FERC for the Kilarc-Cow Creek Hydroelectric Project, FERC No. 606 (Kilarc-Cow Creek Project). As part of the process, PG&E will decommission and remove the Kilarc Development on Old Cow Creek and the Cow Creek Development on South Cow Creek (PG&E 2007a). The Kilarc-Cow Creek Project includes several small diversion dams, approximately 7 miles of water conveyance facilities, and two powerhouses. The project diverts water from North and South Canyon Creeks, Old Cow Creek, Mill Creek, and South Cow Creek (PG&E 2007a). PG&E holds three pre-1914 water rights for a combined diversion of 62 cfs in Old Cow Creek and two pre-1914 water rights for a combined diversion of 70 cfs in South Cow Creek (PG&E 2007a). The Cow Creek Adjudication (decree entered 1969) states that, if the Kilarc-Cow Creek Project is authorized or ordered to decommission, the water rights will be transferred to and used by a resource agency to protect, preserve, or enhance aquatic resources (PG&E 2007a). Decommissioning and removal of the Kilarc-Cow Creek Project should improve passage for Chinook and steelhead in both Old Cow Creek and South Cow Creek.

South Cow Creek has the most suitable spawning and holding habitat for spring-run Chinook in the Cow Creek watershed; however, there is a potential for spatial and temporal overlap with fall-run Chinook.

Restoration of Cow Creek would likely provide more benefits for steelhead than for spring-run Chinook due to the lack of holding habitat in Cow Creek. Past estimates by CDFG suggested that Cow Creek could support steelhead runs of approximately 500 (CDFG 1965 as reported in SHN Consulting 2001).

Bear Creek

Spawning/ Holding Habitat

Bear Creek is a small east-side tributary where rainfall is the primary source of flow (CH2M Hill 1998). Although salmon have access to approximately 24 miles, in low-flow years, the stream can run dry prior to reaching the Sacramento River because diversions exceed the natural flow (CH2M Hill 1998). Due to low flows, warm water temperatures, and lack of large holding pools, only fall-run Chinook and steelhead use Bear Creek consistently (ENPLAN 2006). Spawning runs were estimated at 300 fall-run and 200 steelhead in the 1960s; because no systematic surveys are conducted in Bear Creek, the current population of steelhead is unknown (ENPLAN 2006). Spring-run are not known to spawn in Bear Creek (CDFG 1993). Steelhead have been documented using the mainstem of Bear Creek, North Fork Bear Creek, and Snow Creek. There are no known barriers to migrations in these reaches; however, low flows may prevent adult steelhead from accessing them (ENPLAN 2006).

Rearing Habitat

Non-natal juvenile spring-run Chinook have been reported to use Bear Creek in above-normal water years (ENPLAN 2006). Rearing habitat is a function of the natural hydrologic regime in the Bear Creek watershed; many creeks become intermittent or completely dry in years with below-average precipitation, thus limiting steelhead rearing (ENPLAN 2006). Water diversions in the lower portion of the watershed further reduce rearing habitat for both non-natal spring-run and steelhead.

Limiting Factors

The primary factor limiting spring-run Chinook use of Bear Creek is low flow and the associated increased water temperatures. Limited holding pools; unscreened agricultural diversions; and the effects of timber harvest, fire management, and predation also are limiting factors in this watershed (ENPLAN 2006). DWR is currently conducting a fish passage barrier assessment on Bear Creek, but no recent surveys have been conducted on the amount of suitable spawning habitat and holding pools that exists in the Bear Creek watershed.

Monitoring Activities

No annual monitoring is conducted on Bear Creek for spring-run Chinook or steelhead.

Restoration Activities

The Bear Creek Watershed Group was formed in 2002. With the help of the Western Shasta RCD, they completed both a watershed assessment and water management plan in 2006. Each of the implementation plans outlined in the management plan will be developed as funding becomes available (WSRCD 2006).

The hydrology and water quality objectives include developing and implementing a long-term monitoring program, establishing a baseline geomorphology for the major streams, and implementing projects to increase water quantity and quality within the Bear Creek watershed. The botanical objectives include conducting vegetation inventories, protecting and restoring riparian corridors, and developing a management strategy for non-native species. The fisheries objectives include establishing a comprehensive monitoring program for anadromous species and developing a program to assist landowners to install screens and ladders at diversions. Other objectives focus on land use and fire and fuels management, and education and outreach within the watershed (WSRCD 2006.)

Historically, this watershed supported only small populations of both Chinook and steelhead. Therefore, while these restoration actions will improve conditions in Bear Creek, the opportunity for establishing independent self-sustaining populations is limited.

Cottonwood/Beegum Creeks

Spawning/ Holding Habitat

The Cottonwood Creek watershed encompasses 929 square miles and has three main tributaries, the South Fork, the North Fork, and Beegum Creek (off the Middle Fork), which provide approximately 130 miles of Chinook spawning habitat (CH2M Hill 2007). Like Clear Creek, Cottonwood Creek has steep, narrow canyons starting from the headwaters and transitioning to braided alluvial streams in the valley reach (CH2M Hill 2002).

Spring-run spawning and holding habitat is limited primarily to Beegum Creek and the South Fork above Maple Creek (CH2M Hill 1998); however, some spawning has been documented on the North Fork (CH2M Hill 2002). Several natural partial barriers can block migration into portions of Beegum Creek under certain flow conditions; on the South Fork, a human-made barrier exists about 3.5 miles upstream of Maple Creek (CH2M Hill 2002). Prior to this barrier, spring-run were observed 7 to 8 miles upstream of Maple Creek (CH2M Hill 2002). On the North Fork, a natural barrier is upstream of the Ono Bridge. Historical records indicate that up to 500 spring-run spawned in Cottonwood and Beegum Creeks (CH2M Hill 2007).

Steelhead utilize all the forks and the mainstem of Cottonwood Creek. Approximately 42% of the mainstem has suitable spawning areas for steelhead and fall-run Chinook; however, low flows can restrict access to a large portion of these areas (CH2M Hill 2002).

Rearing Habitat

Rainfall provides most of the natural flow in the Cottonwood Creek watershed, resulting in a hydrology with abrupt swings correlated to storm events; higher flows are in winter and spring, and low flows are in summer and fall (CH2M Hill 2002). In years with low rainfall, both flow and water temperatures can impede escapement and successful recruitment of juvenile salmonids (CH2M Hill 2002). However, the mainstem does have deep pools and riffles to provide cooler holding areas during summer and fall (CH2M Hill 2002). In addition, Cottonwood Creek has an established riparian corridor that is beneficial for juvenile rearing (CH2M Hill 2002).

Limiting Factors

Low flows in years with limited precipitation can limit the availability of habitat given the flashy nature and limited aquifer recharge within the Cottonwood Creek watershed (CH2M Hill 2002). Other limiting factors include heavy sediment loads, gravel extraction, agricultural practices including the Anderson-Cottonwood Irrigation District canal, timber harvesting, and urban development. One of the recommendations in the Cottonwood Creek Watershed Management Plan is for the Cottonwood Creek Watershed Group (CCWG) to conduct or facilitate a limiting factors analysis to fully evaluate the existing limitations for salmonids (CH2M Hill 2007).

Monitoring Activities

CDFG staff conducts a snorkel survey on Beegum Creek to estimate the annual spring-run escapement. The survey is conducted three times a year on the North Fork from RM 0.5 to the Highway 36 Bridge. The survey also provides information on the spatial distribution of holding Chinook. CDFG has conducted the survey in most years since 1973. No annual monitoring is of Cottonwood Creek for steelhead.

Restoration Activities

CCWG was formed in 1999 to "preserve the environment, private property and water rights, and economic resources of the Cottonwood Creek Watershed through responsible stewardship, liaison, cooperation, and education" (CH2M Hill 2007). CH2M Hill, with funding from the State Water Board and CALFED and input from stakeholders, prepared a watershed management plan for the CCWG. The management plan identifies issues in the watershed and establishes goals, objectives, and actions for addressing them.

The watershed management plan identifies issues in four categories: water resources and future development; channel and riparian conditions; fishery, vegetation, and wildlife resources; and fire and fuels management (CH2M Hill 2007). The goals that directly impact salmonids include addressing bank and channel instability, developing a sustainable gravel management program, sustaining and enhancing native fish populations, sustaining and expanding riparian habitat, sustaining and enhancing water quality, increasing both stormwater infiltration and base flows, and reducing fine-grained sediment discharge into the waterways (CH2M Hill 2007). In part, the watershed management plan recommends that the CCWG should establish both juvenile and adult salmonid monitoring programs, conduct a limiting factors analysis for salmonids, assess the impacts of bank stabilization projects on riparian and aquatic habitats, and implement CALFED ERP targets that are applicable to Cottonwood Creek (CH2M Hill 2007). The ERP targets include maintaining and improving existing habitat and facilitating passage of spring-run and steelhead to holding, spawning, and rearing habitat.

Cottonwood Creek is the third largest tributary on the western side of the Sacramento River basin and the largest undammed watershed in the northern Central Valley (CH2M Hill 2002). The watershed is relatively undeveloped with an active, established, riparian corridor and provides important habitat for spring-run Chinook and steelhead that could be both expanded and enhanced with watershed improvements.

Battle Creek

Spawning/ Holding Habitat

Battle Creek is an east-side tributary of the Sacramento River that drains from the southern Cascade Range, with attributes similar to tributaries upstream of Shasta Dam (Kier Associates 1999, Lindley et al. 2007). Large snowfields and spring-fed creeks maintain streamflow until late summer in both the North and South Forks of Battle Creek, providing suitable holding and spawning water temperatures. Spring-run Chinook and steelhead can access approximately 14 miles of spawning and holding habitat in the North fork and approximately 18 miles in South Fork (Kier Associates 1999).

The spawning habitat in the North Fork has high-gradient stream segments, similar to those in Mill and Deer Creeks, upstream of Eagle Canyon Dam and elevations over 2,000 feet occur above North Battle Creek Feeder Dam. On the South Fork, similar high-gradient stream segments exist upstream of Inskip Dam; elevations over 2,000 feet occur upstream of the South Dam (Kier Associates 1999).

The Coleman National Fish Hatchery (CNFH) barrier weir, the CHFH Intake 3 diversion weir, the Orwick Diversion Dam, and the Coleman Powerhouse tailrace are potential passage barriers or impediments on the mainstem (DWR 2005). The fish ladder on the CNFH barrier weir is used during the adult steelhead migration period for broodstock collection; however, since 1996, all naturally spawned adult steelhead are allowed to pass the barrier (Jones & Stokes 2005). Steelhead also can pass over the barrier weir and access the upper watershed during periods of higher flow (>300 cfs) (Kier Associates 1999).

The North Fork has three diversion dams (Wildcat, Eagle Canyon, and North Battle Creek) and the South Fork has three diversion dams (South Diversion, Inskip, and Coleman) that can impede adult migration (DWR 2005). PG&E currently provides minimum flows of 30 cfs under an interim flow agreement to improve passage in both the North and South forks (Kier Associates 1999).

Rearing Habitat

The Battle Creek Watershed Conservancy developed a set of biologically optimum flows for each reach and month using an IFIM study. The biologically optimum flows that were selected provide at least 95% of the maximum weighted usable area (WUA) for the limiting life history stage *(*Kier Associates 1999). If implemented, these flows would provide sufficient habitat for salmonids rearing in Battle Creek. The current interim flow agreement targets also improve habitat conditions for spring-run and steelhead rearing in part by reducing water temperature in the lower reaches of the watershed.

Limiting Factors

The primary limiting factors on Battle Creek are associated with hydroelectric and agricultural diversions (Kier Associates 1999). Past hatchery operations also limited passage of spring-run and steelhead into the upper watershed until a disease-free water supply was established in the late 1990s (Kier Associates 1999).

The hydroelectric operations and agricultural diversions affect instream flow, water temperatures, fish passage, entrainment, and gravel supplies. PG&E currently operates five powerhouses; two small storage reservoirs; three forebays; and eight diversions along with a network of approximately 20 canals, ditches, flumes, and pipelines (Kier Associates 1999). In 1995, PG&E agreed to an interim flow agreement to increase flows above the minimum FERC requirements until a more permanent arrangement is reached (Kier Associates 1999).

Monitoring Activities

Spring-run escapement surveys were conducted from 1946 to 1956 using spawning area surveys and/or redd counts. In the early 1950s, some counts of spring-run Chinook passing CNFH were recorded, and stream surveys were conducted in the early 1960s (Kier Associates 1999). In 1995, USFWS installed a trap on the CNFH barrier weir and installed an underwater video camera to record passage of spring-run Chinook and steelhead. The weir trap is operated daily from March through May, and the underwater video monitoring is conducted from June through July. In 2002, USFWS added jumper video monitoring during daylight hours from August through December. These three monitoring programs provide passage estimates into upper Battle Creek.

In 2001, USFWS standardized the snorkel survey to sample from the mainstem at RM 2.8 up to the confluence, the North Fork up to Eagle Canyon Dam, and the South Fork up to Coleman Diversion Dam. USFWS staff conducts the survey once or twice a month from May until mid-November to identify spawning locations and timing for both spring-run Chinook and steelhead.

Between 2002 and 2006, USFWS also conducted a steelhead redd survey on the mainstem, on the North Fork from the confluence to Eagle Canyon Dam, and on the South Fork from the confluence to Coleman Diversion Dam. The survey is conducted twice a month from November through April to collect data on the number of redds and the spatial and temporal spawning distribution.

Restoration Activities

Battle Creek offers a unique opportunity to support spring-run and steelhead recovery due to its geological and hydrological features. The proposed Battle Creek Salmon and Steelhead Restoration

Project (Restoration Project) would restore and enhance approximately 42 miles of habitat by modifying hydroelectric operations in a way that minimizes the loss of clean, renewable energy (Jones & Stokes 2005). In 1999 Reclamation, NMFS, USFWS, CDFG, and PG&E signed a memorandum of understanding (MOU) outlining the Restoration Project (Jones & Stokes 2005). Under the MOU, PG&E agreed to forego some energy generation in order to provide instream flows, pursue an amendment to the FERC license, and transfer certain water rights to CDFG (Jones & Stokes 2005). Other actions address flow management, passage, restoration of stream function, diversions, and water routing.

The proposed actions include removing five hydroelectric diversion dams (Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman), installing screens and ladders on three diversion dams (North Battle Creek Feeder, Eagle Canyon, and Inskip), increasing flows, dedicating instream water rights, and eliminating the mixing between the North Fork and South Fork water (Jones & Stokes 2005). The actions are divided into three phases, 1A, 1B, and 2. Funding agreements were reached in July 2008 to provide $49.25 million to implement Phase 1A which focuses on the North Fork (Marshall 2008). In Phase 1A, fish screens and ladders will be installed on Battle Creek Feeder and Eagle Canyon Dams, Wildcat Diversion Dam and appurtenant conveyance systems will be removed, the Eagle Canyon Canal pipeline will be installed, and Asbury Dam will be modified (Marshall 2008).

Phase 1B involves installing a tailrace connector and bypass at Inskip Powerhouse; funding is being actively pursued. Potential funding for Phase 2 has not been identified. Phase 2 includes installing a fish screen and ladder on Inskip Dam, installing a tailrace connector at South Powerhouse, and removing several diversion dams and appurtenant conveyance systems on the South Fork.

The Restoration Project will allow Chinook salmon and steelhead to access prime habitat from the confluence with the Sacramento River to the natural barriers above the hydroelectric dams as they did historically (Jones & Stokes 2005).

Thomes Creek

Spawning/ Holding Habitat

Historically, spring-run Chinook were observed sporadically in Thomes Creek, but the intermittent nature of the flow in this tributary limits the use by spring-run Chinook for spawning and holding. Steelhead can use Thomes Creek for spawning in years with adequate streamflows (Vestra 2006). CDFG identified a low-elevation impassable barrier immediately above the confluence with Horse Trough Creek that limits the amount of spawning and holding habitat for both spring-run and steelhead (Vestra 2006).

Rearing Habitat

Thomes Creek has potential for non-natal rearing of spring-run juveniles in years with adequate flow (Vestra 2006). Juvenile steelhead rearing is limited in Thomes Creek due to the reduced streamflows in years with below-normal precipitation. There is potential for natal and non-natal steelhead rearing in some years when suitable conditions exist (Vesta 2006).

Limiting Factors

Low flows in Thomes Creek are the major limiting factor for both spring-run and steelhead. Spring-run and steelhead production also is limited by high water temperature, lack of holding pools, erosion, and gravel mining (CH2M Hill 1998). Potential entrainment of juvenile salmonids by two seasonal diversions dams also may contribute to reduced production (Vestra 2006).

Monitoring Activities

No annual monitoring is conducted on Thomes Creek for spring-run Chinook or steelhead.

Restoration Activities

In 2007, the Tehama County RCD prepared a bi-annual report outlining their management actions from July 2005 through June 2007 to improve the Tehama West Watershed (TCRCD 2007). The report focused on actions in two areas, land use and planning and watershed management and health. The actions included completing the Tehama West Watershed Assessment and development of the Tehama West Watershed Management Plan (TCRCD 2007). The draft management plan that was released in August 2008 outlines actions to protect and enhance fall-run Chinook and steelhead populations in Thomes Creek (TCRCD 2008). These actions would benefit any spring-run that use Thomes Creek in wet years. However, the intermittent flow characteristics limit establishment of self-sustaining populations of spring-run Chinook or steelhead in Thomes Creek (Vestra 2006).

Stony Creek

Spawning/ Holding Habitat

Historically, spring-run Chinook spawning occurred upstream of the Stony Gorge Dam, which was built in 1928 (CH2M Hill 1998). Downstream of Stony Gorge, Black Butte Dam is a total barrier to salmonid migration (USFWS 1995). Fall-run Chinook have been documented spawning 6 miles downstream of Black Butte Dam at the North Diversion Dam, but no spring-run have been observed spawning in that area. The North Diversion Dam is a migration barrier to fall-run Chinook under most flow conditions (CH2M Hill 1998). Because of an impassable barrier at the Glenn-Colusa Irrigation District (GCID) canal at RM 3, an underground siphon was installed in 1999 (H. T. Harvey & Associates et al. 2007a). No passage studies have been conducted at the siphon site.

Steelhead spawning is possible in some years in Stony Creek and is used opportunistically when attraction flows are present (H.T. Harvey & Associates et al. 2007b). Gravel recruitment is limited due to entrapment behind Black Butte Dam, thus reducing the amount of useable spawning habitat for steelhead. Low flows may be a passage barrier for steelhead in years with below-normal precipitation.

Rearing Habitat

Non-natal spring-run Chinook and steelhead rearing has been documented in Stony Creek, but stranding and entrainment is known to occur due to operation of the Tehama-Colusa canal and the GCID canal (CH2M Hill 1998). Low flows and high water temperatures limit the amount of rearing habitat in Stony Creek in some years (H.T. Harvey & Associates et al. 2007b).

Limiting Factors

Migration barriers, low flows, high water temperatures, limited spawning habitat, and poor water quality limit salmonid production in Stony Creek (CH2M Hill 1998). Entrainment and standing caused by operations of the Tehama-Colusa canal and the GCID canal affect both juvenile rearing and adult escapement to Stony Creek (CH2M Hill 1998). Streambank erosion, loss of riparian habitat, and gravel mining also limit salmonid production (H. T. Harvey & Associates 2007b).

Monitoring Activities

No annual monitoring is conducted on Stony Creek for spring-run Chinook or steelhead.

Restoration Activities

Stony Creek is the second largest west-side tributary of the Sacramento River; it has undergone substantial geomorphic change, channel instability, and degradation of native riparian plant communities (H.T. Harvey & Associates 2007b). Historically, Stony Creek was a flashy, episodic channel; because of dam operations and extensive gravel mining, the creek now meanders within an artificially narrow channel causing both bed and bank erosion (H.T. Harvey & Associates 2007b).

In 2004, the Glenn County RCD organized a Landowner Advisory Committee and a Technical Advisory Committee to help with implementing projects in the Lower Stony Creek Watershed (GCRCD 2008). The Stony Creek Watershed Assessment was completed in 2007, and work began on the Lower Stony Creek Watershed Restoration Plan (GCRCD 2008). The Glenn County RCD also established a demonstration site for invasive plant removal and bank stabilization, and implemented a monitoring program (GCRCD 2008). An adopted long-range plan set goals related to water resources, loss of agricultural land and urban encroachment, range management, weed control, and loss of habitat (GCRCD 2006).

The natural recruitment of native riparian seedlings suggests that the hydrological conditions needed to support a riparian corridor already exist in lower Stony Creek (H. T. & Associates et al. 2007a). Although the low elevation, lack of holding pools, low flows, and high water temperatures make Lower Stony Creek unsuitable for spring-run Chinook, restoration efforts could benefit both fall-run Chinook and steelhead.

Antelope Creek

Spawning/ Holding Habitat

The Antelope Creek watershed is relatively long and narrow, with moderate to steep slopes, and is located within the southernmost extension of the Cascade Range (Armentrout et al. 1998). The watershed is similar to both Mill and Deer Creeks, which support self-sustaining runs of spring-run Chinook salmon and steelhead.

Spring-run have access to approximately 9 miles of spawning and holding habitat in Antelope Creek, starting from approximately 1.6 miles downstream of Paynes Creek crossing to McClure Place on the North Fork and Buck’s Flat on the South Fork (CDFG 1966, Airola 1983 as reported in Armentrout et al. 1998). Paynes Creek crossing also is referred to as Tehama Wildlife Area Crossing.

Armentrout et al. (1998) used results from the U.S. Forest Service Fisheries Habitat Assessment to determine the number of holding pools present in Antelope Creek. Holding pools were defined as pools greater than 6 feet deep. In Antelope Creek, seven holding pools on the mainstem represent 54% of all pools, six holding pools on the South Fork represent 26% of all pools, and no holding pools are on the North Fork (Armentrout et al. 1998).

Very little information on steelhead distribution and abundance is available for Antelope Creek; however, they probably use the same spawning areas as spring-run Chinook and may have access to habitats beyond what is known for salmon (Armentrout et al. 1998).

Rearing Habitat

The high habitat diversity of Antelope Creek helps support juvenile salmonid rearing (Armentrout et al. 1998). In addition, the deep pools, cool water springs, vegetative shading, and natural diurnal fluctuations in water temperature offset the potential effects of increased water temperature during summer and early fall, supporting the yearling life history stage for both spring-run Chinook and steelhead (Armentrout et al. 1998).

Limiting Factors

Water temperature, low flows, agricultural diversions, loss of natural river morphology, limited spawning habitat, fine sediments, water quality, loss of riparian habitat, and harvest/angling affect salmonid production in Antelope Creek (NMFS 2008). Low flows in the valley portion due to springtime agricultural diversions are the largest limiting factor for spring-run production in Antelope Creek. Low flows also can impede access to Antelope Creek by reducing attraction flows, creating passage issues at agricultural barriers, and increasing water temperatures for holding and spawning salmonids (NMFS 2008).

Monitoring Activities

In 1989, CDFG began conducting snorkel surveys on various stretches of the creek. In 1992, CDFG standardized the snorkel survey methods and has conducted an annual survey during the fourth week of July to estimate the spring-run population. The survey also provides data on the distribution of holding Chinook. Staff surveys the North Fork from the confluence to McClure Place and the South Fork from the confluence to SF Gun Club. No annual monitoring is conducted on Antelope Creek for steelhead.

Restoration Activities

Tehama County RCD is currently preparing a watershed assessment for both Paynes Creek and Antelope Creek. Tehama County RCD will use the information from the assessment to develop the Tehama Eastside Watershed Plan.

Antelope Creek is one of few remaining tributary streams where salmonids have access to the historical headwater stream habitat with a natural hydrograph in the upper watershed (Armentrout et al. 1998). Historically, Antelope Creek was estimated to support 500 spring-run Chinook and 300 steelhead (CH2M Hill 1998). Due to the steep sides of the canyon, human land use impacts are mostly limited to the valley floor portion of the watershed. These factors make Antelope Creek a promising area for expansion and enhancement of spring-run Chinook and steelhead habitat.

Mill Creek

Spawning/ Holding Habitat

Mill Creek is a long, narrow watershed; most of the watershed is bordered by Lassen National Forest (CH2M Hill 1998). Because the upper watershed is relatively inaccessible, it is undisturbed, pristine, salmonid spawning habitat (CH2M Hill 1998). No significant water storage impoundments in the watershed allow for a natural hydrograph that is supported by both seasonal rainfall and snowmelt (CH2M Hill 1998). Mill Creek supports an independent, self-sustaining spring run and provides the highest elevation spawning habitat known in California (CH2M Hill 1998).

Spring-run holding pools exist in the upper canyon areas, and spawning occurs between Little Mill Creek confluence and the Highway 36 Bridge (CH2M Hill 1998). Armentrout et al. (1998) noted that the amount of holding habitat is limited in the upper 7.6 miles of Mill Creek and that holding habitat was more abundant in the section below the Mill Creek Campground. There are 20 holding pools out of 86 pools in the 13 miles of stream that were surveyed downstream of the campground (Armentrout et al. 1998). The amount of holding habitat just below this reach is unknown because it could not be accessed for the survey, but spring-run were previously observed holding in this area (Armentrout et al. 1998).

Mill Creek has higher sediment loading than Antelope or Deer Creeks; however, it does not appear to limit spring-run salmon from spawning. It may impact redds after flood events that redistribute the fines during the incubation period (Armentrout 1998). Low flows in the lower portion of the watershed can impede upstream passage of adult salmonids in some years (CH2M Hill 1998). No physical passage barrier limits upstream migration on Mill Creek; however, the combined effect of higher stream gradients, lower streamflows, and habitat availability sets the upper limit for migration in the headwater reaches (Armentrout et al. 1998).

Very little distribution and abundance data on steelhead spawning are available in Mill Creek, but their range is expected to include the range for spring-run and can extend beyond it (Armentrout et al. 1998).

Historically, Clough Dam, Ward Dam, and Upper Diversion Dam impeded the upstream passage of salmonids under low-flow conditions. Clough Dam was removed in 2003, and Ward Dam was modified in 1997 to improve upstream passage (DWR 2005). In recent years, streamflows have been augmented through a water exchange program to improve upstream passage for spring-run Chinook (DWR 2005).

Rearing Habitat

The upper watershed substrate composition and pools provide a high level of habitat diversity and overwintering cover that supports juvenile salmonid rearing (Armentrout et al. 1998). This portion of the creek is relatively undisturbed by human land use and provides relatively pristine rearing conditions. Water temperatures remain low during the spring-run rearing period and support a stream-type life history. The proportion of fry that remains in the creek to migrate as yearlings varies annually, depending on stream conditions (Harvey-Arrison pers. comm.). The lower portion of Mill Creek also provides good rearing habitat although low flows due to diversions can increase water temperature and impede juvenile migration from the creek (DWR 2005).

Limiting Factors

The Mill Creek watershed is relatively undisturbed with a natural flow regime; however water diversions in the lower portion of the creek can increase water temperatures and impede adult passage upstream and juvenile passage downstream.

Monitoring Activities

CDFG staff has monitored spring-run escapement on Mill Creek since 1947 using spawning area surveys and/or aerial redd counts (1947–1953), ladder counts (1954–1964 and 1986–1987), area surveys (1971–1985), electronic fish counters (1988–1996), carcass surveys, and redd surveys. Since 1997, CDFG staff has conducted a single redd survey at the peak of the spawning period to estimate the annual spring-run spawning population. The survey takes place between October 1 and October 15 from the Lassen National Park boundary to the confluence of Little Mill Creek. Staff collects data on the number of complete redds and the number, age class, and sex of carcasses. The survey also provides information on the spatial spawning distribution and population trends over time.

CDFG staff also conducted a hydroacoustic pilot study in 2006 to evaluate the use of two different hydroacoustic methods, Biosonics split-beam sonar and the dual-frequency identification sonar (DIDSON), to estimate spring-run escapement to Mill Creek at Sherwood Bridge (Creek Mile 2.0). CDFG found the DIDSON system to be more effective because it samples a great volume and detects targets across a broader range of flows and water levels (Johnson et al. 2006). No annual monitoring is conducted for steelhead on Mill Creek.

Restoration Activities

Mill Creek was identified as a priority stream in the USFWS-AFRP Final Restoration Plan (USFWS 2001). In the Restoration Plan, USFWS identified four actions to help increase the natural production of anadromous fish in Mill Creek: (1) continue providing instream flows to facilitate adult and juvenile salmonid passage; (2) develop a watershed strategy to preserve habitat productivity; (3) improve spawning habitat in lower Mill Creek for fall-run Chinook; and (4) establish, restore, and maintain riparian habitat in lower Mill Creek. To date, AFRP has spent approximately $1,000,000 on restoration projects in Mill Creek (AFRP website).

There are four ongoing watershed projects: (1) the Lower Mill Creek Riparian Restoration Project, (2) the Deer and Mill Creek Watershed Project; (3) the Deer, Mill, and Antelope Creek Stabilization Project; and (4) the Mill Creek Water Exchange Program (DWR 2005). The objective of the Lower Mill Creek Riparian Restoration Project is to maintain and restore riparian habitat in the lower reaches; the project is funded through the Mill Creek Conservancy and The Nature Conservancy (DWR 2005). The Deer and Mill Creek Watershed Project develops and coordinates resource plans to benefit spring-run Chinook and is funded by the State Water Board (DWR 2005). A final Mill Creek Watershed Management Strategy Report was completed in 1997. The Stabilization Project is funded by CALFED to reduce inputs of fine sediments from road-related sources (DWR 2005). The Mill Creek Water Exchange Program is discussed in more detail below.

Historically, Clough Dam fish ladder was considered ineffective in passing salmonids under low-flow conditions (Armentrout et al. 1998). DWR removed the dam and installed an inverted siphon pipe to move the diverted water to the Upper Diversion Dam under a contract awarded by the California

Bay-Delta Authority (DWR 2005). Clough Dam was removed in 2002, and the entire project was finished in 2003 (DWR 2005).

The two diversion dams on Mill Creek, Ward Dam and Upper Diversion Dam, can impede the upstream migration of spring-run due to reductions in streamflow (DWR 2005). CDFG constructed a new modified pool and chute ladder on Ward Dam in 1997 improving upstream passage under lower flow conditions (DWR 2005). A new fish screen also was installed at the Upper Diversion Dam in 2000 to reduce entrainment of juvenile salmonids (DWR 2005).

Streamflows at the diversion dams are augmented through a Water Exchange Program Agreement between CDFG, DWR, and Los Molinos Mutual Water Company (LMMWC) to improve both upstream and downstream passage of salmonids (DWR 2005). The program exchanges instream water for groundwater where landowners forego diversions of up to 16 cfs when additional flows are needed. The Mill Creek Conservancy conducted a study starting in 2004 to investigate and develop a long-term or permanent water management program on Mill Creek (DWR 2005).

Mill Creek, like Antelope Creek, is one of few remaining tributaries streams where salmonids have access to the historical headwater stream habitat with a natural hydrograph in the upper watershed (Armentrout et al. 1998). Past escapement estimates indicate that Mill Creek could support up to 3,500 spring-run Chinook and 2,000 steelhead (CH2M Hill 1998). Due to the steep sides of the canyon, human land use impacts are mostly limited to the valley floor portion of the watershed. AFRP and other organizations recognized the importance of Mill Creek for spring-run Chinook and have funded numerous restoration projects over the last 10 years.

Deer Creek

Spawning/ Holding Habitat

Unlike most tributaries in the Sacramento River basin, salmonids can still access the headwater stream habitat because there are no impoundments in Deer Creek (Armentrout et al. 1998). Deer Creek currently supports a self-sustaining population of spring-run Chinook (Lindley et al. 2007). Like Mill and Antelope Creeks, Deer Creek has excellent instream habitat conditions for spring-run Chinook holding, spawning, and rearing (Armentrout and other 1998). Deer Creek is in a long, narrow watershed with moderate to steep slopes. It has approximately 25 miles of spring-run holding habitat from Upper Falls downstream to the confluence with Rock Creek, but most holding occurs in the first 15.5 miles above Ponderosa Way (Armentrout et al. 1998). Based on a survey of the upper 17 miles of the holding habitat, Armentrout et al. (1998) noted the presence of 166 pools—of which 60% where classified as holding pools (depth > 6 feet).

Spring-run spawning extends from Upper Falls downstream nearly 30 miles, but the distribution of spawning can vary based on water temperatures and the amount of runoff (Armentrout et al. 1998). Based on visual observations, Armentrout et al. (1998) noted that the spawning substrate is in good condition with a low amount of fine sediment.

Very little distribution and abundance data are available on steelhead spawning in Deer Creek, but their range is expected to include the range for spring-run and can extend beyond it (Armentrout et al. 1998). Steelhead have access to an additional 13 miles of habitat when the fish ladder at Upper Falls is opened in fall (DWR 2005).

Rearing Habitat

The habitat diversity is high in Deer Creek and provides an abundance of microhabitats to support the needs of juvenile salmonids during their stream residency (Armentrout et al. 1998). Deer Creek also provides the cobble and gravel substrates with open interstitial spaces necessary for overwintering juvenile spring-run Chinook and steelhead (Armentrout et al. 1998). Like Mill Creek, Deer Creek supports a stream-type life history, with a varying proportion of spring-run remaining in the creek and migrating as yearlings. Rearing and outmigration in the lower portion of the Creek has improved after all the diversions were screened to prevent entrainment (Harvey 1997).

Limiting Factors

Water diversions on the valley floor of the creek are physical barriers and reduce springtime flows, which can delay adult spring-run migration into the creek and impact outmigration of juvenile spring-run and steelhead. The five diversions are Stanford-Vina Ranch Diversion Dam, Cone-Kimball Diversion Dam, North Main Diversion Canal, Deer Creek Irrigation Dam, and an unnamed canal on Deer Creek (DWR 2005). The low flows also increase water temperatures in the lower portion of the creek, limiting juvenile rearing in the Valley reach.

The upper watershed is inaccessible for most of its length due to the steep canyon walls, except where Highway 32 parallels the creek, limiting human use. However, the unstable sloughing of soil on the canyon shelves due to roads, landings, and skid trails can affect water quality (DWR 2005). Fishing for spring-run on a catch-and-release basis (with gear restrictions) is permitted from the end of April until November 15 (NMFS 2008). The impacts of fishing on the holding and spawning adults have not been documented, but some inadvertent negative impacts due to anglers disturbing redds are possible (NMFS 2008).

Deer Creek provides relatively good rearing habitat for juvenile salmonids; but flood control activities have reduced channel diversity, riparian habitat, instream cover, and floodplain habitat (NMFS 2008). All of the water diversions have fish screens to reduce mortality, but low flows can impede fish passage (DWR 2005).

Monitoring Activities

CDFG has monitored spring-run escapement in Deer Creek since 1940 using partial weir and ladder counts (1940–1948), spawning area surveys and/or aerial redd counts (1948–1956), electronic fish counters (1963–1964), area surveys (1970–1986), carcass surveys, and snorkel surveys (1987–1991). Since 1992, CDFG staff has conducted a standardized snorkel survey to estimate the annual spawning population by making a single pass during the first week of August between Upper Deer Creek Falls and Dillon Cove. CDFG collects data on the number of salmon observed and the spatial distribution. No annual monitoring is conducted for steelhead on Deer Creek.

Restoration Activities

In 1999, USFWS prepared a draft Programmatic Environmental Assessment of anadromous fish restoration actions in Lower Deer Creek (USFWS 1999). The proposed actions were divided into 10 categories: (1) land conservation; (2) fish screens; (3) fish passage; (4) channel and instream habitat modifications; (5) spawning gravel replenishment; (6) streambank modification; (7) riparian revegetation; (8) meander belt and floodplain management; (9) agricultural management; and (10) road management.

Deer Creek was identified as a priority stream in the AFRP Final Restoration Plan (USFWS 2001). In the Restoration Plan, USFWS identified five actions to help increase the natural production of anadromous fish in Deer Creek: (1) acquire water from willing sellers to supplement instream flows in the lower 10 miles of Deer Creek; (2) develop a watershed management plan; (3) improve spawning habitat in lower Deer Creek for fall and late-fall-run Chinook; (4) restore and preserve riparian habitats along Deer Creek; and (5) plan and coordinate flood management activities with least damage to fishery resources and riparian habitat.

AFRP has funded several projects in Deer Creek to protect riparian habitat and reduce erosion. Two projects focused on protecting the riparian corridor in the lower Deer Creek watershed. In 1997, 2.5 miles of riparian corridor was acquired resulting in the protection of 468 acres of riparian habitat; another project, completed in 2004, fenced off two sections of streambank to protect a Nature Conservancy conservation easement (DWR 2005). In addition, an erosion control project was undertaken to identify the highest erosion sites in the Upper Meadows area of Deer Creek and offered engineered solutions to some specific sites (CSUC 2001a).

In August 2007, the Deer Creek Irrigation District (DCID) entered into a long-term agreement with DWR and CDFG to construct, operate, maintain, and monitor a flow enhancement program on lower Deer Creek in order to improve passage for both adult spring-run and juvenile salmonids. The Deer Creek Flow Enhancement Program provides DCID with a supplemental agricultural water supply so that surface water can remain in the creek when needed in spring and early fall to support fish passage. The supplemental supply includes water acquired from new groundwater wells, efficiency improvements to DCID's distribution system, and new water management techniques (DCID et al. 2005). Operation of the program incorporates adaptive management and a comprehensive monitoring program, and fulfills the groundwater protection requirements in the Tehama County AB 3030 Groundwater Management Plan (DCID et al. 2005).

The instream flows are augmented when the flows below the Stanford-Vina Diversion Dam are measured at less than or equal to 50 cfs between April 1 and June 30, and again between October 15 and November 15 (DCID 2008). In that case, DCID bypasses up to 10 cfs of surface water in Deer Creek. CDFG also can request DCID to bypass up to 30 cfs for 1 or 2 consecutive days in order to generate a pulse flow to attract migrating adults (DCID 2008). As part of the agreement, CDFG will conduct a Fish Passage Management Assessment Program to evaluate the effectiveness of the flow actions (DCID 2008). In addition to the Flow Enhancement Program, DWR is working with DCID to improve fish passage at the DCID Diversion Dam (DWR website). DWR is currently developing a detailed topographic survey of the area and will conduct a preliminary engineering investigation (DWR website).

The Stanford-Vina Ranch Irrigation Company (SVRIC) has improved its fish ladder on the Stanford-Vina Ranch Diversion Dam and constructed a holding pool downstream of the dam to improve adult passage (DWR 2005). The SVRIC also has voluntarily bypassed instream flow upon request by CDFG to augment flows during critical migration periods for anadromous salmonids (DWR 2005).

Further downstream, the Deer Creek Watershed Conservancy (DCWC) is working on a Lower Deer Creek Restoration and Flood Management Feasibility Study with funding from the CALFED ERP (Tompkins et al. 2007). The project is intended to implement flood management actions that provide flood flow conveyance while improving ecosystem health and function (Tompkins et al. 2007). The project includes baseline monitoring, a feasibility study, identifying project elements, conceptual design of those elements, environmental documentation, implementation, monitoring, and adaptive management. As part of the study, Mussetter Engineering et al. (2007) identified two sets of alternatives—one that involves actions downstream of Highway 99 and another that involves actions upstream of Highway 99, two hydraulically disconnected reaches.

Deer Creek, like Antelope and Mill Creeks, is one of few remaining tributaries streams where salmonids have access to the historical headwater stream habitat with a natural hydrograph in the upper watershed (Armentrout et al. 1998). The average natural production has been estimated at 3,260 spring-run Chinook and approximately 1,000 steelhead (CH2M Hill 1998). Due to the steep sides of the canyon, human land use impacts are mostly limited to the valley floor portion of the watershed. Similar to Mill Creek, AFRP and other organizations recognized the importance of Deer Creek for spring-run Chinook and have funded numerous restoration projects over the last 10 years.

Butte Creek

Spawning/ Holding Habitat

Butte Creek currently supports an independent, self-sustaining spring-run Chinook population (Lindley et al. 2007). This population is also the largest remaining population in the Central Valley. Near the headwaters, several small tributaries converge in the Butte Meadows basin then Butte Creek flows through a steep canyon approximately 25 miles in length where it drops into the valley floor near the city of Chico (BCWP 1998). Approximately 6 miles downstream of the Butte Meadows is the first major diversion dam, the Butte Creek Diversion Dam (also referred to as the Butte Creek Head Dam). Downstream of the Butte Creek Diversion Dam is a section with several large waterfalls that is "pool-drop" in nature and is believed to restrict upstream salmonid migration except during periods of extremely high flows (BCWP 1998). Butte Creek continues downstream to the DeSabla Powerhouse where the creek is commingled with water from the West Branch of the Feather River (PG&E 2007b). Just downstream of the DeSabla Powerhouse, Butte Creek is diverted at the Centerville Diversion Dam, which is considered the upper limit for salmonid migration (PG&E 2007b).

During summer, spring-run Chinook use holding pools between a natural barrier (known as the Quartz Bowl) about 1 mile below Centerville Diversion Dam and the Honey Run Covered Bridge, a distance of about 10 miles (BCWP 1998). Most of the spawning occurs in this area, but spring-run also move further downstream near the Parrot-Phelan Diversion (BCWP 1998). In years with higher flows, both spatial and temporal overlap in spawning of fall and spring-run Chinook can occur; in most years, fall-run spawning occurs downstream of the Parrot-Phelan Diversion (CH2M Hill 1998). Imported water from the Feather River may encourage straying by Feather River Hatchery spring-run Chinook into Butte Creek.

Historically, steelhead may have accessed the Butte Meadows, but spawning is now restricted to the area between the Centerville Diversion Dam and Parrot-Phelan Diversion on the mainstem and to tributaries such as Dry Creek, except during periods of extremely high flows (BCWP 1998).

Rearing Habitat

Because spawning occurs at a much lower elevation in Butte Creek compared to Mill and Deer Creeks, the spring-run exhibit more of an ocean-type life history. Most of the fry migrate out of the creek upon emergence while a smaller fraction migrates as juveniles in spring (BCWP 1998). A few spring-run remain and migrate as yearlings the following fall. Steelhead and the remaining spring-run rear below Centerville Diversion Dam where summer flows are generally high enough to keep water temperature below 68 °F (BCWP 1998). The fry that migrate upon emergence use both the lower portion of Butte Creek and the Sutter Bypass for rearing prior to emigration in the late spring (BCWP 1998).

Limiting Factors

Fish passage is a major factor affecting both adult and juvenile salmonids in Butte Creek. Starting from the Sutter Bypass, adult salmonid passage is affected by about 22 major structures—including agricultural diversions, hydroelectric dams, and flood bypasses (DWR 2005). Low flows and the associated increased water temperatures can be problematic for all life stages of salmonids within Butte Creek. Water quality is generally good in the upper watershed, but dissolved oxygen concentrations and water temperatures are the primary water quality issues in the lower portion of Butte Creek (DWR 2005). Agricultural and flood management practices have altered the natural stream processes, reducing the amount of riparian habitat in Butte Creek (DWR 2005). Beneficial uses that can impact salmonid habitat include gravel extraction, mining, recreation, water diversions for waterfowl habitat, and timber harvest (DWR 2005).

Monitoring Activities

Since 1995, CDFG staff has conducted a snorkel survey on Butte Creek in July—from the Quartz Bowl to the Covered Bridge—to estimate the annual escapement of spring-run Chinook and steelhead. CDFG collects data on the number of spawners, age distribution, and spatial distribution. From 1954 to 1990, CDFG estimated spring-run escapement based on expansions from an annual carcass, redd, and live salmon counts survey. In 1991, CDFG switched to the snorkel survey; and the methods were standardized in 1995. PG&E also conducted a snorkel survey in Butte Creek from 1981 to 1994.

Since 1995, CDFG staff also has conducted a carcass survey to estimate spring-run escapement. The survey is conducted between June 15 and December 31 each year between the Quartz Bowl and the Western Canal Siphon. CDFG uses the survey to calculate the annual spring-run escapement along with an estimate of pre-spawn mortality, spatial and temporal distribution, and size and age composition.

Restoration Activities

Formation of the Butte Creek Watershed Conservancy (BCWC) in 1995 brought together landowners; water users; recreational users; conservation groups; and local, state, and federal agencies to protect, restore, and enhance the Butte Creek watershed (BCWC 2000). BCWC enlisted the services of California State University (CSU), Chico to prepare an Existing Conditions Report that was completed in 1998. The Existing Conditions Report was used to support BCWC in preparing a Watershed Management Strategy that was completed in 2000. The Watershed Management

Strategy outlines a series of goals and objectives to provide an adaptive management framework and a list of potential projects and actions (BCWC 2000).

The goals and objectives addressed issues related to education and outreach, recreation, fisheries, fuel load, timber management, road erosion, groundwater and water supply, water quality, and flooding (BCWC 2000). For fisheries, the goal was to help enhance and maintain the native fishery—with emphasis on salmon and steelhead. The objectives included supporting efforts to improve passage; protect and enhance existing riparian habitat by providing outreach, assistance, and incentives to willing landowners; maintain and improve water quality through monitoring and encouraging implementation of best management practices (BCWC 2000). Since then, BCWC has worked on projects to improve fish passage, provided facilities for community cleanups, and supported educational programs within the watershed. Currently, BCWC is completing the education and outreach portions of two grants, the CALFED Rural Roads Grant and the Butte Creek Groundwater Modeling Grant (BCWC website).

Butte Creek was identified as a priority stream in the AFRP Final Restoration Plan (USFWS 2001). In the Restoration Plan, USFWS identified 14 high-priority and 27 medium-priority actions to help increase the natural production of anadromous fish in Butte Creek. The priority actions addressed increasing instream flow, passage and screens at diversions, removing dams, developing a watershed management plan, establishing operational criteria, and evaluating juvenile spring-run Chinook life history (USFWS 2001). Since 2001, AFRP has provided approximately $2.5 million towards these restoration actions (AFRP website).

Western Canal District involvement in restoration actions to improve passage in the middle reaches of the mainstem of Butte Creek has resulted in removal of five diversion dams: the Western Canal Main Dam, Western Canal East Channel Dam, Point Four Dam, McGowan Dam, and McPherrin Dam (DWR 2005).

CDFG worked with landowners and other agencies to improve passage in Butte Creek, including installing a new fish screen and a pool and chute ladder at the Parrot-Phelan Diversion Dam (DWR 2005). CDFG is conducting a multi-year study on juvenile spring-run Chinook life history and manages a 285-acre Ecological Preserve along Butte Creek. In 1998, with funding from USFWS, National Fish and Wildlife Foundation, CALFED, and the Wildlife Conservation Board, the CSU, Chico Research Foundation purchased a 93-acre parcel now known as the Butte Creek Ecological Preserve Honey Run unit. The unit is adjacent to the CDFG Butte Creek Canyon Ecological Reserve (CSUC 2001b). The management goals for the Honey Run unit are restoring, protecting, and enhancing habitat for spring-run Chinook and steelhead; improving riparian habitat; and creating a living laboratory and field classroom (CSUC 2001b).

DWR engineered three fish ladders and screen designs. The ladders and screens were constructed in 1997 at Durham Mutual, Adams, and Gorrill Diversion Dams (DWR 2005). In 1999, the Sanborn Slough/Butte Creek Bifurcation Structure was modified to improve flow and fish passage. DWR also is working with Ducks Unlimited and various consulting firms on the multi-faceted Lower Butte Creek Project (DWR 2005). As part of the Lower Butte Creek Project, the Sutter Bypass East Borrow Canal Water Control Structures Project modifies Weir No. 2 and the Willow Slough Weir, including replacing existing fish ladders to improve passage (DWR website).

PG&E is in the process of relicensing the DeSabla-Centerville Project, FERC Project No. 803, with FERC. The current license expires in October 2009. PG&E is proposing to continue operating the project with no changes to the generation facilities but will adopt resource management measures, remove five stream diversions that are no longer used, and rebuild or refurbish the Centerville Powerhouse (PG&E 2007b). Since 1999, PG&E has worked with CDFG, NMFS, and USFWS to develop an Annual Operations and Maintenance Plan to enhance and protect spring-run Chinook habitat each summer. PG&E releases water from Round Valley and Philbrook Reservoirs to provide additional cool water for spring-run holding from June until mid-September each year (PG&E 2007b). In addition, PG&E increased flows below Lower Centerville Diversion Dam to 60 cfs from late September through February in 2004 to increase spring-run spawning habitat (PG&E 2007b). In following years, PG&E has increased the instream flows from 60 to 75 cfs. In the FERC license application, PG&E proposed additional changes to the minimum instreamflow releases below Lower Centerville Dam based on water-year type in order to continue maximizing the cool water benefits for spring-run Chinook holding, spawning, and rearing (Table 2).

Table 2. Proposed Minimum Instream Flows below Lower Centerville Diversion Dam According to Water-Year Type

Months	Normal Water-Year Type Minimum Instream Flows	Dry Water-Year Type Minimum Instream Flows
Sep 15 – Jan 31	75 cfs	60 cfs
Feb 1 – Apr 30	80 cfs	75 cfs
May 1 – May 31	80 cfs	65 cfs
Jun 1 – Sep 14	40 cfs	40 cfs

Source: Pacific Gas and Electric Company. 2007. DeSabla-Centerville Project: license application. FERC Project No. 803. October. San Francisco, CA.

The spring-run Chinook population in Butte Creek has increased in the last 10 years in part due to the restoration activities taking place (Figure 2). Due to the low elevation of the watershed, years with below-normal precipitation water temperatures can limit spring-run salmon production. High levels of pre-spawn mortality can occur in years when summer water temperatures exceed the tolerance of holding spring-run Chinook. High summer water temperatures also can affect salmonid rearing within Butte Creek. Recent and ongoing improvements in the Sutter Bypass, however, are providing additional salmonid rearing habitat.

Big Chico Creek

Spawning/ Holding Habitat

Historically, Big Chico Creek supported a small run (up to 1,000 fish) of spring-run Chinook, but a viable population is no longer believed to exist (CH2M Hill 1998). Spring-run Chinook have been observed in low numbers in recent years, and water temperatures below Iron Canyon often exceed their tolerance during the summer holding and egg incubation period. Spring-run summer holding and spawning habitat is limited to a 9-mile stretch between Iron Canyon and Higgin’s Hole in the foothill reach of Big Chico Creek (BCCWA date unknown). Although passage through Iron Canyon Fish Ladder can be impeded in low-flow years, the habitat in this upper portion of the watershed is relatively pristine (CH2M Hill 1998).

Steelhead also use Big Chico Creek, and spawning occurs in the foothill reach (BCCWA date unknown). Steelhead distribution data are limited due to a lack of species-specific monitoring. Historically, steelhead were observed in Big Chico Creek, and their presence has been detected in recent monitoring by CDFG.

Rearing Habitat

Both the foothill reach, between Higgin's Hole and Iron Canyon, and the valley reach provide salmonid rearing habitat (BCCWA unknown date). Conditions in the foothill reach are suitable for the year-round rearing necessary for steelhead (BCCWA unknown date). Rearing also occurs in Mud and Rock Creeks although habitat in these creeks has been degraded by flood control measures leading to high water temperatures in most years (CH2M Hill 1998).

Limiting Factors

Low flows and high water temperatures are the most limiting factors in Big Chico Creek for spring-run and steelhead. Low flows affect passage for both adults and juveniles. Loss of riparian habitat in the valley reach and diversion by flood control structures also limit salmonid production (BCCWA 2006).

Monitoring Activities

CDFG staff conducts a single snorkel survey on Big Chico Creek each July to estimate the annual escapement of spring-run Chinook and steelhead. CDFG collects data on the number of spawners, age distribution, and spatial distribution. From 1956 to 1985, CDFG estimated spring-run Chinook escapement based on expansions from observational surveys. In 1989, CDFG switched to the snorkel survey; and the methods were standardized in 1995.

Restoration Activities

The Big Chico Creek Watershed Alliance adopted a Watershed Management Strategy in 2006 (BCCWA 2006). The management strategy identifies goals, objectives, and potential actions to protect and enhance both the ecological integrity and economic vitality of the watershed. Several goals related to salmonids include restoring water quality, restoring sustainable populations of native fish, restoring functioning riparian habitat, and eradicating non-native plant species.

Some of the specific actions include reducing agricultural and urban runoff, reducing stream temperatures, improving the Iron Canyon Fish Ladder, improving passage at diversion dams and culverts, enhancing rearing habitat, restoring floodplain and riparian habitats, and eradicating non-native plant species and replanting with native species.

DWR prepared a Preliminary Engineering Technical Report (2002) for the proposed Iron Canyon Fish Ladder repair. Following this technical report, HDR et al. (2006) evaluated the feasibility of the project. HDR et al. (2006) concluded that no physical constraints would preclude construction of the ladder and that performance of the proposed ladder was expected to surpass that of the existing ladder over its 50-year life span. Improvements to the existing ladder would allow passage to existing spawning and holding habitat over a broader range of flows (HDR et al. 2006).

Yuba River

Spawning/ Holding Habitat

Englebright Dam (RM 24) is the upper limit for salmonid migration in the Yuba River (CH2M Hill 1998). The channel below Englebright Dam, referred to as the Lower Yuba River channel, is still strongly influenced by the effects of historical hydraulic mining (ENTRIX and Monroe 2003). The entire Lower Yuba River channel is accessible to both spring and fall-run Chinook for spawning and rearing.

The section just downstream of Englebright Dam to the confluence with Deer Creek does not provide adequate habitat for spring-run spawning due to the bedrock canyon geometry, high velocities, and lack of spawning gravel (Pasternack 2008). This reach is the most heavily impacted, and spring-run were observed clustering in this area where they failed to reproduce (Pasternack 2008).

Below this reach is the Rose Bar reach, as defined by ENTRIX and Monroe(2003), which has a relatively complex stream morphology consisting of deep pools, long riffles and runs, low amounts of fine sediment, and low water temperatures (ENTRIX and Monroe 2003). This reach has good spawning gravel and provides adequate spawning and holding habitat for spring-run Chinook (ENTRIX and Monroe 2003). Pasternack (2008) noted that this section is incising due to a lack of sediment influx but nevertheless is geomorphically self-sustaining, with excellent Chinook salmon spawning habitat and sufficient gravel supplies.

The next reach, Parks Bar, is approximately 6 miles long between the Rose Bar Reach and Daguerre Point Dam. The channel is less sinuous with wide, flat, fluvial terraces and sparse riparian habitat (ENTRIX and Monroe 2003). The upper 2 to 3 miles of the reach are similar to the Rose Bar reach and provide the best spawning and holding habitat in this reach; however, spawning does occur throughout the reach along the cobble bars and the backwater areas of side channels (ENTRIX and Monroe 2003).

Both the Rose Bar and Parks Bar reaches support steelhead spawning, but habitat availability and quality may be more limiting due to the preponderance of larger cobble and small boulders (ENTRIX and Monroe 2003). Pasternack (2008) noted that there are temporary local patches of finer gravel for steelhead spawning.

The Daguerre reach, beginning at the Daguerre Point Dam (RM 11) and ending at the confluence with the Feather River, is used by adult spring-run only as a migration corridor. The river gradient decreases in this stretch and the floodplain widens, with only a few deep pools (ENTRIX and Monroe 2003). Summer water temperatures and the lack of sufficient holding pools make the reach unsuitable for spring-run spawning and holding.

CDFG (1991) calculated that spring flows of 1,000 cfs in April, 2,000 cfs in May, and 1,500 cfs would provide adequate spring-run Chinook attraction and adult migration flows. Flows at 700 cfs would provide adequate conditions for salmonid adult migration and spawning, and would prevent redd dewatering between mid-October and March (CDFG 1991).

Rearing Habitat

All three reaches provide suitable rearing habitat, and the upper reaches provide adequate year-round temperatures to support the spring-run yearling life stage. However, the Daguerre reach may not be as suitable in some years, especially low-flow years, due to higher water temperatures and more predation pressure (ENTRIX and Monroe 2003). Based on an analysis conducted by CDFG (1991), the greatest amount of rearing habitat for fry occurs at flows of 100 cfs and between 150 and 200 cfs for juvenile Chinook. However, CDFG calculated that flows near 700 cfs between mid-October and March did not significantly reduce the amount of fry and juvenile habitat while benefitting early outmigrant spring-run juveniles and spawning adults. The higher spring flows (1,000 to 2,000 cfs) also reduce the amount of fry and juvenile habitat but are necessary for the needs of other life stages (CDFG 1991).

The greatest amount of steelhead fry habitat occurs between 100 and 200 cfs (CDFG 1991). For steelhead, juvenile flows between 200 and 350 cfs maximize the amount of rearing habitat; however, spawning steelhead need flows between 600 and 800 cfs (CDFG 1991). Below Daguerre Point Dam, adequate juvenile steelhead rearing conditions are available when flows are between 250 and 450 cfs, between July and mid-October (CDFG 1991).

Limiting Factors

Englebright Dam is an impassable barrier to spring-run migration into the upper reaches of the watershed, limiting spawning habitat availability. The lack of spawning habitat and gravel in the reach just below Englebright Dam also can affect spring-run production in the Yuba River (Pasternack 2008). In the reach below Daguerre Point Dam, gravel recruitment is limited except when flows are high enough to move gravel from the mined debris along the edge of the riverbank (ENTRIX and Monroe 2003). Because of no spatial separation with fall-run, redd superimposition can occur in the two reaches above Daguerre Point Dam (ENTRIX and Monroe 2003).

Spring-run passage through the fish ladder on Daguerre Point Dam can be delayed when springtime flows are less than 400 cfs or greater than 2,500 cfs (ENTRIX and Monroe 2003). Steelhead passage at Daguerre Point Dam can be delayed when fall flows are greater than 2,000 cfs (ENTRIX and Monroe 2003). When passage is delayed for an extended period, the chance of injury associated with attempting to pass over the dam face is increased; or a loss of condition can affect egg production (ENTRIX and Monroe 2003).

The existing riparian habitat below Daguerre Point Dam only minimally benefits rearing salmonids (CDFG 1991). The loss of riparian habitat reduces nutrient inputs to the river and increases water temperatures, making the lowest portion of the river less suitable for juvenile Chinook and steelhead rearing. Entrainment of juvenile Chinook in agricultural diversions also reduces spring-run Chinook and steelhead production in the Yuba River. There are three major diversions facilities on the Lower Yuba River: Browns Valley Irrigation, Hallwood-Cordua, and South Yuba and Brophy Water Districts (CDFG 1991).

Monitoring Activities

CDFG and USFWS conducted spring-run spawning surveys on the Yuba River between 1999 and 2003; historically, annual surveys were conducted only sporadically starting in 1972 (ENTRIX and Monroe 2003). In 2003, CDFG installed a Vaki River-Watcher system in the fish ladders on Daguerre

Point Dam. The automated fish counters allow for continuous monitoring of adult salmonid passage through the fish ladders and evaluation of the temporal distribution of Chinook salmon and steelhead populations and straying rates of non-native salmonids.

Restoration Activities

The Yuba County Water Agency (YCWA) worked with a coalition of stakeholders and agencies to develop a set of agreements that form the proposed Lower Yuba River Accord (Yuba Accord) (YCWA 2005). The Yuba Accord resolves nearly 15 years of litigation over instream flows requirements for the Lower Yuba River (YCWA 2005) that were recommended in the CDFG Lower Yuba River Fisheries Management Plan. The Yuba Accord has three separate proposed agreements: a Fisheries Agreement, a Water Purchase Agreement, and a Conjunctive Use Agreement (YCWA 2005).

The Fisheries Agreement establishes new instream flow requirements based on the water-year type (YCWA 2005). The higher flows will improve instream habitat conditions during summer and fall months in part for spring-run holding and spawning, and juvenile steelhead rearing. The agreement also provides funding for long-term scientific fisheries monitoring, studies, and enhancement projects (YCWA 2005). Implementation of the instream flows was started on an interim basis in 2006, with full implementation to begin in 2008. The final environmental impact report/environmental impact statement for the Yuba Accord was completed in October 2007.

The Daguerre Point Dam Fish Passage Improvement Project was initiated, with DWR and the U.S. Army Corps of Engineers (USACE) as lead agencies, to address the fish passage problem identified at Daguerre Point Dam (Wood Rodgers 2003). The goal of the project is to improve upstream and downstream passage for salmonids while keeping water interests whole and not increasing the risk of flood (Wood Rodgers 2003). Wood Rodgers (2003) evaluated the benefits, limitations, and estimated cost of the alternative projects identified by the Yuba River Technical Working Group. The alternatives include: (1) no action; (2) build new fish passage facilities at either the existing location or at a new location or low-head weirs; (3) notch the dam; (4) construct either a short or long reach natural channel around the dam; and (5) remove the dam and construct new fish screens and pump stations at the existing location or 3 miles upstream (Wood Rodgers 2003).

In November 2007, University of California, Davis, USFWS, and USACE implemented an experimental gravel injection project just below Englebright Dam to evaluate its use as a habitat enhancement tool for spring-run Chinook (Pasternack 2008). Because flows were not sufficiently high in winter 2008 to mobilize the gravel, the results from the project are not yet available. However, modeling efforts conducted as part of the project demonstrated constriction of the upper part of the Englebright reach, which limits the potential for gravel deposition (Pasternack 2008). Pasternack (2008) concluded that this reach is not geomorphically self-sustaining like the reach below, scour is focused on the center of the channel preventing cross-channel gravel riffles from forming, and gravel deposition would occur only along channel margins and recirculation zones. In addition, shot rock has replaced a large point bar, composed of spawning gravel, and is taking up potential deposition space (Pasternack 2008).

The Upper Yuba River Studies Program Study Team (Study Team) prepared a watershed habitat assessment of the Upper Yuba River for DWR in 2007. The purpose of the assessment was to determine the biological, environmental, and socioeconomic feasibility of introducing Chinook salmon and steelhead into the watershed above Englebright Dam (UYRSPST 2007). The assessment focused on the Middle and South Yuba River because the North Yuba River is blocked by New

Bullards Bar Dam (UYRSPST 2007). Water temperatures could potentially limit the use of both forks by Chinook and steelhead. Field studies conducted in 2003 suggested that water temperatures were problematic; however, further analysis conducted in 2004 found that temperatures were thermally suitable for holding on a portion of the Middle Yuba River (UYRSPST 2007).

Approximately 5.6 miles of habitat on the Middle Yuba River were thermally suitable, and 0.5 mile was within the optimal range for spring-run Chinook holding and spawning below a natural barrier (UYRSPST 2007). The Study Team (UYRSPST 2007) estimated that combined habitat would support approximately 600 spring-run Chinook. An increase in flow would extend the habitat by an additional 11.7 miles and support a total of 1,650 spring-run Chinook. The increased flow also would provide 14 miles of steelhead spawning habitat supporting approximately 2,640 adults (UYRSPST 2007). Under 2004 operations, conditions were suitable for fall-run Chinook; therefore, hybridization and redd superimposition could reduce spring-run production on the Middle Yuba River (UYRSPST 2007).

2004 operations provided suitable habitat and thermal conditions to support other life stages of both spring-run Chinook and steelhead on the Middle Yuba River. Given the results, the Study Team determined that the upper watershed is capable of supporting salmonids and that increased flow would lengthen the amount of thermally suitable habitat for both spring-run Chinook and steelhead on the Middle Yuba River (UYRSPST 2007). The South Yuba River did not have suitable thermal conditions under 2004 operations, but operational changes could lower water temperatures to support spring-run Chinook and steelhead spawning (UYRSPST 2007).

NMFS recently issued a contract for a watershed-based habitat suitability assessment and conceptual plans for engineered fish passage design alternatives to allow fish passage through or around Englebright Dam (Edmondson pers. comm.). The contract is scheduled for completion by the end of the fiscal year 2009. The plan will, in part, identify potential habitat, facilities, and conceptual-level operation procedures and will clarify the hydropower regulatory environment among the multiple licensees and agencies (Edmonson pers. comm.).

The lower Yuba River does not have a self-sustaining, independent population of spring-run Chinook; however, it does have a small spring-run population that is supported by Feather River Hatchery operations (DWR 2007, Lindley et al. 2007). The lower Yuba River has a relatively naturalized flow regime and substantial sediment storage that will support reach-scale rehabilitation (Pasternack 2008). Therefore, this small population could benefit from restoration activities. However, the Yuba River continues to experience hybridization between spring-run and fall-run Chinook due to the lack of spatial and temporal separation (Yoshiyama et al. 2001). Fish passage around Englebright Dam could be managed to provide access to spawning, holding, and rearing habitat for both spring-run Chinook and steelhead and could provide spatial separation between spring-run and fall-run Chinook.

American River

Spawning/ Holding Habitat

By 1955, with the completion of Folsom and Nimbus Dams, spring-run Chinook were extirpated from the American River. No suitable habitat for spring-run exists in the lower American River.

Steelhead are currently limited to the lower 23 miles of the American River at the confluence with the Sacramento River to Nimbus. The upper portion of lower American River from Nimbus Dam to Goethe Park (RM 14) provides a diversity of aquatic habitat unrestricted by levees, while the section downstream from Goethe Park is bordered by levees resulting in a reduction in river meander and a deeper channel (SWRI 2001).

Snider and Beak Consultants, Inc. (1992) developed a geomorphically based habitat classification system for the lower American River that divided the lower river into three reaches. Reach 1, from the confluence to Paradise Beach Recreation Area, is approximately 5 miles long and characterized by a very low channel gradient and tidal fluctuations (SWRI 2001). The reach is dominated with long uniform flatwater stretches along with bar complexes consisting of glide and pool habitats only (SWRI 2001). Reach 2, from Paradise Beach Recreation Area to the Gristmill Dam Recreation Area, is approximately 7 miles long and is characterized by a predominately sand-bed channel dominated with flatwater areas (SWRI 2001). However, Reach 2 also has eight off-channel features and bar complexes with all four habitat types (riffle, run, glide, and pool) (SWRI 2001). Reach 3, from Gristmill Dam Recreation Area to Nimbus Dam, is approximately 11 miles long and is characterized by a relatively high gradient, gravel bed channel. Reach 3 has less flatwater area than the other two reaches, five off-channel features, and various bar complexes with all four habitat types (SWRI 2001).

Most spawning occurs in the upper 3 miles of the lower American River (NMFS 2004). The total spawning area peaks at flows of 2,400 cfs, but the availability varies only slightly between 1,000 and 4,000 cfs (NMFS 2004).

Rearing Habitat

Conditions from Watt Avenue (RM 9) to Nimbus Dam are generally suitable for the year-round rearing necessary for steelhead. Steelhead occasionally can be found rearing slightly lower in the river between Paradise Beach (RM 5) and Watt Avenue, depending on water temperatures (SWRI 2001).

Limiting Factors

High water temperature between July and September is probably the primary factor limiting steelhead production in the lower American River (SWRI 2001). NMFS set the temperature objective at a daily mean temperature of 65 °F at Watt Avenue for juvenile rearing but can adjust this objective depending on the size of the coldwater pool in Folsom Reservoir each year (NMFS 2004). In years with a low coldwater pool, water temperatures can exceed 65 °F between May and October; temperatures can reach 75 °F in July and August (NMFS 2004).

Flood control releases in spring can cause redd scouring, and the flow reductions following the releases can cause redd dewatering or stranding of fry and juveniles (NMFS 2004). In addition, harvest impacts (angling), hatchery practices, loss of riparian habitat, and predation may limit steelhead production in the lower American River (SWRI 2001).

Monitoring Activities

Since 2001, CDFG has conducted redd surveys and live adult counts for steelhead to estimate the number of in-river spawners, spawning distribution and time, and the percent of hatchery to wild spawners. CDFG staff surveys every 2 weeks from December 20 through the first week in April, from Nimbus Dam (RM 23) to Paradise Beach (RM 5). The surveys are conducted by jet boat, walking, or snorkeling.

Restoration Activities

Reclamation operates Folsom and Nimbus Dams as part of the CVP; flows are managed on the lower American River to provide flood protection, water supplies, hydropower, recreational opportunities, and water quality control in the Delta (Water Forum 2005). Reclamation also manages flows to protect fish and wildlife downstream of Nimbus Dam. The American River Operations Work Group (AROG) meets once or twice a month to focus on real-time flow and water temperature management on the lower American River and provides operational recommendations to Reclamation (Water Forum 2005).

In the 1980s, the lower American River was designated as a “Recreational River” under both the California Wild and Scenic Rivers Act and the National Wild and Scenic Rivers Act. This designation provides additional protection to the scenic, wildlife, historic, cultural, and recreational value of the river (Water Forum 2005).

In 1994, the Water Forum was formed of a diverse group of business and agricultural leaders, citizen groups, environmental groups, water managers, and local governments in Sacramento County. Its purpose is to guide development of a regional solution in order to provide a reliable and safe water supply and to preserve the fishery, wildlife, recreational, and aesthetic values of the lower American River. A Memorandum of Understanding for the Water Forum Agreement that was signed in 2000 allows the region to meet its needs in a balanced way through year 2030 (Water Forum 2000).

In 2002, the Lower American River River Corridor Management Plan (RCMP) was developed by the Lower American River Task Force, with support from Sacramento Area Flood Control Agency (SAFCA), the Water Forum, and Sacramento County (Water Forum 2005). The RCMP sets goals, objectives, and actions for four distinct elements: fisheries and in-stream habitat management, vegetation and wildlife management, flood management, and recreation management. The Fisheries and Instream Habitat (FISH) Workgroup of the Lower American River Task Force developed a FISH Plan that works as a single blueprint to identify and prioritize opportunities to improve the fish and aquatic habitats in the lower American River; this plan serves as the habitat management element of the RCMP (Water Forum 2005). The goals of the FISH Plan is to increase and maintain viable populations of naturally spawning fall-run Chinook salmon, steelhead, and splittail; restore and maintain an appropriate distribution and abundance of other native species; and sustain American shad and striped bass fisheries consistent with restoring native species.

The three key areas in managing the river to protect fall-run Chinook and steelhead involve improving water temperatures and flow; restoring, maintaining, and improving fish habitat; and reducing the impact of water supply diversions (Water Forum 2005). Recent improvements related to the FISH Plan include improving and updating the flow management standards, minimizing flow fluctuations, constructing and operating a temperature control device on Folsom Dam to improve cool water pool management, implementing the Discovery Park floodplain habitat enhancement project, reducing surface water diversions, removing non-native invasive plants, and increasing riparian habitat (Water Forum 2005).

Reclamation, through CVPIA projects, has placed approximately 6,000 tons of gravel in the three sites on the lower American River to improve spawning habitat (Reclamation and USFWS 2009). In addition, several AFRP projects totaling $501,000 have been completed including an instream flow study and a temperature reduction modeling project.

Construction of Folsom and Nimbus Dams completely blocked access to spawning habitat for both spring-run Chinook and steelhead in the American River. While no suitable habitat exists in the lower American River for spring-run, a small population of steelhead remains. Water temperatures in summer and fall, flow fluctuations, and limited spawning habitat limit the potential recovery for steelhead in the American River basin.

References

Literature Cited

Airola, D. 1983. A survey of spring-run Chinook salmon and habitat in Antelope Creek, Tehama County, CA. Unpublished report. Lassen National Forest.

Armentrout, S., H. Brown, S. Chappell, M. Everett-Brown, J. Fites, J. Forbes, M. McFarland, J. Riley, K. Roby, A. Villalovos, R. Walden, D. Watts, and M. R. Williams. 1998. Watershed Analysis for Mill, Deer, and Antelope Creeks. Prepared by the Watershed Analysis Team for the U.S. Department of Agriculture. Lassen National Forest. Almanor Ranger District. Chester, CA. 299 pp.

BCCWA. See Big Chico Creek Watershed Alliance.

BCWC. See Butte Creek Watershed Conservancy.

BCWP. See Butte Creek Watershed Project.

Big Chico Creek Watershed Alliance. 2006. Big Chico Creek Watershed Management Strategy. Adopted May 8. Chico, CA.

Big Chico Creek Watershed Alliance. Big Chico Creek Existing Conditions Report. Publication date unknown. Available online: http://www.bigchicocreek.org. Chico, CA.

Brown, M. R. 1996. Benefits of increased minimum instream flows on Chinook salmon and steelhead in Clear Creek, Shasta County, CA: 1995–1996. U.S. Fish and Wildlife Service. Red Bluff, CA.

Busby P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS-NWFSC-27. Seattle, WA. 275 pp.

Butte Creek Watershed Conservancy. 2000. The Butte Creek Watershed Conservancy Watershed Management Strategy. Final Report. November. Chico, CA.

Butte Creek Watershed Project. 1998. Butte Creek Watershed Project Existing Conditions Report. Prepared for the Butte Creek Watershed Conservancy. August. California State University, Chico. Chico, CA.

CALFED. See California Bay-Delta Program.

California Bay-Delta Program. 2001. Ecosystem restoration program draft Stage 1 implementation plan. August 6. Sacramento, CA.

California Department of Fish and Game. 1952. Fisheries problems of the Feather River with special reference to the proposed Oroville Dam. Sacramento, CA.

California Department of Fish and Game. 1960. Division of Fish and Game 46th biennial report: July 1, 1958 through June 30, 1960. Sacramento, CA.

California Department of Fish and Game. 1966. California Department of Water Resources. Bulletin No. 137. Sacramento Valley East Side Investigation. Appendix C, Fish and Wildlife. Sacramento, CA.

California Department of Fish and Game. 1990. Status and management of spring-run Chinook salmon. Report by Inland Fisheries Division to California Fish and Game Commission. Sacramento, CA. 33 pp.

California Department of Fish and Game. 1991. Lower Yuba River fisheries management plan. Sacramento, CA. 197 pp.

California Department of Fish and Game. 1993. Restoring Central Valley streams: A plan for action. Available online: http://www.dfg.ca.gov/nafwb/pubs/1993/RCVS.pdf.

California Department of Fish and Game. 1998. A status review of the spring-run Chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento River drainage. Sacramento, CA.

California Department of Fish and Game. 2000. Butte Creek, Big Chico Creek, and Sutter Bypass Chinook salmon and steelhead evaluation. Sacramento, CA.

California Department of Fish and Game. 2004a. Butte and Big Chico Creeks spring-run Chinook salmon, *Oncorhynchus tshawytscha* Life History Investigation 2002–2003. Inland Fisheries Administrative Report No. 2004-6. Prepared by P. D. Ward, T. R. Reynolds, and C. E. Garman. Sacramento Valley-Central Region. Sacramento, CA.

California Department of Fish and Game. 2004b. Sacramento River spring-run Chinook salmon. Biennial Report 2002–2003. Prepared for the California Fish and Game Commission. Sacramento, CA.

California Department of Water Resources. 2002. Iron Canyon and Bear Hole fish passage project on Big Chico Creek. Preliminary engineering technical report. Division of Planning and Local Assistance. 60 pp. with preliminary engineering drawings and Appendices A–E. Sacramento, CA.

California Department of Water Resources. 2005. Fish passage improvement. Bulletin 250. June. Sacramento, CA.

California Department of Water Resources. 2007. Biological assessment for federally listed anadromous fishes. Oroville Facilities Relicensing FERC Project No. 2100. Sacramento, CA.

Campbell, E. A., and P. B. Moyle. 1990. Effects of temperature, flow, and disturbance on adult spring-run Chinook salmon. University of California, Water Resources Center. Technical Completion Report W-764. Department of Wildlife and Fisheries Biology. University of California at Davis, California. Davis, CA. 39 pp.

CDFG. See California Department of Fish and Game.

CH2M Hill. 1998. Central Valley Project Improvement Act Tributary Production Enhancement Report. Draft report to Congress. Prepared for U.S. Fish and Wildlife Service. Sacramento, CA.

CH2M Hill. 2002. Cottonwood Creek Watershed Assessment. Red Bluff, CA. 712 pp.

CH2M Hill. 2007. Cottonwood Creek Watershed Management Plan. Prepared for Cottonwood Creek Watershed Group. September. Red Bluff, CA.

California State University, Chico Research Foundation and Meadowbrook Conservation Associates. 2001a. Deer Creek Erosion Control Project Final Report. Prepared for U.S. Fish and Wildlife Service and the Deer Creek Watershed Conservancy. August. Chico, CA.

California State University, Chico Research Foundation. 2001b. Butte Creek Ecological Preserve Honey Run Unit Management Plan. California State University, Chico. July. Chico, CA.

Clark, G. H. 1929. Sacramento-San Joaquin salmon (*Oncorhynchus tschawytscha*) fishery of California. California Department of Fish and Game. California State Printing Office. Sacramento, CA.

Cramer, S. P. and D. B. Demko. 1997. The Status of Late-Fall and Spring Chinook Salmon in the Sacramento River Basin Regarding the Endangered Species Act. Special Report submitted to National Marine Fisheries Service on behalf of Association of California Water Agencies and California Urban Water Agencies. Sacramento, CA.

CSUC. See California State University, Chico Research Foundation.

DCID. See Deer Creek Irrigation District.

Deer Creek Irrigation District. 2008. Deer Creek flow enhancement project fact sheet. Prepared for California Environmental Quality Act Scoping Meeting. May 1. Vina, CA.

Deer Creek Irrigation District, California Department of Fish and Game, and California Department of Water Resources. 2005. Agreement between the State of California Department of Fish and Game, California Department of Water Resources, and Deer Creek Irrigation District for construction, operation, maintenance, and monitoring of a flow enhancement program on Deer Creek in Tehama County. Draft agreement edited November 28. Sacramento, CA.

DWR. See California Department of Water Resources.

ENPLAN. 2006. Bear Creek watershed assessment. Prepared for Western Shasta Resource Conservation District. January. Redding, CA.

ENTRIX, Inc., and J. Monroe. 2003. Daguerre Point Dam fish passage improvement project. 2002 fisheries studies: Analysis of potential benefits to salmon and steelhead from improved fish passage at Daguerre Point Dam. Prepared for California Department of Water Resources and U.S. Army Corps of Engineers. Sacramento, CA. 78 pp.

Fisher, F. W. 1994. Past and present status of Central Valley Chinook salmon. *Conservation Biology* Vol. 8:870–873. Blackwell Publishing, Inc. Malden, MA.

Fry, D. H. 1961. King salmon spawning stocks of the California Central Valley, 1940–1959. California Department of Fish and Game. Vol. 47:55–71. Sacramento, CA.

GCRCD. See Glenn County Resource Conservation District.

Giovannetti, S. L. and M. R. Brown. 2007. Central Valley steelhead and late-fall Chinook salmon redd surveys on Clear Creek, California, 2007. U.S. Fish and Wildlife Service. December. Red Bluff, CA.

Glenn County Resource Conservation District. 2006. Long Range Plan 2006–2011. Adopted July 17. Willows, CA.

Glenn County Resource Conservation District. 2008. 2007–2008 Annual Report. Willows, CA.

H. T. Harvey & Associates, G. M. Kondolf, Fluvial Geomorphology Consulting, Graham Matthews & Associates, and Watersheds & Fish. 2007a. Stony Creek Watershed Assessment. Volume 1: Lower Stony Creek Watershed Analysis. Prepared for Glenn County Resource Conservation District. Project No. 2610-01. Willows, CA.

H. T. Harvey & Associates, G. M. Kondolf, Fluvial Geomorphology Consulting, Graham Matthews & Associates, and Watersheds & Fish. 2007b. Stony Creek Watershed Assessment. Volume 2: Existing Conditions Report. Prepared for Glenn County Resource Conservation District. Project No. 2610-01. Willows, CA.

Hanson H. A., O. R. Smith, and P. R. Needham. 1940. An investigation of fish-salvage problems in relation to Shasta Dam. U.S. Fish and Wildlife Service, Special Scientific Report No. 10. 200 pp.

Harvey, C. D. 1997. Historical review of anadromous fisheries in Deer Creek. California Department of Fish and Game. Inland Fisheries Division. Sacramento, CA.

HDR Engineering, Inc., and Sanders & Associates Geostructural Engineering, Inc. 2006. Evaluation of Iron Canyon for proposed fish ladder structure repair and construction. Report prepared for U.S. Fish and Wildlife Service. May 24.

Healey, M. C. 1991. Life History of Chinook Salmon (*Oncorhynchus tshawytscha*). Pp. 311–393 in C. Groot and L. Margolis, Eds. *Pacific Salmon Life Histories*. University of British Columbia Press. Vancouver, BC.

Johnson, P., B. Nass, D. Degan, J. Dawson, M. Johnson, B. Olson, and C. Harvey-Arrison. 2006. Assessing Chinook salmon escapement in Mill Creek using acoustic technologies in 2006. Draft technical report. Submitted to U.S. Fish and Wildlife Service, Anadromous Fish Restoration Program. November. Bonneville, WA.

Jones & Stokes. 2005. Battle Creek Salmon and Steelhead Restoration Project Final Environmental Impact Statement/Environmental Impact Report. Prepared for U.S. Department of the Interior, U.S. Bureau of Reclamation, and California State Water Resources Control Board. July. Sacramento, CA.

Kier Associates. 1999. Battle Creek Salmon and Steelhead Restoration Plan. Prepared for Battle Creek Working Group. Sausalito, CA.

Lieberman, D. M., M. J. Horn, S. Duffy. 2001. Effects of a temperature control device on nutrients, POM, and plankton in the tailwaters below Shasta Lake, California. *Hydrobiologia* 452:191–202.

Lindley, S. T., R. S. Schick, A. Agrawal, M. Goslin, T. E. Pearson, E. Mora, B. May, J. Anderson, S. Green, C. Hanson, A. Low, D. McEwan, R. MacFarlane, C. Swanson, and J. Williams. 2006. Historical population structure of Central Valley steelhead and its alteration by dams. *San Francisco Estuary and Watershed Science* 4(1):1–25.

Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. *San Francisco Estuary and Watershed Science* 5(1):1–26.

Low, A. (Ed.). IEP Salmonid Escapement Project Work Team, and IEP Juvenile Monitoring Project Work Team. 2007. Existing program summary: Central Valley salmon and steelhead monitoring program. Sacramento, CA.

Marshall, M. 2008. Battle Creek salmon and steelhead restoration project. Presented at Battle Creek Watershed Conservancy Annual Committee Meeting. September. Manton, CA.

McElhany, P., M. H. Rucklelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. National Oceanic and Atmospheric Administration, NOAA Fisheries, Northwest Fisheries Science Center. Technical Memorandum NMFS-NWFS 42. Seattle, WA.

McEwan, D.R. 2001. Central Valley steelhead. California Department of Fish and Game. *Fish Bulletin* 179:1–43. Sacramento, CA.

Moyle, P. B. 2002. Inland Fishes of California Revised and Expanded. Regents of the University of California. University of California Press. Berkeley and Los Angeles, CA.

Mussetter Engineering, Inc.; McBain & Trush; M. MacWilliams; M. Kondolf; and M. Tompkins. 2007. Memorandum to the technical advisory committee on alternatives for the Lower Deer Creek restoration and flood management study. August 15.

Myers, J. M., R. G. Hope, G. J. Bryant, D. Teel, L. Lierheimer, T. C. Wainwright, W. S. Grant, F. W. Waknitz, K. Neely, S. T. Lindley, and R. S. Waples. 1998. Status review of Chinook salmon From Washington, Idaho, Oregon, and California. National Oceanic and Atmospheric Administration Technical Memorandum. Report No. NMFS-NWFSC-35. Seattle, WA. 443 pp.

National Marine Fisheries Service. 1998. Endangered and Threatened Species; Threatened Status for Two ESUs of Steelhead in Washington, Oregon, and California. 50 CFR Parts 227. *Federal Register* Vol. 63, No. 53. March 19. Washington, DC.

National Marine Fisheries Service. 1999. Endangered and Threatened Species; Threatened Status for Two Chinook Salmon Evolutionary Significant Units (ESUs) in California. 50 CFR Parts 223. *Federal Register* Vol. 64, No. 179. September 16. Washington, DC.

National Marine Fisheries Service. 2002. Biological opinion on interim operations of the Central Valley Project and State Water Project between April 1, 2002, and March 31, 2004. Southwest Region. Long Beach, CA.

National Marine Fisheries Service. 2004. Endangered and threatened species; threatened designation of critical habitat for seven evolutionarily significant units of Pacific (*Oncorhynchus tshawytscha)* salmon and steelhead (*O. mykiss*) in California. Proposed Rule. 50 CFR Parts 226. *Federal Register* Vol. 69, No. 237. December 10. Washington, DC.

National Marine Fisheries Service. 2008. Recovery plan for the evolutionarily significant units of Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon and the distinct population segments of Central Valley steelhead. Co-manager review draft. May. Sacramento, CA.

Needham, J. L., O. R. Smith, H. A. Hanson. 1941. Salmon salvage problems in relations to Shasta Dam, California, and notes on the biology of the Sacramento River salmon. Transactions of the American Fisheries Society. 17th annual meeting. Bethesda, MD.

Newton, J. M. and M. R. Brown. 2004. Adult spring Chinook monitoring in Clear Creek, California, 1999–2002. U.S. Fish and Wildlife Service. Red Bluff, CA.

Newton, J. M., and M. R. Brown. 2005. Adult Spring Chinook Monitoring in Clear Creek, California, 2003–2004. U.S. Fish and Wildlife Service. Red Bluff, CA.

Nickelson, T. E., J. W. Nicholas, A. M. McGie, R. B. Lindsay, D. L. Bottom, R. J. Kaiser, and S. E. Jacobs. 1992. Status of anadromous salmonids in Oregon coastal basins. Oregon Department of Fish and Wildlife, Research and Development Section and Ocean Salmon Management. Corvallis, OR. 83 pp.

NMFS. See National Marine Fisheries Service.

Pacific Gas and Electric Company. 2007a. Kilarc-Cow Creek hydroelectric project: preliminary proposed decommissioning plan. FERC Project No. 606. September. San Francisco, CA.

Pacific Gas and Electric Company. 2007b. DeSabla-Centerville Project: license application. FERC Project No. 803. October. San Francisco, CA.

Pasternack, G. B. 2008. SHIRA-based river analysis and field-based manipulative sediment transport experiments to balance habitat and geomorphic goals on the Lower Yuba River. Prepared for the Cooperative Ecosystems Studies Unit 81332 6 J002, University of California at Davis, Department of Land, Air, and Water Resources. Final report. August. Davis, CA.

Reclamation. See U. S. Bureau of Reclamation.

Reynolds, F. L., T. Mills, R. Benthin, and A. Low. 1993. Central Valley anadromous fisheries and associated riparian and wetlands area protection and restoration action plan. California Department of Fish and Game, Inland Fisheries Division. Draft. Sacramento, CA.

Schick, R. S., A. L. Edsall, and S. T. Lindley. 2005. Historical and current distribution of Pacific salmonids in the Central Valley, CA. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. Technical Memorandum 369:1–30. Santa Cruz, CA.

SHN Consulting Engineers and Geologists, Inc. 2001. Cow Creek Watershed Assessment. Western Shasta RCD and Cow Creek Watershed Management Group. Redding, CA.

Snider, B. and Beak Consultants, Inc. 1992. Lower American River fish habitat studies. Habitat characterization of the Lower American River. October. Sacramento, CA.

Surface Water Resources, Inc. 2001. Aquatic resources of the Lower American River: Baseline report. Draft Report. Prepared for the Lower American River Fisheries and Instream Habitat (FISH) Working Group. Funded by California Bay-Delta Program, Water Forum, Sacramento Area Flood Control Agency, and the City of Sacramento. Sacramento, CA.

SWRI. See Surface Water Resources, Inc.

TCRCD. See Tehama County Resource Conservation District.

Tehama County Resource Conservation District. 2007. Bi-annual report: July 1, 2005–June 30, 2007. Red Bluff, CA.

Tehama County Resource Conservation District. 2008. Tehama west watershed management plan. August. Red Bluff, CA.

Tompkins, M., M. Kondolf, McBain & Thrush, Inc., and CH2M Hill. 2007. Deer Creek restoration and flood management project monitoring plan. Prepared for Deer Creek Watershed Conservancy. Funded by California Bay-Delta Authority Ecosystem Restoration Program ERP-02D-P53. April. Vina, CA.

U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service. 2001. Record of Decision: Central Valley Project Improvement Act (CVPIA) final programmatic environmental impact statement. U. S. Bureau of Reclamation Mid-Pacific Region and U.S. Fish and Wildlife Service California-Nevada Operations Office. January. Sacramento, CA.

U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service. 2007. CVPIA fiscal year 2008 annual work plan. Clear Creek Restoration, CVPIA Section 3406(b)12. Revised November 7. Sacramento, CA.

U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service. 2009. Draft CVPIA fiscal year 2009 annual work plan. Gravel Replacement Program, CVPIA Section 3406(b)13. December 1. Sacramento, CA.

U.S. Fish and Wildlife Service. 1995. Working paper on restoration needs: habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. Sacramento, CA. 937 pp.

U.S. Fish and Wildlife Service. 1999. Draft Programmatic Environmental Assessment, Anadromous Fish Restoration Actions in Lower Deer Creek. Prepared by Sacramento Fish & Wildlife Office. Sacramento, CA. December. Sacramento, CA.

U.S. Fish and Wildlife Service. 2001. Final restoration plan for the anadromous fish restoration program. Prepared for the Secretary of the Interior. January 9.

Upper Yuba River Studies Program Study Team. 2007. Upper Yuba watershed Chinook salmon and steelhead habitat assessment. Technical report prepared for the California Department of Water Resources. November. Sacramento, CA.

USFWS. See U. S. Fish and Wildlife Service.

UYRSPST. See Upper Yuba River Studies Program Study Team.

Vestra Resources, Inc. 2006. Tehama west watershed assessment. Prepared for Tehama County Resource Conservation District. April. Red Bluff, CA. 548 pp.

Water Forum. 2000. The Water Forum agreement. January. Available online: http://www.waterforum.org/agreement.cfm.

Water Forum. 2005. Lower American River: State of the river report. April. Sacramento, CA.

Western Shasta Resource Conservation District and Cow Creek Watershed Management Group. 2005. Cow Creek Watershed management plan. Redding, CA**.** 89 pp.

Western Shasta Resource Conservation District. 2006. Bear Creek Watershed management strategy. Prepared for Bear Creek Watershed Group. March.

Wood Rodgers, Inc. 2003. Daguerre Point Dam fish passage improvement project: Alternative concepts evaluation. Draft. Sacramento, CA. 106 pp.

WSRCD. See Western Shasta Resource Conservation District.

YCWA. See Yuba County Water Agency.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 1996. Historical and present distribution of Chinook salmon in the Central Valley drainage of California. Sierra Nevada Ecosystem Project: Final report to Congress, Vol. III, Assessments, Commissioned Reports, and Background Information. Centers for Water and Wildland Resources, University of California at Davis. Davis, CA.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 2001. Historical and present distribution of Chinook salmon in the Central Valley. Pp. 71–176 in R. Brown, Ed. *Contributions to the Biology of Central Valley Salmonids*. California Department of Fish and Game Fish Bulletin 179. Sacramento, CA.

Yuba County Water Agency. 2005. The proposed Lower Yuba River accord: A collaborative settlement initiative. Yuba County Water Agency brochure. Marysville, CA.

Zimmerman, C. E., G. W. Edwards, and K. Perry. 2008. Maternal origin and migratory history of *Oncorhynchus mykiss* captured in rivers of the Central Valley, California. California Department of Fish and Game. Sacramento, CA.

Personal Communications

Edmondson, Steve. Northern California Habitat Supervisor. National Marine Fisheries Service, Southwest Region Office. Santa Rosa, CA. Email to the HEA Steering Committee regarding contract issuance for an assessment of anadromous fish passage at Englebright Dam, Yuba River. September 26, 2008.

Harvey-Arrison, Colleen. Associate Fisheries Biologist. California Department of Fish and Game, Northern Region. Red Bluff, CA. Telephone conversation with Erin Chappell, California Department of Water Resources regarding spring-run life history strategies in Deer and Mill Creeks. August, 2008.

Online Sources

AFRP. See Anadromous Fish Restoration Program.

Anadromous Fish Restoration Program watershed. Available online: http://www.delta.dfg.ca.gov/afrp/watersheds.asp.

BCWC. See Butte Creek Watershed Conservancy Program.

Butte Creek Watershed Conservancy Program. Available online: http://buttecreekwatershed.org/Projects.htm.

DWR. See California Department of Water Resources Fish Passage Improvement Program.

California Department of Water Resources Fish Passage Improvement Program. Available online: http://www.watershedrestoration.water.ca.gov/fishpassage/.

Appendix F

Scoring Habitat Expansion Actions Using the HEA Criteria

Appendix F
Scoring Habitat Expansion Actions Using the HEA Criteria

The Habitat Expansion Agreement (HEA) contains several criteria for identifying, evaluating, recommending, and approving habitat expansion actions. The Steering Committee developed working definitions for the various HEA criteria to facilitate their utilization in selecting actions to be included in the Habitat Expansion Plan (HEP).The Steering Committee also developed a detailed approach for applying the HEA criteria by scoring potential habitat expansion actions based on the working definitions. The various lists of potential habitat expansion actions (found in Appendix B of the Final HEP) were developed based on scores assigned to the actions. Actions with higher scores met the most HEA criteria and were moved forward; actions with lower scores were not considered further. This approach culminated in the recommended actions presented in the Draft HEP and the Final HEP (see Chapter 2 in the Final HEP for more information about developing potential habitat expansion actions).

This appendix (1) identifies the HEA criteria working definitions used by the Steering Committee to consider potential habitat expansion actions (Sections F.1 and F.2); (2) describes the scoring procedure and rationale (Section F.3); and (3) provides the scoring results for the Lower Yuba River Actions and the Upper Yuba River Actions (Section F.4, Table F-1).

F.1 HEA Criteria Working Definitions

The HEA contains several criteria for identifying, evaluating, recommending, and approving habitat expansion actions, including:

- HEA Evaluation Criteria (Section 4.1.1 of the HEA),
- HEA Selection Criteria (Section 4.1.2 of the HEA), and
- NMFS Approval Criteria (Section 4.2.3 of the HEA).

During preparation of the Draft HEP, the Steering Committee developed working definitions for the various HEA criteria (Appendix C1 of the Draft HEP) to facilitate utilization of these criteria for selecting actions to be included in the HEP. Criteria definitions draw on the concepts captured in the HEA, current scientific literature, recovery plans, and other sources. The Steering Committee requested feedback on the working definitions from NMFS, the HEA signatories, and other stakeholders to further develop these definitions in order to consistently apply the criteria when identifying, evaluating, and recommending habitat expansion actions. Based on comments received during preparation of the Draft HEP, the Steering Committee revised the working definitions and presented them to the HEA signatories and other interested stakeholders at an August 12, 2009 informational meeting.

The *Working Definitions of Evaluation, Selection, and Approval Criteria* are available on the HEA website and are presented below. As noted above, the same working definitions were used to evaluate habitat expansion actions during preparation of the Final HEP.

F.2 Working Definitions

This section provides working definitions of the evaluation, selection, and approval criteria found in the HEA. These definitions were developed by the Steering Committee to aid in the process of selecting actions for inclusion in the HEP. The working definitions are meant to complement the HEA definitions and assist in their communication; they are not meant to replace the definitions presented in the HEA.

F.2.1 HEA Evaluation Criteria

This section presents working definitions for the 17 Evaluation Criteria (items a–q contained in Section 4.1.1 of the HEA and in italicized font below). These definitions form the basis for the Steering Committee's application of the Evaluation Criteria to the list of potential actions. Section 4.1.1 states: "The Licensees shall use the following non-exclusive and non-prioritized Evaluation Criteria to screen potential habitat expansion action(s) and develop a preliminary list of viable actions."

(a) favorable feasibility (technically feasible; supported by accepted science; low potential for disease and other risks; proven actions are favored over experimental actions);

Actions/projects should have a high likelihood of success. The type of action should be technically feasible, with a proven track record of results in similar settings. There should be a high degree of scientific support both in terms of the feasibility of the action and its potential contribution to the Habitat Expansion Threshold (HET).

(b) adequate scale of expansion of spawning, rearing and adult holding habitat (one or more larger contiguous gains is favored over numerous smaller gains; increased habitat is favored over enhanced habitat);

The HEP should focus sufficient effort to make measurable and meaningful improvement in habitat for spring-run Chinook salmon. This requires that projects be designed to solve problems limiting existing habitat potential. Several small, independent projects may not actually solve current problems and hence would provide less benefit than a larger, potentially integrated project that focuses on critical limiting factors. Similarly, the greatest potential for the HEP to make meaningful change may involve focusing projects on a limited number of watersheds (sub-basins of the Sacramento River Basin) rather than spreading projects out across many watersheds.

(c) favorable sustainability of action;

The intent of the HEA is to create "permanent" solutions to problems, or at least to provide benefits through the term of a typical Federal Energy Regulatory Commission license (i.e., up to 50 years). Where possible, projects should address the root cause of current habitat constraints rather than dealing with their symptoms or surface expression, and should consider the potential effects of climate change. Once implemented, projects ideally would be self-sustaining (i.e., requiring a minimum amount of maintenance over the long term). In conjunction with Evaluation Criterion (e), projects providing volitional access for fish to currently unoccupied habitat would likely be considered more sustainable than passage projects requiring high levels of human intervention.

(d) favorable cost-effectiveness and economic feasibility (including consideration of costs necessary to operate and maintain the expansion);

Project funding under the HEA will include capital cost, operations and maintenance (O&M), and project administration. Projects that show efficient use of funds for these cost elements will be favored. One measure of cost effectiveness is the estimated net increase in the population of spawning fish (i.e., the contribution toward the HET) versus the total cost of the action. Projects that include cost sharing, labor sharing, or other measures that allow the HEP to leverage funds, while making meaningful change, would also be favored.

(e) minimal human intervention needed to achieve access to expanded spawning, rearing and adult holding habitat (volitional access is favored over that which requires a high degree of human intervention);

Projects that provide access into habitat currently blocked to anadromous passage will be evaluated relative to the amount of human intervention (e.g., annual maintenance) required. For example, a project that removes a barrier to allow free access (requiring no further maintenance) would be favored over a trap-and-transport project that requires annual collection and transport of fish.

(f) favorable spatial separation from other populations or runs to maintain genetic diversity by minimizing interbreeding;

A priority within the HEA is the segregation of habitat for spring-run and fall-run Chinook salmon (see Section 4.2.3[d]). In the Central Valley, introgression of fall- and spring-run Chinook salmon has been identified as a potential factor limiting spring-run Chinook. In many cases, this is due to the spawning of hatchery-produced fall-run Chinook in areas where spawning of spring-run Chinook occurs. To address this problem, projects that encourage the separation of fall- and spring-run Chinook will be considered favorable under this criterion. Separation may be achieved either through physical barriers or through the development of habitat conditions that favor spring-run fish over fall-run fish. For example, projects that expand or enhance habitat for spawning in upper portions of a watershed favored by spring-run Chinook would be more desirable than projects enhancing spawning conditions in lower reaches favored by fall-run Chinook. Seasonal flow releases can be used to enhance passage and spawning of spring-run Chinook salmon.

(g) favorable spatial separation from other spawning streams to minimize population impacts of a stream-specific adverse event (geographic distribution is favored over centralization);

A priority within the HEA is the development of a new, geographically separate, self-sustaining population of spring-run Chinook (see Section 4.2.3[c]). NMFS has identified presently viable spring-run Chinook populations in Mill, Deer, and Butte Creeks—a part of the Northern Sierra Nevada diversity group delineated by the Central Valley Technical Recovery Team (Lindley et al. 2007). NMFS recovery efforts call for development of additional viable spring-run populations. In conjunction with Evaluation Criterion (b), a number of projects might need to be concentrated in a single watershed to result in sufficient environmental change to support an additional population.

(h) acceptable length of time to implement (earlier gains are favored over later gains);

Sacramento River spring-run Chinook salmon are in need of immediate assistance to support their recovery. Thus, factors important to the success of a project include not only the length of time to implement the project but also the length of time to realize benefits. Thus, “shovel-ready” projects (i.e., those projects for which implementation can begin within approximately 5 years) will be favored. “Implementation” means initiation of construction after approval of the Final HEP.

The more favorable projects will be those that need minimal additional public process, particularly related to permitting, zoning, or land use issues. In addition, projects that benefit spring-run Chinook within a relatively short period of time (e.g., approximately 10 years or less) will be favored. The environmental and biological benefits of many habitat restoration actions occur only after extended periods. For example, sufficient recovery of riparian forests to address temperature, water quality, and channel needs may require timeframes from decades to centuries to realize. While such projects will not be excluded from consideration, projects that can be implemented sooner and realize benefits within a relatively short period will be preferred.

(i) favorable local/political support;

To provide benefits in the desirable time frame (Evaluation Criterion [h]) and to make best use of available funds (Evaluation Criterion [d]), it is important that HEP projects have public support. Primary stakeholders include affected land owners, management agencies, Resource Conservation Districts (RCDs), and watershed conservancies. As a project moves through the environmental permitting/design process, crucial support from the stakeholders will be sought. An extended public review process is outside the purview of the HEA. Proposed projects should be vetted with watershed councils; RCDs; and other local, state, and federal agencies. To the maximum extent possible, permitting concerns, land ownership, and required access should be identified in the evaluation of potential actions.

(j) consistency with NMFS Viable Salmonid Population guidance, ESA recovery goals and recovery plan (as available), and expected contribution to species recovery (higher consistency and greater contributions are favored);

The NMFS Viable Salmonid Population (VSP) concept provides direction for characterization of salmonid populations listed under the Endangered Species Act (ESA) (McElhany et al. 2000). The VSP concept underlies most NMFS ESA recovery planning. Elements of VSP thinking are woven throughout the HEA (e.g., Evaluation Criteria [f] and [g]). VSP is also incorporated as part of the HEA conceptual framework. However, VSP does not provide specific criteria for recovery; these are left to recovery planners (e.g., Lindley et al. 2004). Based on VSP and its application to salmon recovery, projects should contribute to the following: (1) abundance, through contribution to the HET; (2) productivity, by increasing the quality of existing and new habitat for spring-run Chinook; (3) biological diversity, by enhancing the breadth of habitat and by discouraging interbreeding of fall- and spring-run Chinook (Evaluation Criterion [f]); and (4) spatial diversity, by promoting development of an additional viable spring-run Chinook population(s) in the Sacramento River Basin (Evaluation Criterion [g]).

(k) balance of benefits to Spring-Run and Steelhead (actions that provide a balance of benefits to both Spring-Run and Steelhead are favored over actions that primarily benefit one species; if multiple actions are undertaken, a combination of actions that provides a balance of benefits to both Spring-run and Steelhead is favored);

The HET provides a numeric habitat goal for spring-run Chinook salmon as the priority species of the HEA and states that “expansion of habitat for spring-run typically accommodates steelhead as well” (see Section 2.2). Spring-run Chinook and steelhead populations often overlap and are found in similar habitats within the same watersheds. Hence, expansion of habitat to meet the HET numeric threshold for spring-run Chinook should also benefit steelhead. While habitat requirements for spring-run Chinook and steelhead are similar, they are not identical. For example, the two species are separated by adult return timing and juvenile and adult life history. However, projects that meet the common habitat requirements of spring-run Chinook and steelhead and contribute to the restoration of both species will be favored.

(l) consistency with other resource uses such as water supply, public safety, flood control, recreation, and power production;

Projects should identify potential conflicts with other uses of the affected watershed and seek to avoid or minimize adverse impacts to other resource uses.

In conjunction with Evaluation Criterion (i), if a potential project is likely to impact other resource uses, there should be demonstrated support for the project from the affected stakeholders (e.g., written documentation of the landowner/water right holder's agreement). Those projects that are most consistent with other resource uses and/or have support from affected stakeholders will be favored.

(m) *favorable relative availability of appropriate stocks of Spring-Run and Steelhead for reintroduction;*

The purpose of the HEP is to provide habitat for spring-run Chinook salmon and steelhead, with the expectation that fish will expand into new or enhanced habitat. This process of movement of individuals into expanded or enhanced habitat occurs when adult fish stray from their natal areas and spawn in non-natal habitat. Colonization of habitat provided under the HEP will be enhanced in watersheds with some existing remnant populations. Colonization of those watersheds with no spring-run Chinook and/or steelhead, or with no known historical occurrence of these species, would likely be slower without direct intervention (i.e., supplementation from nearby streams with naturally reproducing populations and/or hatcheries). Consequently, projects on streams with remnant populations or with nearby naturally reproducing populations will be favored over those requiring hatchery supplementation.

(n) *low expectation for the action to be undertaken by the Licensees or others in the near future;*

Projects required as part of other regulatory or legal proceedings are not eligible, as described in Section 3.2 of the HEA. If a project is not likely to be implemented by others within a reasonable period of time (e.g., approximately 5 years), it may be considered. Refer to discussion of Evaluation Criterion (h).

(o) *favorable potential to benefit other anadromous, catadromous, and resident fisheries affected by the Feather River Hydroelectric Projects;*

Enhancement and expansion of habitat favors a community of co-evolved fish, invertebrate, and plant species. Projects that will provide identifiable benefits to other native fish species, including lamprey, sturgeon, resident trout, hardhead, Sacramento sucker, and pikeminnow, among others, will be favored.

(p) *low expectation for adverse impact on listed species and destruction or adverse modification of critical habitat under the ESA (actions with low or no impact are favored);* and

The HEA is intended to benefit listed spring-run Chinook salmon and steelhead. Projects should avoid or minimize adverse impacts to other ESA-listed fish, wildlife, amphibian, and plant species.

(q) *low potential for an adverse impact on historic or cultural resources.*

Projects should avoid or minimize adverse impacts to known historic and pre-historic cultural resources.

F.2.2 HEA Selection Criteria

This section presents working definitions for the four Selection Criteria (items a–d contained in Section 4.1.2 of the HEA and in italicized font below). These definitions form the basis for the Steering Committee's application of the Selection Criteria to the list of Viable Actions. Section 4.1.2 states "After developing a preliminary list of viable habitat expansion action(s) using the Evaluation Criteria set forth in Section 4.1.1 above, the Licensees shall use the following non-prioritized Selection Criteria to select recommended habitat expansion action(s) for implementation:"

(a) contribution to achieving the Habitat Expansion Threshold;

Section 2.2 of the HEA identifies the specific goal "to expand spawning, rearing and adult holding habitat sufficient to accommodate an estimated net increase of 2,000 to 3,000 Spring-run for spawning ("Habitat Expansion Threshold") in the Sacramento River Basin…". Projects may contribute to expanding one or more of these three functional types of habitat, with the final result being achievement of the HET.

Projects are expected to increase the habitat potential for steelhead as well. The contribution of projects to the HET will be defined by the estimated change in equilibrium abundance of spring-run Chinook in the Sacramento River Basin that results from expanding the quantity and quality of habitat available to spring-run Chinook and steelhead. The expansion of habitat potential will be structured to support the development of an additional viable population of spring-run Chinook in the Sacramento River Basin, support the separation of fall and spring runs of Chinook salmon, and be consistent with the Evaluation Criteria in Section 4.1.1.

(b) most cost-effective compared to other potential habitat expansion actions;

For each Viable Action, a rough estimate of its cost and contribution to the HET will be determined. Each Viable Action then will be ranked in terms of its cost effectiveness (i.e., the cost of the action versus its contribution to the HET). Refer to the discussion of favorable cost effectiveness in Evaluation Criterion (d).

(c) feasibility (action[s] can reasonably be accomplished); and

As stated in Evaluation Criterion (a), actions/projects must have a high likelihood of success (i.e., they must be highly feasible). The term "feasibility" is being interpreted broadly to include the concepts described for four Evaluation Criteria: a) technical feasibility, d) economic feasibility, i) favorable political and local support, and (l) consistency with other resource uses.

(d) timing (action[s] can be accomplished in a reasonable period of time).

As noted in Evaluation Criterion (h), factors important to the success of a project include not only the length of time to implement the project but also the length of time to realize benefits. Thus, the HEP will favor "shovel-ready" projects that can be implemented in a reasonable period of time (e.g., less than approximately

5 years). The more favorable projects will be those that need minimal additional public process, particularly related to permitting, zoning, or land use issues. In addition, projects that benefit spring-run Chinook within a relatively short period of time (e.g., approximately 10 years or less) will be favored.

F.2.3 NMFS Approval Criteria

This section presents working definitions for the six NMFS Approval Criteria (items a–f contained in Section 4.2.3 of the HEA). These definitions were considered as part of the Steering Committee's selection process. Section 4.2.3 states: "In determining whether to approve the Final Habitat Expansion Plan, NMFS shall review information submitted by the Licensees, comments by other Parties and directly affected and responsive third parties, and any other relevant information, and consider the extent to which the habitat expansion action(s) recommended in the Plan meet the following Approval Criteria."

(a) estimated to meet the Habitat Expansion Threshold;

As stated in Selection Criterion (a), the proposed projects must expand habitat to support 2,000 to 3,000 spring-run Chinook salmon. It is assumed that the Steering Committee and NMFS will agree on a readily available quantification method to define the contribution of the proposed projects to the HET. Refer to Selection Criterion (a) for further discussion on the HET.

(b) assures necessary testing, operation, and maintenance;

Each proposed project must include a funding mechanism for a period of time equivalent to the life of a typical FERC license (i.e., up to 50 years). The HEP will describe any proposed O&M and other necessary actions, as well as the associated funding mechanism, for a period of 50 years. PG&E and DWR will comply with the requirements of the HEA concerning reporting to the signatories (identified in Section 6.2 of the HEA).

(c) supports establishing a geographically separate, self-sustaining population of Spring-Run;

As discussed in Evaluation Criterion (g), the proposed projects should support development of a viable population of spring-run Chinook salmon within the Sacramento River Basin, in addition to those that already exist in Mill, Deer, and Butte Creeks. The proposed actions need to provide habitat that is of sufficient quantity (e.g., watershed size of 500 km^2 or greater as a guideline) and quality, and sufficiently separate to support a self-sustaining population of spring-run Chinook.

(d) supports segregating Spring-Run habitat from Central Valley fall-run Chinook salmon;

As discussed in Evaluation Criterion (f), the proposed projects should support segregation of spring-run and fall-run Chinook salmon populations. Segregating the two runs can involve creating a segregation barrier, increasing instream flow, or enhancing habitat for spring-run over fall-run Chinook.

(e) meets the requirements for eligible habitat expansion action(s) pursuant to Section 3 of this Agreement; and

As indicated in Section 3 of the HEA: (1) a variety of action types can fulfill the HEA (e.g., dam removal, dam re-operation, creation or enhancement of fishways, and water temperature/flow improvement); (2) the proposed actions must ensure future O&M and include functional start-up testing as needed; and (3) actions identified in other venues are eligible for consideration provided that what is implemented under the HEA results in an expansion of habitat over any existing requirements and commitments. As stated in Evaluation Criterion (n), projects required as part of other proceedings or with a high likelihood of being implemented within approximately 5 years will not be favored and may be considered ineligible.

(f) expected to be implemented within a reasonable period of time.

Refer to discussion of Evaluation Criterion (h).

F.3 Scoring

The Steering Committee prepared a detailed approach for applying the HEA criteria to potential habitat expansion actions. The Evaluation Criteria were applied to the List of Potential Actions to develop a Ranked Preliminary List of Viable Actions; the Selection Criteria were then applied to the Ranked Preliminary List of Viable Actions to develop a Ranked List of Viable Actions. Based on how they rated against the overall HEA criteria, actions were selected from the Ranked List of Viable Actions to become recommended actions.

The following sections describe the approach that was followed to apply the HEA criteria and develop the various lists of actions, culminating in development of the recommended actions. See Chapter 2 in the Final HEP for additional detail on developing habitat expansion actions.

F.3.1 Applying Evaluation Criteria

Section 4.1.1 of the HEA identifies that "the Licensees shall use the…non-exclusive and non-prioritized Evaluation Criteria to screen potential habitat expansion action(s) and develop a preliminary list of viable actions." Evaluation Criteria scores were applied to the actions in the Short List of Potential Actions to develop a Ranked Preliminary List of Viable Actions (Appendix B4 of the Final HEP). The scoring rationale is described below.

A scale of 1 to 5 was used to score how each action met each of the 17 HEA Evaluation Criteria. No zero values were used in the scoring process. If an action fully met a criterion, it was given a score of 5. If an action failed to meet a criterion, it was given a score of 1. The intermediate degree to which actions did or did not meet a criterion determined a score of 2, 3, or 4.

(a) Feasibility – The primary components of this criterion were technical feasibility, support by accepted science, and proven methodology (i.e., not experimental). If an action met the three primary components of criterion (a), it was given a score of 5; if one or two of the components were not met, the action scored a 3; if none of the three components was met, the action scored a 1.

(b) Scale – The primary components of this criterion are the estimated contribution to the HET, representing amount of habitat gain; benefits provided to the three habitat types identified in the goal of the HEA (i.e., spawning, rearing, and adult holding habitat); and the type of habitat expansion (i.e., increase in habitat versus enhancement of existing habitat). Actions resulting in a large gain of potential spawners, an increase in habitat, and benefits to all three habitat types received a score of 5; actions resulting in a moderate gain of potential spawners and addressing at least one habitat type either through increased or enhanced habitat received a score of 3; actions with a low gain of potential spawners and poor habitat quality received a score of 1.

(c) Sustainability – The lifespan and the degree to which an action was self-sustaining (i.e., requiring a minimum amount of maintenance) are the primary components of this criterion. Actions that provided a solution with a long lifespan and minimal maintenance throughout the lifespan of the action received a score of 5; actions that provided limited-term solutions, required annual maintenance, and/or relied on long-term agreements received a score of 3; actions with a short lifespan and requiring a high degree of maintenance received a score of 1.

(d) Cost Effectiveness – The estimated net increase in the population related to the total cost of the action and annual operations and maintenance (O&M) costs are the primary components of this criterion. Actions estimated to have low capital and O&M costs along with an estimated moderate to high contribution to the HET received a score of 5; actions with moderate capital and/or O&M costs and with a low to moderate contribution to the HET received a score of 3; actions with high capital and high O&M costs that outweigh the potential contribution to the HET received a score of 1.

(e) Minimal Human Intervention – Actions were scored based on the level of human intervention required for habitat expansion during the lifespan of the action. Self-sustaining actions that required no maintenance received a score of 5; actions that required minimal to moderate annual O&M and no handling of fish received a score of 3; actions that required intensive handling of fish along with high O&M received a score of 1.

(f) Separation (Genetic) – The actions were scored based on the degree to which they would provide for the spatial segregation of fall-run and spring-run Chinook salmon. Actions that would provide spatial separation between fall-run and spring-run Chinook salmon either by volitional passage into the upper watershed or by a physical barrier received a score of 5; actions that would promote spatial separation by addressing spring-run Chinook salmon life history strategies (e.g., springtime flows) received a score of 3; actions that would not provide or promote spatial separation received a score of 1.

(g) Separation (Catastrophe) – The actions were scored based on the degree to which they would provide for protection against catastrophic events (e.g., volcanic eruption or wildfire) potentially impacting existing independent, self-sustaining spring-run Chinook salmon populations in Mill, Deer, and Butte Creeks. If an action is within a watershed that is outside the predicted range of large-scale catastrophic events (e.g., eruption of Mt. Lassen or Mt. Shasta), it received a score of 5; if an action is within a watershed that is in the range of a smaller-scale catastrophic event (e.g., wildfire) it received a score of 3; if an action is within a watershed supporting an independent, self-sustaining population (i.e., Mill, Deer, or Butte Creek) it received a score of 1.

(h) Time to Implement – If the action could begin implementation (i.e., receive permits and break ground) within approximately 5 years, it received a score of 5; if the action could begin implementation within approximately 5 to 10 years, it received a score of 3; if an action would likely take more than 10 years to begin implementation, it received a score of 1.

(i) Local/Political Support – If support for an action was anticipated from all HEA signatories and local stakeholders, it received a score of 5; if the action had some support but also some known opposition from either HEA signatories or local stakeholders, it received a score of 3; if an action had substantial opposition and little or no support from HEA signatories or local stakeholders, it received a score of 1.

(j) VSP/ESA Consistency – The actions were scored based on the degree to which they were consistent with the VSP concept. Because there are four components to the VSP concept (i.e., abundance, productivity, biological diversity, and spatial structure), actions anticipated to contribute to all four components were given a score of 5, contribution to three components was given a score of 4, contribution to two components was given a score of 3, and contribution to one component was given a score of 2. If an action was not anticipated to contribute to any of the VSP components, it was given a score of 1.

(k) Balance of Benefits – If an action was anticipated to result in equal benefits to both spring-run Chinook salmon and steelhead, it received a score of 5; actions with moderately more benefits to spring-run Chinook salmon than steelhead received a score of 3; actions specifically targeting spring-run Chinook salmon and providing no benefit to steelhead received a score of 1.

(l) Resource Consistency –There are five primary components to this criterion: water supply, public safety, flood control, recreation, and power production. Actions that would not negatively affect any of these components received a score of 5. For each component the action could adversely affect, the score was reduced by 1.

(m) Available Stocks – If an action would occur in a watershed with an independent, self-sustaining population, it received a score of 5; actions in watersheds with extant, remnant populations received a score of 4; actions in watersheds where a population could be re-established via straying from a nearby watershed received a score of 3; actions in watersheds where a population could be re-established via straying from more distant streams, increasing time to realize benefits, received a score of 2; actions in watersheds where the population would need to be re-established by inter-basin transfer of fish received a score of 1.

(n) Actions Taken by Others – Actions that were not likely to be taken by others within the foreseeable future (i.e., approximately 5 years) received a score of 5; actions with potential to be taken by others within the foreseeable future received a score of 3; actions likely to be taken by others within the foreseeable future received a score of 1. Actions taken by others could include actions taken by the Licensees in other forums outside of the HEA.

(o) Benefit to Other Feather River Species – Actions that would provide identifiable benefits to the entire community of fishes native to the Feather River received a score of 5; actions that would provide benefits to some of the native fishes received a score of 3; those that would provide benefits to only spring-run Chinook salmon and steelhead received a score of 1.

(p) Adverse Effects (Listed Species) – If an action was not expected to adversely affect listed species or their critical habitat, it received a score of 5. If an action could result in minimal impacts that could be mitigated, it received a score of 3. If an action could cause impacts that could not be mitigated, it received a score of 1.

(q) Adverse Effects (Cultural) – If an action was not expected to adversely affect historic or cultural resources, it received a score of 5. If an action could result in minimal impacts that could be mitigated, it received a score of 3. If an action could cause impacts that could not be mitigated, it received a score of 1.

Scoring the Short List of Potential Actions by the Evaluation Criteria resulted in the Ranked Preliminary List of Viable Actions found in Appendix B4 of the Final HEP.

F.3.2 Applying Selection Criteria

Section 4.1.2 of the HEA explains that "[a]fter developing a preliminary list of viable habitat expansion action(s) using the Evaluation Criteria set forth in Section 4.1.1…, the Licensees shall use the…non-prioritized Selection Criteria to select recommended habitat expansion action(s) for implementation." After the Evaluation Criteria were applied, the Ranked Preliminary List of Viable Actions was reevaluated. Some actions were removed because the actions were (1) already completed; (2) addressed in other actions on the list; (3) not viable; or (4) not eligible under Section 3.2 of the HEA. Selection Criteria scores were applied to the remaining actions, resulting in the Ranked List of Viable Actions (Appendix B5 of the Final HEP). The scoring rationale is described below.

Consistent with the methodology used for the Evaluation Criteria, a scale of 1 to 5 was used to score how well each action met each of the Selection Criteria. No zero values were used in the scoring process.

(a) Contribution to the HET – The procedure described in Chapter 3 of the Final HEP was used to estimate how many additional fish the area of the watershed might support for each action or group of actions. Because a number of assumptions were made to arrive at the estimates, the contribution to the HET for a particular action or group of actions was assigned a score of 1, 3, or 5 based on the estimate. A score of 1 was used for those actions that would not meet the HET, a score of 3 was used for those actions that would meet the HET, and a score of 5 was used for those actions that would exceed the HET. Scores were assigned to all of the actions or groups of actions on the Ranked Preliminary List of Viable Actions.

(b) Cost effectiveness compared to other actions on the Ranked Preliminary List of Viable Actions – The actions were assessed based on a relationship between cost and contribution to the HET, consistent with the working definitions of the HEA criteria (Section G.2). Cost effectiveness was assigned a score of 1, 3, or 5 based on how cost effective the action or group of actions was compared to the others on the Ranked Preliminary List of Viable Actions. The total estimated cost of each action or group of actions was divided by the estimated contribution to the HET in order to calculate an estimated cost-per-fish. The estimated cost-per-fish for each action or group of actions was then divided by the highest cost-per-fish action. This approach enabled a comparison of the cost effectiveness of the actions on the Ranked Preliminary List of Viable Actions. Scores were assigned to the actions based on resulting values. A score of 1 was assigned to the actions that fell in the highest 10% (most expensive per fish) of all the actions, a score of 3 was assigned to the actions that fell in the middle of the range, and a score of 5 was assigned to the actions that fell in the lowest 10% (least expensive per fish).

(c) Feasibility – Feasibility was based on four of the Evaluation Criteria: (a) feasibility; (d) cost-effectiveness; (i) local/political support; and (l) resource consistency. The scores of these four Evaluation Criteria were combined to develop a single feasibility score for each action or group of actions. Specifically, an average of the four Evaluation Criteria scores was used to determine the feasibility score for the actions.

(d) Timing – The Evaluation Criterion (h) time to implement, score was used to score the timing for the Selection Criteria as well.

The scores resulting from application of the four Selection Criteria were added to yield a total score. The next step was to combine the scores from the Selection Criteria with the scores from the Evaluation Criteria in order to identify which actions best met these two elements of the HEA. This was achieved by weighting the Evaluation Criteria. The Evaluation Criteria weighting was determined by dividing the “Total Score” for each action or group of actions from the Ranked Preliminary List of Viable Actions by the highest total score. Scores from the Selection Criteria were then multiplied by these weights, thereby utilizing the Evaluation Criteria scores while not diminishing the importance of the Selection Criteria. The resultant scores were normalized.

The results of scoring the Ranked List of Viable Actions by the Selection Criteria are found in Appendix B5 of the Final HEP.

F.4 Scoring the Upper Yuba River and Lower Yuba River Actions

Following release of the Draft HEP, NMFS submitted a completed HEA questionnaire for the Upper Yuba River. NMFS requested that the Licensees re-evaluate the Upper Yuba River Actions in the Final HEP (see Chapter 2 in the Final HEP). In addition, the Licensees modified the components recommended in the Lower Yuba River Actions (see Chapters 2 and 4 in the Final HEP). Consequently, both actions required re-evaluation and re-scoring for the Final HEP. The Steering Committee used the same working definitions and scoring process developed for the Draft HEP to re-evaluate the Lower Yuba River Actions and the Upper Yuba River Actions in the Final HEP.

Table F-1 presents the scores for the Upper and Lower Yuba River Actions that were developed for the Final HEP. For comparative purposes, scores for the Upper Yuba River Actions that were included in the Draft HEP and those that were provided by NMFS in their comment letter on the Draft HEP also are included in Table F-1.

F.5 References

Lindley, S. T. and others. 2004. Population structure of threatened and endangered Chinook salmon ESUs in California's Central Valley Basin. National Oceanic and Atmospheric Administration, National Marine Fisheries Service. (NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-360.) 56 pages.

Lindley, S. T. and others. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science [online serial] Volume 5, Issue 1, Article 4.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionary significant units. U.S. Department of Commerce. (NOAA Technical Memorandum NMFS-NWFSC-42.) 156 pages.

Table F-1. Scoring of the Upper and Lower Yuba River Habitat Expansion Actions

Upper Yuba River Actions[a]					Lower Yuba River Actions[b]	
Criterion	**Draft HEP Score**	**NMFS Score**	**Final HEP Score**	**Rationale**	**Final HEP Score**	**Rationale**
Evaluation Criteria						
(a) Feasibility	2	5	2	Each of the three components of this criterion (technical feasibility, support by accepted science, and proven methodology) would be only partially met by these actions. Multiple issues limit feasibility (e.g., uncontrolled flows on the North Yuba River would complicate juvenile collection, and there are accessibility issues for potential juvenile collection sites). Full-blown trap-and-transport operations have had limited application and success in situations similar to this one. Given these issues, a score of 2 is warranted.	5	These actions meet all three components of the criterion: technical feasibility, support by accepted science, and proven methodology. Fulfilling all three components of this criterion results in a score of 5.
(b) Scale	4	5	5	These actions would meet/exceed the HET (thus resulting in a large gain of potential spawners), expand spawning habitat in the upper North Yuba River, and benefit all three habitat types; thus, it fulfills all three components of this criterion. Also, given the length of available stream and the size of the project compared to other actions assessed, it warrants a score of 5.	4	These actions would meet the HET, thus resulting in a large gain of potential spawners; expand spawning habitat in the Lower Yuba River at Sinoro Bar and Narrows Gateway; and benefit spawning and holding habitat types. Providing a large gain in potential spawners and fulfilling two components of this criterion results in a score of 4.
(c) Sustainability	2	4	3	These actions have a moderate to long lifespan, but substantial operations and maintenance (O&M) (annual trap-and-transport operations) would be required to sustain it. Given this balance, a mid-range score of 3 is reasonable.	4	The sustainability of these actions is projected to be high over the approximately 50-year term (Pasternack pers. comm.). However, the likely need for periodic maintenance of the spawning beds and potential O&M activities for the segregation weir lowers the score to 4.

Table F-1. Continued

Upper Yuba River Actions[a]					Lower Yuba River Actions[b]	
Criterion	**Draft HEP Score**	**NMFS Score**	**Final HEP Score**	**Rationale**	**Final HEP Score**	**Rationale**
(d) Cost Effectiveness	1	4	1	If considered simply to fulfill the HEA, these actions would involve the transport of only enough fish to satisfy the HET. The capital cost of constructing the facilities to collect and transport fish is estimated to be $80 million. Annual operation and maintenance costs would also have to be provided for an approximately 50-year period. Thus, a trap-and-transport action to support 2,000−3,000 spring-run Chinook salmon would be expensive and warrants a score of 1.	4	These actions would meet the HET (habitat for 2,000−3,000 spring-run Chinook salmon), while combined capital and O&M costs would be $23.4 million. Thus, a score of 4 is warranted.
(e) Minimal Human Intervention	1	1	1	Trap-and-transport operations require intensive handling of both upstream migrating adults and downstream migrating smolts. Of all of the types of habitat expansion actions available, trap and transport requires the greatest amount of human intervention warranting a score of 1.	3	Once implemented, these actions would support the natural behavior of spring-run and steelhead. Intervention (installation of a segregation weir) would be required only in the event that inadequate segregation between spring-run and fall-run Chinook salmon occurs. A mid-range score of 3 is appropriate.
(f) Favorable Spatial Separation (Run Timing)	5	5	5	By transporting adult spring-run Chinook salmon to the North Yuba River above New Bullards Bar Reservoir and leaving fall-run fish to spawn in the Lower Yuba River, clear separation between the runs would be achieved, resulting in a score of 5.	3	Separation between spring-run and fall-run Chinook salmon using the segregation weir would receive a 5 (physical barrier provided). However, without implementation of the optional segregation weir, the remaining actions would receive a score of 3 (promote separation by providing expanded habitat favored by spring-run Chinook salmon).
(g) Favorable Spatial Separation (Catastrophe)	5	5	5	The North Yuba River is beyond the predicted range of catastrophic events; thus, these actions receive a score of 5.	5	The Lower Yuba River is beyond the predicted range of catastrophic events; thus, these actions receive a score of 5.

Table F-1. Continued

Upper Yuba River Actions[a]					Lower Yuba River Actions[b]	
Criterion	**Draft HEP Score**	**NMFS Score**	**Final HEP Score**	**Rationale**	**Final HEP Score**	**Rationale**
(h) Time to Implement	2	3	2	These actions are likely to take 10 years or more to reach the implementation stage for the following reasons: (1) they are in the very informative stages of development; (2) multiple parties need to come together and agree upon actions and responsibilities; and (3) many technical issues need to be resolved. A similarly scaled project in the Battle Creek watershed has taken well over 10 years to reach implementation. An estimated 10-year timeframe for implementation of these actions yields a score of 2.	5	Implementation of these actions could likely begin within approximately 5 years, warranting a score of 5.
(i) Local and Political Support	3	4	3	Initial meetings of the Yuba River Multi-Party Forum (now the Yuba Salmon Forum) to discuss these and related actions in the Upper Yuba River watershed indicate a mixture of support and opposition among the watershed stakeholders for this type of project, thus warranting a mid-range score of 3. The Steering Committee met with Yuba County Water Agency (YCWA) on August 17, 2010, to explore possible partnering opportunities related to the Upper Yuba River Actions. None have been identified.	3	These actions are widely supported for their expansion/enhancement benefits for anadromous salmonids in the Lower Yuba River. In the event that these actions are approved for implementation under the HEA, they would be well supported. Lack of concensus among all the signatories to the HEA, however, warranted a lower, mid-range score of 3.

Table F-1. Continued

Upper Yuba River Actions[a]					Lower Yuba River Actions[b]	
Criterion	Draft HEP Score	NMFS Score	Final HEP Score	Rationale	Final HEP Score	Rationale
(j) VSP/ESA Consistency	4	5	4	Overall, these actions support the four viable salmonid populations (VSP) components (abundance, productivity, biological diversity, and spatial structure); however, there are likely issues with productivity. While trying to provide for a "wild" population, some negative impacts would be associated with the inefficiencies and stress associated with trap-and-transport operations. These impacts would limit productivity, warranting a score of 4.	5	Given the expansion of habitat and the option of installing a segregation weir to facilitate segregation between fall-run and spring-run Chinook salmon, these actions would contribute to all four VSP components (abundance, productivity, biological diversity, and spatial structure) and thus warrant a score of 5.
(k) Balance of Benefits	5	5	5	If trap-and-transport actions were implemented for spring-run Chinook salmon, operations could ultimately include steelhead. Thus, there is potential for balanced benefits for both species, warranting a score of 5.	4	The benefits of these actions would largely be to spring-run Chinook salmon, with ancillary benefits to steelhead. Benefits to steelhead could be significant, but they are likely to be less than for spring-run Chinook salmon, thus warranting a score of 4.
(l) Resource Consistency	3	4	4	Of the five components of this criterion, only recreation holds the potential of being adversely affected, warranting a score of 4. Angling could be restricted in the North Yuba River to protect introduced salmon, and boating could be obstructed by the juvenile collection facilities.	4	Of the five components of this criterion, only recreation has the potential to be adversely affected, warranting a score of 4. Angling opportunities could be reduced if additional regulations were enacted to protect areas rehabilitated under the HEP, and boating could be seasonally obstructed if a weir was installed.
(m) Available Stocks	4	4	3	Spring-run Chinook salmon stocks available for reintroduction would likely be coming from the Feather River Hatchery or the Lower Yuba River, which appears to be predominated by hatchery strays. In either scenario, the dependency on hatchery fish warrants a score of 3.	3	Recent data indicate that spring-run Chinook salmon returns in the Lower Yuba River are dominated by straying fish from the Feather River Hatchery, warranting a score of 3.

Table F-1. Continued

Upper Yuba River Actions[a]					**Lower Yuba River Actions**[b]	
Criterion	**Draft HEP Score**	**NMFS Score**	**Final HEP Score**	**Rationale**	**Final HEP Score**	**Rationale**
(n) Actions Taken by Others	4	5	5	Despite these and other related actions being addressed as part of the Yuba Salmon Forum, it is highly unlikely that other parties would undertake these actions in the near term (i.e., within approximately 5 years). Thus, a score of 5 is reasonable.	4	Efforts are ongoing by the South Yuba River Citizens League to develop potential off-channel rearing habitat in the Lower Yuba River. The score for this criterion therefore should drop to 4, because some recommended actions for off-channel rearing habitat may be partially included in other efforts.
(o) Benefit to Other Feather River Species	1	1	1	Benefits to Feather River fish species other than spring-run Chinook salmon and steelhead are highly unlikely, warranting a score of 1. Ecological benefits could result from nutrient enhancement in the North Yuba River. However, considering 2,000–3,000 carcasses over 35 miles of river, no appreciable benefit would be likely.	3	Other native Feather River fishes would benefit based on similar spawning substrate requirements and the volitional nature of passage into the created habitat. However, given the lack of data regarding habitat use of non-salmonids in the Lower Yuba River, a score of 3 is reasonable.
(p) Adverse Effects on Other ESA Species	4	5	5	It is unlikely that there are any listed species in the upper watershed that would be affected by these actions. Thus, a score of 5 is warranted.	5	Based on the U.S. Fish and Wildlife Service special species list prepared for the *Lower Yuba River Gravel Augmentation Project Yuba and Nevada Counties, California Draft Environmental Assessment* (September 2010), no listed species in the Lower Yuba River would be affected by these actions. Thus, a score of 5 is warranted.
(q) Adverse Effects on Cultural Resources	5	5	5	It is unlikely that these actions would adversely affect any cultural resources. Thus, a score of 5 is warranted.	5	It is unlikely that these actions would adversely affect any cultural resources. Thus, a score of 5 is warranted.
Total Score	**55**	**70**	**59**		**69**	

Table F-1. Continued

Upper Yuba River Actions[a]					Lower Yuba River Actions[b]	
Criterion	**Draft HEP Score**	**NMFS Score**	**Final HEP Score**	**Rationale**	**Final HEP Score**	**Rationale**
Selection Criteria						
(a) Contribution to the HET	1	5	3	A trap-and-transport program on the North Yuba River has the potential to provide access to habitat that would accommodate more than 3,000 spring-run Chinook salmon. However, such a program under the HEA would need to specify transport of fish sufficient to meet the HET, as there is no obligation to exceed the HET. There is the potential to partner with others to increase the number of fish transported. Likely partners would be the U.S. Army Corps of Engineers or YCWA, or perhaps a consortium of stakeholders. At present, there is no obligation, commitment, or consensus of the likely partners. This may be achieved through the Yuba River Salmon Forum currently being formed but not within the expected timeline of the HEA. Thus, under the HEA, these actions would meet the HET and receive a mid-range score of 3.	4	These actions are likely to exceed the HET, but the degree to which they would exceed the HET is uncertain. Therefore, a score of 4 is appropriate.
(b) Cost Effectiveness	3	3	1	Compared to other actions evaluated, trap-and-transport actions, including the Upper Yuba River Actions, are the most expensive on a cost-per-fish basis because of the necessary infrastructure and O&M costs required to sustain the program. Thus, a score of 1 is warranted.	5	Compared to other actions evaluated, the Lower Yuba River Actions are the more cost effective on a cost-per-fish basis, warranting a score of 5.
(c) Feasibility	2	5	3	The average of the four Evaluation Criteria that comprise this Selection Criterion—(a) feasibility, (d) cost effectiveness, (i) local/political support, and (l) resource consistency—is 2.5. Rounding up this value yields a score of 3 for this criterion.	4	The average of the four Evaluation Criteria that comprise this Selection Criterion—(a) feasibility, (d) cost effectiveness, (i) local/political support, and (l) resource consistency—is 4.

Table F-1. Continued

Upper Yuba River Actions[a]					Lower Yuba River Actions[b]	
Criterion	**Draft HEP Score**	**NMFS Score**	**Final HEP Score**	**Rationale**	**Final HEP Score**	**Rationale**
(d) Time to Implement	2	3	2	As stated for Evaluation Criterion (h), time to implement, these actions likely would require 10 or more years to reach the implementation stage; thus, a score of 2 is warranted.	5	As stated for Evaluation Criterion (h), time to implement, implementation of these actions likely could begin within approximately 5 years. Thus, a score of 5 is warranted.
Total Score	**8**	**16**	**9**		**17**	

Notes:

HEA = Habitat Expansion Agreement for Central Valley Spring-run Chinook Salmon and California Central Valley Steelhead.

HEP = Habitat Expansion Plan.

HET = Habitat Expansion Threshold.

NMFS = National Marine Fisheries Service.

[a] Reintroduction of spring-run Chinook salmon into the North Yuba River above New Bullards Bar Reservoir.

[b] Spawning habitat expansion at Sinoro Bar and Narrows Gateway and installation of an optional segregation weir, if deemed necessary by the resource agencies (NMFS, U.S. Fish and Wildlife Service, and California Department of Fish and Game).

Appendix G
Responses to Comments Received on the Draft Habitat Expansion Plan

Appendix G
Contents

List of Tables

Acronyms and Abbreviations

2007 BiOp	*Biological Opinion for the U.S. Army Corps of Engineers' Operation of Englebright and Daguerre Point Dams on the Yuba River, California* (NMFS 2007)
AFRP	Anadromous Fish Restoration Program
AMP	adaptive management plan
CEQA	California Environmental Quality Act
Co-Manager Review Draft Recovery Plan	*Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead Co-Manager Review Draft*
Corps	U.S. Army Corps of Engineers
Delta	Sacramento River-San Joaquin River Delta
DFG	California Department of Fish and Game
DWR	California Department of Water Resources
ESA	Endangered Species Act
FED	federal agency
FERC	Federal Energy Regulatory Commission
Forest Service	U.S. Department of Agriculture Forest Service
HEA	Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead
HEP	Habitat Expansion Plan
HET	Habitat Expansion Threshold
Licensees	(California Department of Water Resources and Pacific Gas and Electric Company)
LOC	local agency
Lower Yuba River Actions	Lower Yuba River Habitat Expansion Actions
LYRL	Lower Yuba River landowner
NGO	non-government organization

NMFS	National Marine Fisheries Service
Oroville Facilities	Oroville Facilities, FERC Project No. 2100
Oroville Settlement Agreement	Settlement Agreement for Licensing of the Oroville Facilities
PG&E	Pacific Gas and Electric Company
Poe	Poe Hydroelectric Project, FERC Project No. 2107
Public Draft Recovery Plan	*Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead* (NMFS 2009)
RM	river mile
RMT	Yuba Accord River Management Team
STA	State agency
State Water Board	State Water Resources Control Board
SWP	State Water Project
SYRCL	South Yuba River Citizens League
Three-Creek Actions	Battle Creek, Big Chico Creek, and Antelope Creek Habitat Expansion Actions
Upper North Fork Feather River	Upper North Fork Feather River Hydroelectric Project, FERC Project No. 2105
USFWS	U.S. Fish and Wildlife Service
VSP	Viable Salmonid Population
YCWA	Yuba County Water Agency
Yuba Accord	Lower Yuba River Accord

Appendix G

Responses to Comments Received on the Draft Habitat Expansion Plan

The Draft Habitat Expansion Plan (HEP) for the Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead (HEA) was released on November 20, 2009. Pursuant to the HEA, the Department of Water Resources (DWR) and Pacific Gas and Electric Company (PG&E) (together, the *Licensees*) were required to submit the Draft HEP to the HEA signatories and other interested parties for review and comments within 2 years from the HEA effective date of November 20, 2007. Comments on the Draft HEP were to be submitted to the Licensees within 90 days, or no later than February 18, 2010. This appendix includes all comment letters and electronic mail received by the Licensees on the Draft HEP from the release of the document through October 2010. Responses are provided for each comment received.

Comment Letters

Eighteen comment letters (including electronic mail) were received from federal agencies, state agencies, local agencies, non-government organizations, and individuals (Lower Yuba River landowners). The comment letters are organized and numbered with acronyms as follows:

- Federal agency – FED
- State agency – STA
- Local agency – LOC
- Non-government organization – NGO
- Lower Yuba River landowner – LYRL

Table G-1 lists the comment letters that were received on the Draft HEP.

Table G-1. Comment Letters Received on the Draft Habitat Expansion Plan

Comment Letter No.	Date	Agency/Organization	Name
Federal Agencies			
FED1	02/18/10	National Marine Fisheries Service	Rodney R. McInnis, Regional Manager
FED2	02/18/10	U.S. Fish and Wildlife Service	M. Kathleen Wood, Assistant Field Supervisor, Sacramento Fish and Wildlife Office
State Agencies			
STA1	02/10/10	California Department of Fish and Game	John McCamman, Director
Local Agencies			
LOC1	02/15/10	Yuba County Resource Conservation District (RCD)	John Waskiewicz, Chair, Yuba County RCD Board of Directors
LOC2	02/17/10	High Sierra Resource Conservation & Development Area	William J. Bennett, President
LOC3	02/18/10	KC Hydro	Kelley W. Sackheim, Principal
LOC4	02/18/10	Yuba County RCD	John Waskiewicz, Chair, Yuba County RCD Board of Directors
Non-Government Organizations			
NGO1	01/19/10	California Fisheries and Water Unlimited	Robert J. Baiocchi, President
NGO2	01/22/10	California Sportfishing Protection Alliance	Chris Shutes, FERC Projects Director
NGO3	02/12/10	Pacific Coast Federation of Fishermen’s Associations	W. F. “Zeke” Grader, Jr., Executive Director
NGO4	02/12/10	Yuba Watershed Protection & Fire Safe Council	Glenn Nader, Facilitator
NGO5	02/17/10	State Water Contractors	Terry Erlewine, General Manager
NGO6	02/18/10	South Yuba River Citizens League	Gary Reedy
NGO7	02/20/10	American Rivers	Steve Rothert, Director, California Regional Office

Table G-1. Continued

Comment Letter No.	Date	Agency/Organization	Name
Lower Yuba River Landowners			
LYRL1	01/21/10	Private landowner	Ralph Mullican
LYRL2	02/05/10	Law Offices of Letty Litchfield	Letty Litchfield
LYRL3	02/12/10	Private landowner	Kit Burton
LYRL4	02/18/10	Western Aggregates	David A. Greenblatt, Senior Vice President

Responses to Comments

This appendix includes scanned copies of the letters received. Each distinct issue in the comment letter is numbered, and the corresponding response to the comment is similarly numbered. For example, the first comment received from the National Marine Fisheries Service (NMFS) (Comment Letter FED1) is labeled FED1-1.

Comments received on the Draft HEP were considered during preparation of the Final HEP. According to Section 4.2.1 of the HEA, "The Final Habitat Expansion Plan shall address all comments received during the 90-day review and comment period, and shall include an explanation of why any such comment was not adopted." Responses to the comments received identify specific changes that were made to the Draft HEP and incorporated into the Final HEP, or provide an explanation of why the comment was not adopted.

The Licensees recognize that comments regarding the Lower Yuba River Actions proposed in the Draft HEP do not necessarily apply to the Lower Yuba River Actions that are presented in the Final HEP, as the recommended actions were modified.

Master Responses

A review of the comment letters received on the Draft HEP revealed that some comments were made frequently, demonstrating a common concern among those submitting written comments. In some cases, the array of similar comments about a particular topic provided more clarity about a specific issue than any single comment. To allow presentation of a response that addresses all aspects of these related comments, master responses have been prepared for those topics that were raised in a number of comments. These master responses are intended to allow a well-integrated response that addresses all facets of a particular issue, in lieu of piecemeal responses to individual comments that may not have portrayed the full complexity of the issue.

When applicable, the individual responses to comments cross-reference an applicable master response to further respond to the comment or to provide additional explanation and information. In some cases, a master response may fully respond to the individual comment.

Master responses have been provided for the following issues raised in comments received on the Draft HEP:

- Comments related to the contribution to the Habitat Expansion Threshold (HET) (see Master Response 1)
- Comments related to the Three-Creek Actions (see Master Response 2)
- Comments related to the eligibility of the Lower Yuba River Actions (see Master Response 3)
- Comments related to use of an optional segregation weir (see Master Response 4)
- Comments related to mitigation for unmitigated impacts on the Feather River (see Master Response 5)

Each master response is presented in the following sections.

Master Response 1, Contribution to the Habitat Expansion Threshold

"The specific goal of the Agreement [HEA] is to expand spawning, rearing and adult holding habitat sufficiently to accommodate an estimated net increase of 2,000 to 3,000 Spring-Run for spawning ("Habitat Expansion Threshold") in the Sacramento River Basin…" (Section 2.2 of the HEA). The HEA notes that, although the HET refers to habitat for spring-run Chinook salmon, expansion of suitable habitat should benefit steelhead as well. The actual number of fish that return to utilize the expanded habitat in any year is determined to a large degree by factors outside the Yuba River and beyond the scope of the HEA.

The HEA directs the Licensees to use the "[c]ontribution to achieving the Habitat Expansion Threshold" (Section 4.1.2[a] of the HEA) as a criterion for selection of habitat expansion actions; however, the HEA does not specify a methodology for estimating the contribution of recommended actions to the HET. For this reason, and given time and data constraints related to the selection of actions, the Licensees developed a methodology that is based on existing scientific knowledge and provides a conservative estimate of habitat potential associated with the recommended actions. While developing this methodology, the

Licensees took into account comments received through consultation with NMFS and other HEA signatories. In keeping with the language of the HEA, actions benefiting spring-run Chinook salmon were presumed to benefit steelhead, and no explicit evaluation of the actions was made with regard to their benefits for steelhead.

The methodology for determining contribution to the HET involved two steps. First, the *quantity* of habitat for spawning by spring-run Chinook was evaluated based on the extent of habitat expansion and plausible estimates of Chinook spawning densities in the Yuba River and elsewhere (Pasternack 2010a, 2010c). Second, the *quality* of the expanded habitat for spring-run Chinook salmon was evaluated to adjust the quantity of expanded habitat for existing habitat limitations across life stages. The evaluation of environmental conditions adjusted the area-based spawner estimates of Pasternack (2010a, 2010c) downward to account for environmental limitations not addressed by the HEA recommended actions.

Through application of this methodology, the sum of the estimated increases in habitat potential for spring-run Chinook salmon resulting from expansion of spawning habitat in the Lower Yuba River at Sinoro Bar and at Narrows Gateway was demonstrated to exceed the HET (see discussion in Chapter 4 of the Final HEP for more detail).

Master Response 2, Three-Creek Actions

The Licensees removed the Three-Creek Actions (Battle Creek, Big Chico Creek, and Antelope Creek Habitat Expansion Actions) from consideration in the Final HEP because the individual actions have been fully or partially funded by other sources, or funding appears to be imminent. The funding status for each action is described below.

- **Battle Creek Actions.** DFG has identified full funding for the Battle Creek Actions (i.e., Phase 2 of the Battle Creek Salmon and Steelhead Restoration Project). Funding is currently being secured. (Berry pers. comm.)
- **Antelope Creek Action.** As documented during a teleconference with California Department of Fish and Game (DFG) (Bratcher pers. comm.), the Anadromous Fish Restoration Program (AFRP) will provide full funding for Paynes Crossing in Fiscal Year 2010–2011. The Antelope Creek Action will be implemented by DFG in summer 2011.
- **Big Chico Creek Action.** As explained by Susan Strachan (Strachan pers. comm.), partial funding for the restoration of the Iron Canyon fish ladder has been obtained. Providing funding for the remainder of this project would not result in a significant contribution to the HET; thus, the Licensees eliminated this action from consideration.

Should the status of anticipated funding change before approval of the Final HEP by NMFS, the Licensees may reconsider recommending these actions for implementation under the HEA.

Master Response 3, Eligibility of the Lower Yuba River Actions

The recommended actions in the Final HEP are eligible as defined in Section 3.2 (a—d) in the HEA:

> 3.2 Existing Requirements and Commitments
>
> For purposes of this Agreement, the term "Existing Requirements and Commitments" is intended to encompass actions expected to occur in a timeframe comparable to implementation of habitat expansion action(s) under this Agreement. Existing Requirements and Commitments may include but are not limited to:
>
> (a) legal or regulatory requirements that are the subject of any form of binding order issued by a regulatory agency or court of competent jurisdiction, at the time NMFS approves the habitat expansion action(s);
>
> (b) legal or regulatory requirements that are the subject of ongoing or imminent administrative or judicial action by an agency or court of competent jurisdiction at the time NMFS approves the habitat expansion action(s);
>
> (c) obligations or commitments set forth in a draft license application, final license application, settlement agreement, or agreement-in-principle in a pending hydroelectric relicensing proceeding at the time NMFS approves the habitat expansion action(s); and
>
> (d) reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions of any final Biological Opinion that has been issued at the time NMFS approves the habitat expansion action(s).

NMFS comments on the Draft HEP state that the recommended actions in the Draft HEP should be considered within the scope of the actions required in the NMFS 2007 *Final Biological Opinion Concerning the Effects of the U.S. Army Corps of Engineers Operation of Englebright and Daguerre Point Dams on the Yuba River, California* (2007 BiOp) and therefore do not meet the HEA Approval Criteria regarding eligibility. As explained below, the recommended actions are not currently part of a final biological opinion, nor are they an existing legal or regulatory requirement. Consequently, the spawning habitat expansion actions at Sinoro Bar and Narrows Gateway are eligible under the HEA.

Currently, two documents direct resource management activities in the Lower Yuba River and thus hold the potential to affect the eligibility of the Lower Yuba River Actions being recommended under the HEA: the Lower Yuba River

Accord (Yuba Accord) and the 2007 BiOp. The Yuba Accord is a collaborative agreement to provide flows and temperatures that are conducive to successful production of listed anadromous salmonids within the Lower Yuba River. Because the Final HEP does not recommend any change to flows in the river, the existing Yuba Accord does not affect the eligibility under the HEA of actions recommended in the Final HEP. The 2007 BiOp requires the U.S. Army Corps of Engineers (Corps) to implement a gravel augmentation program in the Lower Yuba River within 3 years of issuance, raising the issue of eligibility under the HEA for recommended Lower Yuba River Actions.

Corps Gravel Augmentation Program

The spawning habitat expansion actions at Sinoro Bar and Narrows Gateway are independent of, and complementary to, the Corps' gravel augmentation program below Englebright Dam. The purpose of the HEP recommended actions is to create spawning habitat where negligible amounts currently exist in the lower portion of the Englebright Dam Reach and the upper portion of the Narrows Reach. The spawning habitat expansion action at Sinoro Bar (Englebright Dam Reach) involves the removal of shot rock, reshaping the streambed, and placement and contouring of gravel to create new spawning habitat. The spawning habitat expansion action at Narrows Gateway (Narrows Reach) involves creation of additional spawning habitat immediately downstream of Sinoro Bar through removal of the armored surface layer of the streambed, recontouring of the streambed, and placement and contouring of gravel.

In contrast, the Corps gravel augmentation program is designed to provide a periodic injection of gravel to compensate for the loss of gravel recruitment caused by Englebright Dam. The 2007 BiOp contains, as one of its Reasonable and Prudent Measures, the following:

1. *The Corps shall develop and implement a long-term gravel augmentation program to restore quality spawning habitat below Englebright Dam.*

    A) *The Corps shall utilize information obtained from the pilot gravel injection project to develop and commence implementation of a long-term gravel augmentation program within three years of the issuance of this biological opinion.*

The Corps initiated a pilot gravel injection project in November 2007, with 450 short tons of spawning-sized gravel placed below Englebright Dam (in the pool below Narrows 2 Powerhouse). Based on the results of this and other geomorphic studies, Pasternack (2010b) prepared the *Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River, CA*. As part of that plan, the Corps is proposing to place an additional 2,000 to 5,000 short tons of spawnable-sized gravel below Englebright Dam (approximately 115 feet downstream of the Narrows 1 powerhouse, to avoid potential impacts to powerhouse operations) in November 2010 (Corps 2010). This would likely be the first of multiple gravel injections in the upper portion of the Englebright Dam Reach over a period of a few years, as proposed for the Corps by Pasternack (2010b).

Pasternack (2010b) indicates that implementation of the full plan is designed to erase the current deficit of gravel in the Englebright Dam Reach; however, rehabilitation at Sinoro Bar and Narrows Gateway is clearly beyond the scope of the plan. The Corps' program would likely create new spawning habitat upstream of Sinoro Bar/Narrows Gateway and potentially help to sustain the spawning habitat created downstream by the HEP recommended actions.

As noted, the HEP spawning habitat expansion actions and the Corps gravel augmentation program are complementary. Each set of actions would independently provide expanded spawning habitat, and the Corps program could help to sustain the HEP actions over time through periodic introduction of gravel to Sinoro Bar and Narrows Gateway. Other actions outlined in the 2007 BiOp that complement the HEP recommended Lower Yuba River Actions include injection of woody debris (which could aid in gravel retention and improved microhabitat conditions), improvements to passage at Daguerre Point Dam, and screening of diversions downstream of the Lower Yuba River habitat expansion actions.

Existing Legal and Regulatory Requirements

The 2007 BiOp recently was challenged in federal court (*South Yuba River Citizens League and Friends of the River v. National Marine Fisheries Service et al.*). The July 8, 2010 court order found that the 2007 BiOp had failed to provide a rational connection between the determination that operation of Englebright Dam would perpetuate unmitigated stressors and the conclusion by NMFS that those stressors would not jeopardize the listed fish. Given that, the court held it could not conclude whether the measures required in NMFS Incidental Take Statement achieved the goal of not jeopardizing the species – that is, the court could not decide on the record whether the measures were inadequate [July 8, 2010 Order p. 70].

More importantly, the court's ruling did not center on the Corps' gravel augmentation program, which is currently being implemented. Accordingly, it appears that the other stressors identified in the litigation would be subject to change in any revised biological opinion that may be issued as a result of the court's ruling. The ruling does address inadequate language related to fish passage at Daguerre Point Dam, inadequate language addressing screening at the South Yuba-Brophy diversion, failure to consider the effects of fish straying from the Feather River Fish Hatchery, failure to address the effects of climate change, failure to include a discussion of effects from the condition of the Delta, and failure to address the potential threat of poaching. It should be noted that the court discussed the Corps' gravel augmentation program and concluded that the reliance of the biological opinion on the proposed gravel augmentation program was itself reasonable.

Consequently, the expansion of spawning habitat recommended in the Final HEP is not part of any legal or regulatory requirement that is the subject of any form of binding order issued by a regulatory agency or court of competent jurisdiction. In addition, there is no evidence to indicate that the gravel augmentation program that is currently being undertaken by the Corps will be expanded upon by either the court or by NMFS at a future time to include the recommended HEP actions.

The Final HEP assumes that the gravel augmentation will continue over the long term; however, the Licensees recognize their responsibility for maintaining habitat expansion actions at the spawning rehabilitation sites (Sinoro Bar and Narrows Gateway) for the term of their obligation under the HEA. Therefore, gravel augmentation necessary to sustain the habitat created will be assured by one of these two processes.

Master Response 4, Optional Segregation Weir on the Lower Yuba River

The segregation weir remains in the Final HEP as an optional component of the Lower Yuba River Actions to be used at the discretion of the resource agencies (NMFS, U.S Fish and Wildlife Service [USFWS], and DFG). If the fish do not naturally segregate, the weir could be implemented to minimize potential impacts resulting from fall-run Chinook salmon spawning in the same reach as spring-run Chinook salmon (e.g., superimposition and introgression). If the spring-run and fall-run Chinook salmon naturally segregate to a degree that is deemed acceptable by the resource agencies, the weir would not be implemented.

During the 6-month extension for preparing the Final HEP, the Steering Committee met with DFG to discuss an optional segregation weir and to develop a conceptual adaptive management plan (AMP) (Appendix J). If the resource agencies elect to install a segregation weir, an AMP could be developed to identify the acceptable conditions under which a segregation weir would be installed. The AMP would address criteria for determining whether a sufficient degree of natural selection is occurring (e.g., percentage of spring-run versus fall-run Chinook salmon using the habitat), installation timing, placement, duration, and other watershed-specific considerations. Provisions to minimize or eliminate negative effects on steelhead and fall-run Chinook salmon also would be included through consideration of optimal weir placement and the duration of weir operation, thereby supporting the overall HEA objectives. DFG has expressed support for managing the Lower Yuba River from the Narrows Pool to Englebright Dam for spring-run Chinook salmon (Hill pers. comm.).

The segregation weir could be managed under two strategies, a long-term strategy and an in-season strategy. Both would be supported by monitoring data. The long-term strategy would determine the overall need for installation of the segregation weir to ensure adequate separation between the runs. The in-season strategy would involve an annual decision whether to install the segregation weir based on projections for the seasonal abundance of fall-run Chinook salmon. For example, should the fall-run projections indicate a high potential for spawning overlap with spring-run, the weir could be installed. The Licensees anticipate that the segregation weir would be managed by the resource agencies, with funding provided by the Licensees via the HEA.

A detailed discussion on the optional segregation weir is presented in Chapter 3 of the Final HEP. An example of an AMP that could be used for management of the segregation weir is provided in Appendix J.

Master Response 5, Mitigation for Unmitigated Impacts on the Feather River

The HEA is not intended to mitigate for *all* habitat losses in the Feather River watershed. As specified in Section 1.2 of the HEA, fulfilling the agreement will "*fully mitigate for any presently unmitigated impacts due to blockage of fish passage* (emphasis added) of all fish species caused by the Feather River Hydroelectric Projects." In order to fulfill the agreement, the Licensees must expand spawning, rearing, and adult holding habitat to accommodate a net increase of 2,000–3,000 spring-run Chinook salmon (Sections 2.1 and 2.2 of the HEA). Expansion will be accomplished through enhancements to existing accessible habitat, improving access to habitat, or other physical habitat improvements (Section 2.1 of the HEA). Other mitigation measures to compensate for loss of habitat include those outlined in Appendix A of the Settlement Agreement for Licensing of Oroville Facilities (see Chapter 1 of the Final HEP for more information) and the continued operation of the Feather River Fish Hatchery. Additionally, under the Settlement Agreement, DWR will be developing Hatchery Genetic Management Plans for the three salmonid stocks produced at the Feather River Fish Hatchery to minimize potential negative effects of hatchery fish on natural populations.

The HEA has been adopted to fully mitigate for any presently unmitigated impacts due to blockage of fish passage of all fish species caused by the Feather River Hydroelectric Projects, as an alternative to NMFS exercising their authority under Section 18 of the Federal Power Act (Section 1.2 of the HEA). Impacts of other facilities, State and private, are mitigated under other proceedings not related to the HEA.

Comment Letter FED1 (Rodney R. McInnis, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, February 18, 2010)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

FEB 18 2010

In response, refer to:
SWR/F/SWR3:RW

FED1

Director Hydro Licensing, Power Generation
Pacific Gas and Electric Company
P.O. Box 770000
San Francisco, California 94177

Chief, Division of Environmental Generation
Department of Water Resources
P.O. Box 942836
Sacramento, California 94236

Subject: Response of NOAA's National Marine Fisheries Service to the November 2009 Draft Habitat Expansion Plan submitted by the California Department of Water Resources and Pacific Gas and Electric Company

Dear Licensees:

Thank you for providing a copy of your Draft Habitat Expansion Plan (DHEP) for review by NOAA's National Marine Fisheries Service (NMFS) and other stakeholders who are Parties to the 2007 *Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead* (HEA), applicable to several hydroelectric projects in the Feather River watershed. The HEA Steering Committee is to be commended for their diligent search for prospective projects that will potentially satisfy the requirements of the HEA. Over the course of 12 months, the Committee identified numerous salmonid habitat restoration projects which may be completed to help contribute to the recovery of Central Valley spring-run Chinook salmon and steelhead populations.

As you know, the HEA was a negotiated agreement among Parties concerned with the outcome of FERC relicensing actions pertaining to your respective hydroelectric projects operating in the Feather River watershed. The primary hydroelectric project impact addressed by the HEA is the loss of well over one hundred miles of historic Feather River salmonid habitats due to man-made migration barriers (dams and other project structures) and the alterations to the aquatic environment caused by project operations and maintenance. The basis of the agreement was an understanding that the California Department of Water Resources (DWR) and Pacific Gas and Electric Company (PG&E) would identify and implement a program to restore spring-run

2

Chinook salmon habitat elsewhere in the Sacramento River watershed such that the newly gained habitat: (1) fully mitigates for the loss of habitats in the Feather River due to project-related impacts, (2) meets the conditions and criteria identified within the agreement, and (3) is ultimately subject to acceptance by NMFS within the context of the provisions of the agreement. Consistent with the HEA section 4.1.3 (Draft Habitat Expansion Plan), the Licensees fulfilled the task of producing a Draft Plan and distributed it among the Parties on November 20, 2010. A 90-day period ensued wherein the Parties were provided an opportunity to review and comment on the draft plan. Within 90 days after the close of this review and comment period on the DHEP, the HEA calls for the Licensees to prepare and submit a Final Habitat Expansion Plan to NMFS for approval within 90 days, unless a time extension is agreed to between NMFS and the Licensees.

After reviewing the DHEP, *NMFS determines that there are significant areas of concern that need to be reconciled before moving forward with a Final Habitat Expansion Plan that can meet the approval requirements of the HEA.* Appendix A of this document addresses some of the key reasons for our conclusions and offers our recommendations for moving toward a successful resolution of our concerns.

In light of the deficient status of the DHEP, *NMFS recommends a formal time extension of six months* for completion of the Final Habitat Expansion Plan, consistent with HEA sections 4.2 and 5 (Timeframes). The "good cause" we cite for this extension is to allow time for NMFS to confer with the Licensees and other Parties over the reasons why we believe the DHEP is deficient, and to introduce new information and another alternative that NMFS believes will meet the requirements of the HEA.

NMFS proposes to convene a meeting among all interested Parties at the earliest opportunity to discuss ideas for resolving our disparate viewpoints successfully so that the HEA process can resume in a productive and viable fashion.

If you have questions about NMFS' response to the DHEP, please contact Mr. Rick Wantuck, NMFS Regional Hydropower Program Supervisor, at 707-575-6063.

Sincerely,

for Rodney R. McInnis
Regional Administrator

Enclosure

cc: Bob Hoffman, HCD, NMFS, Long Beach, CA
Chris Yates, PRD, NMFS, Long Beach, CA
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HEA Signatory Parties

Comment Letter FED1 (Continued)

Appendix A

Response of NOAA's National Marine Fisheries Service (NMFS) to the November 2009 Draft Habitat Expansion Plan submitted by the California Department of Water Resources and Pacific Gas and Electric Company

1.0 Introduction

As explained in the 2007 *Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead* (HEA), the purpose of the HEA is to fully mitigate for the unmitigated impacts resulting from the blockage of fish passage caused by the Feather River Hydroelectric Projects:

> "Except as specifically provided, this Agreement: (a) fully mitigates for any presently unmitigated impacts due to the blockage of Fish Passage of all fish species caused by the Feather River Hydroelectric Projects; and (b) resolves among the Parties during the term of this Agreement issues related to regulatory conditions for Fish Passage associated with or related to any of the Feather River Hydroelectric Projects in excess of the action(s) contemplated under this Agreement, including, but not limited to, issues (related to Fish Passage) arising under exercise of authority under the ESA (subject to Section 13 of this Agreement), California Endangered Species Act (subject to Section 13 of this Agreement), Sections 18, 4(e), 10(a) and 10(j) of the FPA, and Section 401 of the Clean Water Act, provided the Licensees are complying with their obligations under this Agreement. (p. 5)."

NMFS' view is that full mitigation should carefully consider the extensive habitat lost to California spring-run Chinook salmon and Central Valley steelhead resulting from the Feather River hydroelectric projects that are the subject of the HEA. These projects block access to what was likely the most productive and largest spring-run Chinook salmon system in the Central Valley; and they create additional impacts to existing aquatic habitats resulting from the operations and maintenance of these facilities.

The Feather River is the only Central Valley watershed that historically supported four independent spring-run Chinook salmon populations (West Branch, North Fork, Middle Fork, and South Fork) (Lindley *et al.* 2004). The North Fork of the Feather River between Oroville Dam and Lake Almanor covers roughly 80 river miles. Factoring in the historic upstream limits for Chinook salmon on the West Branch, Middle Fork, and South Fork (see Yoshiyama *et al.* 1996), access to well over 100 miles of spring-run Chinook salmon habitat are blocked by Oroville Dam. The Central Valley steelhead is blocked from access to at least this much Feather River habitat (and probably much more, given the species' tendency to migrate to high watershed elevations).

The declining status of the California spring-run Chinook salmon and the Central Valley steelhead are evident. These species remain threatened with extinction despite implementation of many habitat improvement projects in the lower elevations of the Central Valley; within currently occupied habitat downstream of dams that block upstream passage (see http://www.fws.gov/stockton/afrp/ to view projects undertaken by the Anadromous Fish Restoration Program). The options for fish passage for the Feather River Hydroelectric Projects that were contemplated during relicensing, if enacted, would have expanded anadromous access into higher elevation Feather River habitats; these options were set aside in lieu of implementing a Habitat Expansion Plan (HEP) under the HEA, that would expand habitat in the Sacramento River basin. Given the origins of the HEA, NMFS encourages development of a HEP that strongly favors expansion into habitats that are presently inaccessible, over actions that only

2

Comment Letter FED1 (Continued)

affect existing habitat. NMFS was pleased that the DHEP includes some proposals that expand habitat for anadromous species, and agrees in principle with these action types. However, among these action types, some are not HEA-eligible proposals and the remaining proposals do not appear to be of sufficient scale to meet the HEA's Habitat Expansion Threshold (HET) of 2,000 to 3,000 adult spring-run Chinook, either individually or collectively. Our comments on actions proposed in the DHEP regarding eligibility, ability to meet the HET, and other facets are found in sections below.

2.0 Goals and Objectives of the Habitat Expansion Agreement

The HEA states at Section 2.1:

> "The overall goal of this Agreement is to expand the amount of habitat with physical characteristics necessary to support spawning, rearing and adult holding of spring-run [Chinook salmon] and Steelhead in the Sacramento River Basin as a contribution to the conservation and recovery of these species. The expansion shall be accomplished through enhancements to existing accessible habitat, improving access to habitat, or other action(s) and, as stated in Section 1.2(a), is intended to fully mitigate for any presently unmitigated impacts due to the blockage of Fish Passage of all fish species caused by the Feather River Hydroelectric Projects."

In addition to the above general goal of the HEA, the specific goal and objective of the HEA is to increase the numbers of spring-run Chinook salmon and steelhead by meeting or exceeding the HET, as stated in relevant part at Section 2.2:

> "The specific goal of the Agreement is to expand spawning, rearing, and adult holding habitat sufficiently to accommodate an estimated net increase of 2,000 to 3,000 spring-run [Chinook salmon] for spawning ('Habitat Expansion Threshold') in the Sacramento River Basin, as compared to the habitat available under any relevant "Existing Requirements or Commitments" [this term is defined in HEA Section 3.2]. The Habitat Expansion Threshold is focused on Spring-Run [Chinook Salmon] as the priority species, as expansion of habitat for Spring-Run typically accommodates steelhead as well."

3

Currently occupied habitats are entirely downstream of major dams and mostly confined to the lower foothills and Central Valley floor. In order to successfully recover these species and ensure their survival and recovery over the next 50 or more years, the habitats for these species must be expanded upstream of some of the major dams and into the historic, higher-elevation, habitats. These historic habitats are located above dams in mountainous elevations where the habitat conditions remain highly viable for these species: year-round supplies of very cold water, little human impacts, ample riparian/forest habitat for shading, and sufficient amounts of spawning substrate and holding/rearing habitats. Thus, one could improve existing habitats on the Central Valley floor, but that may only be a temporary and limited solution. While there may be some detrimental impacts from future potential global climate change scenarios, the much more immediate, ongoing, and likely impacts will continue to result from ever increasing demands for human use of water resources, as well as the increasing anthropogenic impacts from an increasing human population in the lower foothills, the Central Valley, and other developed areas of California that are dependent on limited fresh water resources produced in the western Sierra Nevada mountain range. Therefore, actions in currently occupied habitats are much less likely to meet the goals of the HEA. FED1-1

3.0 NMFS Support of Licensees' Process for Development of DHEP

NMFS commends the Licensees for what has obviously been an extensive and diligent process to search for suitable projects that satisfy the conditions agreed to by the Parties who are signatories to the HEA. Many of the identified projects are certainly worthy of further consideration, but for reasons explained below – some of these projects are ineligible for consideration under the provisions of Section 3 of the HEA, and others do not meet either the

4

Comment Letter FED1 (Continued)

specific selection, evaluation, or acceptance criteria – or the current NMFS management objectives articulated in our Draft Central Valley Recovery Plan .

The Licensees' Steering Committee called its first public HEA meeting in December 2008. NMFS staff attended this meeting, and subsequently met with the Steering Committee and other parties on at least six occasions during the DHEP development phase. In addition, NMFS staff responded to numerous phone calls and e-mails from Steering Committee members to communicate and share information. From the outset, NMFS staff clearly expressed its viewpoints to the Steering Committee. On one occasion in late spring of 2009, NMFS program managers met in person with the DWR and PG&E hydropower managers to ensure that our interests and concerns were as transparent as possible. FED1-2

Unfortunately, we find little evidence that NMFS' perspectives and interests regarding the HEA are embodied in the DHEP. Some of our fundamental concerns surround issues that are clearly matters of interpretation of the agreement, but we can find little support within the HEA for some key conclusions arrived at by the Steering Committee through the DHEP development process. FED1-3 Other matters of concern have to do with the opaque nature of the Steering Committee's techniques for scoring projects and estimating numeric contributions to the Habitat Expansion Threshold. These concerns and other relevant issues are discussed in greater detail in the following sections of this document. FED1-4

5

4.0 NMFS Comments and Instructions Relative to Draft HEP Section 3.2, "Applying the HEA [Evaluation and Selection] Criteria"

4.1 General Comments and Instructions - Evaluation Criteria

Pages 3-9 through 3-12, Section 3.2.2.

In this discussion of applying the Evaluation Criteria under Section 4.1.1 of the HEA, NMFS has the following comments related to specific criteria (for clarity, we have used uppercase to indicate the Criteria below):

(F) Separation (Genetic).

The discussion here relates only to the spatial separation of runs – fall-run and spring-run Chinook salmon. However, HEA section 4.1.1(f) provides an evaluation criteria that calls for "*favorable spatial separation from other populations or runs to maintain genetic diversity by minimizing interbreeding[.]*" This section and the evaluation should be revised based on this criterion to include discussion and consideration of favorable spatial separation from other populations, not just other runs. FED1-5

(J) VSP/ESA Consistency.

The discussion here relates only to consistency with the VSP concept. However, HEA section 4.1.1(j) also includes consistency with "*ESA recovery goals and recovery plan (as available), and expected contribution to species recovery (higher consistency and greater contributions are favored)[.]*" In October 2009, NMFS issued a Public Draft Recovery Plan for Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead. This section and the evaluation should be revised based on this criterion to include FED1-6

6

Comment Letter FED1 (Continued)

discussion and consideration of consistency with ESA recovery goals and this recovery plan, and expected contribution to species recovery, not just consistency with the VSP concept. FED1-6 Cont'd

(M) Available Stocks.

The discussion here indicates that a more favorable score of 5 was given "*[i]f an action would occur in a watershed with an independent, self-sustaining population[.]*" However, HEA section 4.1.1(m) provides an evaluation criteria that calls for "*favorable relative availability of appropriate stocks of Spring-Run and Steelhead for reintroduction.*" There is no explanation why a more favorable score should be given for an action that would occur in a watershed with an independent, self-sustaining population, compared to the text of the criterion that provides "*...relative availability of appropriate stocks.*" For example, there is no explanation why appropriate stocks would be any less available for an action that would occur in watersheds with extant, remnant populations. In addition, providing a greater score based on this factor appears contrary to NMFS' approval criterion in HEA section 4.2.3(c) that the action "*supports establishing a geographically separate, self-sustaining population of Spring-Run[.]*" This section and the evaluation should be revised based on this criterion accordingly. FED1-7

(N) Actions Taken by Others.

The discussion here relates only to actions taken by others. HEA section 4.1.1(n) provides an evaluation criteria that calls for a "*low expectation for the action to be undertaken by the Licensees or others in the near future[.]*" This section and the evaluation should be revised based on this criterion to include discussion and consideration of a low expectation for the action to be undertaken by the Licensees, not just a low expectation for the action to be undertaken by others, especially as this criterion relates to the Battle Creek Salmon and Steelhead Restoration Project. FED1-8

7

4.2 Comparison of Scoring/Ranking of Evaluation Criteria for Upper Yuba River "Trap & Haul" Actions

***4.2.1* Introduction**

NMFS has concerns about certain aspects of the scoring process that yielded the Licensees' recommended actions. Regardless, NMFS advises that because most of these choices are ineligible under HEA section 3; their overall high rankings may be a moot point. FED1-9 In addition, while two of the Three Creeks Actions - Antelope and Big Chico creeks - are eligible, there are still many impacts to listed salmonids occurring in the lower watersheds of these creeks which may tend to negate or impair the purported benefits of implementing these two small actions (see comments on Big Chico Creek and Antelope Creek actions). FED1-10

The scoring/ranking process applied Evaluation Criteria to the "Short List of Potential Actions (Appendix C3) to create the "Ranked Preliminary List of Potential Actions" (Appendix C4) and then the application of the "Selection Criteria" to C4 created the "Ranked List of Viable Actions" ("with Selection Criteria") (Appendix C5). However, NMFS believes the scoring attributes for each of the Evaluation Criteria, and the subsequent scoring of the Selection Criteria on the previous data set, were not correctly applied. The results of the scoring process are shown below, whereby the top choices of the Licensees scored much better than, for example, the two upper Yuba River "Trap & Haul above New Bullards Bar Reservoir" actions currently recommended by NMFS:

(#NS-94a) Trap and Haul to North Yuba River (NY) and
(#NS-94c) Trap & Haul to Middle Fork Yuba River (MY). FED1-11

8

Comment Letter FED1 (Continued)

4.2.2 Licensees' Scoring Results verses NMFS' Scoring Results

Licensees' Lower Yuba River and Three Creeks Actions:
C4 Ranking = 69-73 pts. or 95-100% (C4 range was 69-100%)
C5 Ranking = 12-16 pts. or 78-100% (C5 range was 28-100%)

Licensees' Trap & Haul to North Yuba River (NS-94a) and to Middle Yuba River (NS-94c):
C4 Ranking = 54-55 pts. or 74-75% (C4 range was 69-100%)
C5 Ranking = 6 - 8 pts. or 29-39% (C5 range was 28-100%)

NMFS' Revised Trap & Haul to North Yuba River and to Middle Yuba River:
New C4 Ranking = 69-70 pts. or 95-96% (C4 range was 69-100%)
New C5 Ranking = 15-16 pts. or 94-100% (C5 range was 28-100%)

As NMFS will explain below, when the scoring for C4 and C5 are revisited and logical scoring choices are made (based on relevant data and reasonable assumptions), then the above "Trap & Haul" actions to the North and Middle Yuba Rivers rank much better and could be considered as "equivalent to" the ranked levels of the Licensees' choices as shown above. NMFS explains below how we would score the 17 Evaluation Criteria and the 4 Selection Criteria for our 2 recommended actions, "Trap & Haul to the North (NS-94a) and Middle Yuba (NS-94c) Rivers."

FED1-11 Cont'd

4.2.3 NMFS C4 Scoring by 17 Evaluation Criteria for "Trap & Haul to North and Middle Yuba Rivers

Definitions of how each criterion is to be scored to generate C4 are found in DHEP Section 3.2.2, on pages 3-9 to 3-11 (we have used uppercase letters to denote the criteria for clarity). Ranking/Scoring of the North Yuba (NY) and Middle Yuba (MY) actions are discussed below where NMFS disagrees with the Steering Committee's scoring. NMFS describes below how each Evaluation Criteria ranks some attribute; how each criteria could be scored; and finally, the

9

Licensees' draft scores are listed for the two actions (NY; MY) and NMFS' corrected score and rationale is presented.

(A) Feasibility
Ranks: Technical feasibility, supported by accepted science, and proven methodology.

Scoring Criteria: Meet all three = 5; Meet one or two = 3; Meet none = 1.

Licensees' Score: NY=2; MY=2. (Rated a 2 when above states it as at least a 3).
NMFS' Score: NY=5; MY=5.

NMFS scoring indicates all three feasibility criteria would be met. Trap and haul is technically feasible, supported and accepted by science, and is a proven methodology. Contrary arguments based on a contention that these systems are not in common use for fish passage in California are irrelevant, as successful collection and transport operations have been demonstrated in the Pacific Northwest and elsewhere. In addition, in California, many thousands of hatchery reared salmonids are collected and transported hundreds of miles annually. The facts support that this fish passage method does work, can be safe and effective, and is a feasible alternative for reintroducing anadromous fish to the upper Yuba River. Hence, the revised score should be a 5, rather than a 2.

FED1-12

(B) Scale
Ranks: Large gain in potential spawners; increased habitat; and benefits all three habitat types (spawning, rearing, adult holding).

Scoring Criteria: Meet all three = 5;
Meet some gain in spawners and at least one habitat type = 3;
Low spawner gain and poor habitat =1.

Licensees' Score: NY=4; MY=3.
NMFS' Score: NY=5; MY=5.

FED1-13

10

Comment Letter FED1 (Continued)

NMFS scoring indicates all three scale criteria would be met. The primary purpose is to achieve an increase in spawners and increase available habitats that benefit all three life stages. Moving fish into upstream habitats would achieve this purpose. Hence, the revised score should be a 5, rather than a 3. FED1-13 Cont'd

(C) Sustainability
Ranks: Lifespan and relative maintenance.

Scoring Criteria: Long lifespan and minimal maintenance = 5;
Limited lifespan and regular maintenance = 3; and
Short lifespan and high maintenance = 1.
(implied above is a "4" = Long lifespan, but regular maintenance).

Licensees Score': NY= 2; MY=2. (Rated a 2 when above states it as at least a 3).
NMFS Score': NY=4; MY=4.

The nature of a successful collection and transport system means that it will have a long lifespan over the term of the new licenses. Hence, the revised score should be a 4, rather than a 2. FED1-14

(D) Cost-Effective[1]
Ranks: Total capital/O&M cost verses gain in population.

Scoring Criteria: Low-capital/O&M with a mid-high population gain = 5;
Mid-capital/O&M with a low-mid population gain = 3;
High-capital/O&M with a low population gain = 1.
(implied above is a Mid-high capital/O&M and mid-high population = 4)

Licensees' Score: NY=1; MY=1. (Assumes a "high cost" only and a "low" population gain).
NMFS' Score: NY=4; MY= 4.

The nature of fisheries collection and transport programs to higher elevation habitats dictate a capital cost and O&M that will be significantly higher than incremental habitat enhancement programs on the Valley floor. However, the inherent purpose of such programs is to regain access to large amounts of existing and extremely productive habitats, so it is expected that such a program would ultimately result in a very substantial population gain (or such a program would not be done). In addition, higher elevation salmonid habitats are an invaluable resource – one that is currently under utilized; and therefore the value of these habitats is diminished until access is restored. FED1-15

[1] NMFS believes that cost-effectiveness comparisons must take into account the potential costs of the default alternative to the HEA: a major collection and transport operation on the Feather River above project dams.

11

By comparison to the considered challenges of a similar collection and transport reintroduction program in the Feather River watershed, the Yuba River offers a less complex and less challenging environment from an engineering perspective. A comparable program in the Feather River is estimated by NMFS-engineering at a considerably higher cost. Hence, the revised score should be a 4, rather than a 1. FED1-15 Cont'd

(E) Minimal Intervention; (F) Separation/Genetic; and (G) Separation/Catastrophe
Ranks: Degree of human intervention (E) and separation of stocks both genetically (F), and from potential catastrophes (G)

Licensees' Score: NY=1,5,5; MY=1,5,5. [E,F,G]
NMFS' Score: NMFS agrees with the Licensees' scoring of the above criteria. FED1-16

(H) Time to Implement

Ranks: Relative implementation time.

Scoring Criteria: Implemented within 5 years = 5; Implemented within 5-10 years = 3;
Implemented within more than 10 years = 1.

Licensees' Score: NY=2; MY=2. (Rated a 2 when above states it as at least a 3).
NMFS Score': NY=3; MY=3.

Although there is no scoring level of 2, there could be a 4 if actions could be implemented within a 5-7 year timeframe. However, NMFS would score this conservatively as a 3 because we have already been conducting feasibility studies and are attempting to form broad coalitions FED1-17

12

Comment Letter FED1 (Continued)

comprised of agencies, licensees and stakeholders in order to accomplish NMFS' recovery plan goals. Hence, the revised score should be a 3, rather than a 2. FED1-17 Cont'd

(I) Local/Political Support
Ranks: Relative degree of support.

Scoring Criteria: Support from all = 5; some support, but some opposition = 3 [50/50 implied?];
Little or no support = 1.
(implies that "most support" and "little opposition" = 4).

Licensees' Score: NY=3; MY=3.
NMFS' Score: NY=4; MY=4.

FED1-18

The degree of actual opposition versus support is very hard to quantify and by its nature, speculative. NMFS, however, believes that our initial and ongoing initiatives, NMFS-financed studies, and NMFS' leadership in forming a broad-based coalition, based on the successful Yuba Accords concept, leads NMFS to score this as a 4, rather than a 3. In addition, as institutional momentum and supporting data is acquired, such a scoring shifts closer to a 5.

(J) VSP/ESA Consistency
Ranks: Consistency with Viable Salmonid Populations (VSP) concept: Abundance, Productivity, Biological Diversity, and Spatial Structure.

Scoring: Consistent with: All four = 5; three = 4; two = 3; one = 2; zero = 1.

Licensees' Score: NY=4; MY=4.
NMFS Score': NY=5; MY=5.

FED1-19

Clearly, as NMFS is proposing a collection and transport action to the upper Yuba River and continuing to gather supporting data and form broad-based coalitions for implementing such an action, then it is in our best interests to meet all VSP criteria. Such an action is also contemplated in our draft recovery plan which is underpinned by the VSP concepts. The upper

13

Yuba River proposed action meets all four VSP concepts.[2] Hence, the revised score should be a 5, rather than a 4. FED1-19 Cont'd

(K) Balance of Benefits, (M) Available Stocks, (O) Other Feather River Species, and (Q) Adverse Affects on Cultural Resources

Ranks: Relative degrees for balance of benefits to spring-run Chinook and Steelhead (K); degree of stocks available in watershed(s)(M); benefits to Feather River species (O); and adverse affects to cultural resources (Q).

Licensees' Score: NY=5,4,1,5; MY=5,4,1,5. [K,M,O,Q]
NMFS' Score: NMFS agrees with the Licensees' scoring of the above criteria.

FED1-20

(L) Resource Consistency, (N) Actions by Others, and (P) Adverse Affects on Listed Species

(L) Resource Consistency
Ranks: Degree by which the following are adversely affected by Action: Water supply, public safety, flood control; recreation, and power supply.

Scoring Criteria: Number Affected: None = 5; one = 4; two = 3; three = 2; and four = 1.

Licensees' Score: NY=3; MY=3.
NMFS' Score: NY=4; MY=4.

A claim is made in the DHEP that two components would be adversely affected. NMFS does not believe this to be true. A collection and transport program would have some effects on other resources, but these effects are part of a realistic balancing of natural resources and public uses of those resources. Considering that the Central Valley hydroelectric project impacts have been on-going for decades without commensurate mitigation of their effects on anadromous fish, NMFS believes a re-balancing of public trust resources is in order at this point in time. Some recreation may have to be adapted, but the actual degree is not yet known. Hence, the revised score should be a 4, rather than a 3.

FED1-21

[2] The HEA Steering Committee selected the North and Middle forks of the Yuba River for analysis. At this time, NMFS does not limit its consideration for reintroduction of salmonids to these two streams, but is considering the habitat potential in the South Fork Yuba as well.

14

Comment Letter FED1 (Continued)

(N) Actions by Others

Ranks: Degree by which the action could be done by others within 5 years.

Scoring Criteria: Action not likely to be taken by others = 5; Action potentially taken by others = 3; Action would likely be taken by others =1.

Licensees' Score: NY=4; MY=4.
NMFS' Score: NY=5; MY=5.

NMFS believes that such an action may be taken by others within 5-10 years, but no other party would *likely* take such an action within 5 years. Hence, the revised score should be a 5, rather than a 4. FED1-22

(P) Adverse Affects on Listed Species

Ranks: Degree by which action was not expected to adversely affect listed species or Critical Habitat.

Scoring Criteria: "Not expected to adversely affect" = 5; "minimal, but mitigated, impacts" = 3; "Adversely affected and non-mitigated" = 1.

Licensees' Score: NY=4; MY=4.
NMFS Score': NY=5; MY=5.

NMFS believes that because a collection and transport action is within the guidance of our draft recovery plan and that the purpose of the action is to expand and enhance habitat for all life stages of listed spring-run and steelhead, then this action would benefit these species and not adversely affect them. Increasing available habitat also puts less stress on existing Critical Habitat which also benefits the species as a whole. Hence, the revised score should be a 5, rather than 4. FED1-23

15

4.2.4 Summary

The original scoring of the "Trap & Haul" into North and Middle Yuba Rivers for C4 by the Licensees' was much lower than NMFS' revised C4 scoring, as shown below.

C4 Scoring "Trap & Haul to North Yuba (NS-94a) and to Middle Yuba (NS-94c) Rivers:
Licensees' C4 Ranking = 54-55 pts. or 74-75% (C4 range was 69-100%)
NMFS' C4 Ranking = 69-70 pts. or 95-96% (C4 range was 69-100%)

Consequently, when NMFS' C4 data is integrated and scored with the Selection Criteria for C4, NMFS' recommended "Collection and Transport" to upper Yuba River actions also rated significantly higher than what the Licensees' had rated them. FED1-24

5.0 General Comments on Selection Criteria

5.1 Page 3-12, Section 3.2.3.

The discussion here of the Steering Committee's methodology for applying the Selection Criteria notes that 'cost effectiveness' is considered in the scoring process under <u>both</u> criterion (b) and (c), suggesting a stronger weighting based on a single criteria than was provided for under the HEA. HEA section 4.1.2(b) provides, "*Most cost-effective <u>compared to other potential habitat expansion actions</u>.*" Furthermore, HEA section 4.1.2(c) provides, "*Feasibility (action(s) can reasonably be accomplished)[.]*" HEA section 4.1.2(c) does not suggest that cost effectiveness should be considered again under the feasibility criterion. This section and the evaluation should be revised based on this section to remove consideration of cost effectiveness under the feasibility criterion. FED1-25

16

Comment Letter FED1 (Continued)

5.2 NMFS C5 Scoring/Ranking by Four Selection Criteria for "Trap & Haul" to North and Middle Yuba Rivers

Definitions of how each criterion is to be scored to generate C5 (based on C4 results) are found in DHEP Section 3.2.3, on pages 3-11 to 3-12 (we have used uppercase letters to denote the criteria for clarity). Ranking/Scoring of the North Yuba (NY) and Middle Yuba (MY) actions are discussed below where NMFS disagrees with Licensees' scoring. NMFS describes below how each Selection Criteria ranks some attribute; how each criteria would be scored; and finally, the Licensees' draft scores are listed for the two actions (NY; MY) and NMFS' corrected score and rationale is presented.

(A) Contribution to the HET[3]

Ranks: Relative degree by which action exceeds, meets, or fails to meet the HET.

Scoring Criteria: Exceeds HET = 5; Meets HET = 3; Fails to Meet HET = 1.

Licensees Score': NY=1; MY=1.
NMFS' Score: NY=5; MY=5.

NMFS' data shows that the combination of the North Fork and Middle Fork Yuba River trap and haul actions could exceed the HET of 2,000 to 3,000 fish. Estimates and ongoing studies are still being conducted or reviewed, but a recent conceptual engineering study[4] used an estimate of roughly 20,000 adult spring-run Chinook as a preliminary metric in sizing potential fish collection and transport systems for the upper Yuba River. Hence, the revised scores for both of these upper Yuba River actions should be a 5, rather than a 1. FED1-26

[3] The HEA Steering Committee did not evaluate any reintroduction actions for the South Fork of the Yuba River, but NMFS does not dismiss the potential of the South Fork Yuba to support anadromous salmonids at this point in time. The South Yuba River will be considered in future analysis.
[4] Yuba River Fish Passage – Conceptual Engineering Project Options, Montgomery-Watson-Harza, Inc., February 2010

17

(B) Cost-Effectiveness

Ranks: Relative cost-effectiveness.

Scoring Criteria: Lowest 10% = 5; mid-range = 3, Upper 10% =1.

Licensees Score': NY=3; MY=1.
NMFS' Score: NY=3; MY=3.

NMFS agrees with the Licensees' scoring estimate for this item, but only to a limited degree. In viewing both the North Fork and the Middle Fork Yuba Rivers' collection and transport actions collectively, both should significantly increase the habitat and approach or meet the HET. Economies of scale can be realized in a comprehensive anadromous fish reintroduction program, and the fish production potential in the upper Yuba River watershed is high. NMFS' believes that such a comprehensive program could ultimately be highly cost-effective as compared to other actions. Thus, the revised scoring for both of these actions is a 3 each, rather than a 1 for the Middle Fork action. FED1-27

(C) Feasibility

Ranks: Relative feasibility, based on scores from the C4, Evaluation Criteria, data set: (A) feasibility, (D) cost-effectiveness, (I) local/political support, and (L) resource consistency. These scores were simply added up and averaged.

Scoring Criteria: The above C4, Evaluation Criteria, scores were simply added up and averaged (rounded up or down) for a single C5, Selection Criteria, score.

Licensees' Score: NY's C4: (A+D+I+L) divided by 4: (2+1+3+3)/4 = 9/4 = 2.25 = **[2]**
NMFS' Score: NY's C4: (A+D+I+L) divided by 4: (5+4+4+4)/4 = 18/4 = 4.5 = **[5]** FED1-28

Licensees' Score: MY's C4: (A+D+I+L) divided by 4: (2+1+3+3)/4 = 9/4 = 2.25 = **[2]**
NMFS' Score: MY's C4: (A+D+I+L) divided by 4: (5+4+4+4)/4 = 18/4 = 4.5 = **[5]**

The four Evaluation Criteria scores revised by NMFS provide a higher score for the C5 Selection Criteria category (see rationale for each of NMFS' C4 scoring). NMFS believes that

18

Comment Letter FED1 (Continued)

the direction from NMFS' Central Valley Recovery Plan - as well as the collection of additional scientific data and the ongoing efforts to develop broad-based coalitions in support of an upper Yuba River reintroduction program - will aid in implementing NMFS' recommended upper Yuba collection and transport options.

FED1-28 Cont'd

(D) Time to Implement
Ranks: Relative degree for implementation of action.

Scoring Criteria: C4 Evaluation Criteria score (H) "Time to Implement" was merely repeated here.

Licensees' Score: NY=2; MY=2.
NMFS' Score: NY=3; MY=3.

The same logic applies here, as was presented in: (H) "Time to Implement" Evaluation Criteria scoring. Because this action could be partially implemented within 5 years - and fully implemented within a 5-10 year time frame - and because we have already been conducting feasibility studies and are attempting to form broad coalitions comprising agencies, licensees, and stakeholders in order to accomplish NMFS' recovery plan goals, this element deserves a higher ranking. Hence, the revised score should be a 3, rather than a 2.

FED1-29

5.3 C5 Summary

The original scoring of the "Trap & Haul" [above New Bullards Bar] into North and Middle Yuba Rivers for C5 by the Licensees' was much lower than NMFS' revised C5 scoring, as shown below.

C5 Scoring "Trap & Haul" to North Yuba (NS-94a) and to Middle Yuba (NS-94c) Rivers:
Licensees' C5 Ranking = 6-8 pts. or 29 - 39% (C5 range was 28-100%)
NMFS' C5 Ranking = 15-16 pts. or 94-100% (C5 range was 28-100%)

FED1-30

19

Consequently, when NMFS' new C4 data was integrated and scored with the Selection Criteria for C5, NMFS' preferred Yuba River Collection and Transport actions also rated significantly higher than what the Licensees' had rated them.

FED1-30 Cont'd

6.0 General Comments on the Draft HEP

Page 1-3, section 1.1.2.

This section states:

"NMFS prescribed the upper end of the trap-and-haul program in the Upper North Fork Feather River relicensing proceeding and intended to prescribe the lower end of the trap-and-haul program in the Oroville relicensing proceeding." We clarify that NMFS filed modified or amended modified prescriptions in the Oroville Facilities, Upper North Fork Feather River Hydroelectric Project, and Poe Hydroelectric Project relicensing proceedings to reserve its authority to prescribe fishways as provided in the Habitat Expansion Agreement."

FED1-31

Page 1-4, Section 1.3.

This discussion of section 3.1 of the HEA does not include several important provisions from that section:

- "Habitat expansion action(s) shall ensure future operation and maintenance if such operation and maintenance is needed after initial implementation."
- "Habitat expansion action(s) shall also include functional start-up testing, if needed, for technical validation of the action's design (e.g., that a fish ladder operates as designed), but not long-term monitoring of species utilization or benefit."
- "Actions identified in other venues, including unfunded actions, are acceptable for consideration, provided that implementation of the Agreement results in a net expansion

FED1-32

20

Comment Letter FED1 (Continued)

> of habitat over any Existing Requirements and Commitments, whether by the Licensees or others." Section 3.2 of the HEA provides what the term "Existing Requirements and Commitments" means.

This discussion should be revised to include these important requirements of section 3.1 of the HEA, which are necessary to understand the scope of eligible habitat expansion actions. FED1-32 Cont'd

Page 2-2, section 2.2.1.

We clarify that "Consultation with NMFS", as provided in the header of this section, means "…the act of conferring and is distinct from the term 'Consultation' under the ESA." See HEA section 1.1, definition of "Consultation." FED1-33

Page 5-1.

The discussion at the beginning of Chapter 5 provides… "[o]nce comments are received, the Licensees expect to then select one of the two groups of [recommended] actions, as may be modified by comments received, and propose this group of actions in the final HEP." However, this discussion assumes that comments on the two groups of recommended actions will not result in a change from the actions recommended in the DHEP to any different proposals for action, or group of actions, in the final HEP, and this should not be assumed. FED1-34

Page 10-3, Section 10.2.2.

In this description of Pre-Approval Consultation requirements under the HEA, this section provides, "During the consultation period, NMFS will consider comments received on the DHEP . . . ." However, HEA section 4.2.2 provides for Pre-Approval Consultation "…[p]rior to approving the Final Habitat Expansion Plan . . . ." In addition, HEA section 4.2.2 provides, in relevant part, "During such consultation, NMFS shall give due consideration to any comment FED1-35

21

received. . . ." Therefore, during the Pre-Approval Consultation period, NMFS will give due consideration to any comment received during that consultation period, and those comments will likely be on the final rather than the DHEP. This discussion should be revised accordingly. FED1-35 Cont'd

Appendix A.

In this table, the line related to HEA section 4.2.7, the entry under the schedule column provides, "variable (~90 days)." However, HEA section 4.2.7 does not provide any time limit or refer to any number of days related to NMFS' approval decision. Therefore, delete "(~90 days)." FED1-36

Appendix C.

In all of the tables or sub-appendices for this Appendix (C1 to C5), the actual "method" for determining the HET, numbers of fish, was only indicated as a minor footnote in Table C5, as "Contribution from Quantification Method (unless otherwise noted)." NMFS could find no reference or explanation of what modeling or method was used to determine the contribution of an action to the HET. Please elaborate and describe in detail how all fish numbers were derived and if models were used please reference them and provide NMFS with copies to review. Not all methods or modeling may be acceptable to NMFS. FED1-37

Appendix F.

Section VII of the questionnaire response from Gary Reedy of the South Yuba River Citizens League, states in relevant part:

> "Access to rehabilitation site requires either permission from two private landowners so far offering less than consistent support, or construction of road on steep slopes of PG&E mitigation land. CDFG has expressed concerns

FED1-38

22

Comment Letter FED1 (Continued)

about the new road and immediate impacts of the project on holding spring-run salmon."

Please explain how this access problem and related concerns would be addressed in the recommended Lower Yuba River Actions. FED1-38 Cont'd

Appendix G.

On page 1, this Appendix describes how the River Management Team (RMT) did not feel that it would be appropriate to provide comments as a group to the HEA Steering Committee, and members of the RMT have different views and perspectives about some habitat restoration measures. In addition, this page of the Appendix provides:

> "However, some of the members of the RMT did work together to draft comments for the HEA Steering Committee, and to provide some feedback on the questions posed. Those comments are incorporated in this document."

This page also lists organizations included in the RMT. Please describe which members of the RMT prepared this Appendix in order to clarify whose comments and views are reflected in this Appendix. FED1-39

On page 22, this Appendix describes additional information and analyses that are needed for the segregation weir component on the Lower Yuba River Actions and concludes…"[t]he segregation weir is not supported at this time." Please describe how and when the additional information would be collected and analyses would be done in relation to the recommended Lower Yuba River Actions. FED1-40

23

7.0 Comments on Specific Habitat Actions

7.1 Comments on Lower Yuba River Draft HEP Actions

Section 6.1.1 of the DHEP (p. 6-1) provides a brief historical background regarding the habitat potential of the Yuba River, which describes habitat considerably diminished by extreme geomorphic alteration resulting from hydraulic and dredge mining for gold and then by construction of dams that blocked access to major spring-run Chinook salmon spawning areas. Englebright Dam (completed in 1941) at river mile 24 is mentioned, which now blocks all upstream passage of fish to the upper Yuba River. NMFS reviewed the historical background of the Yuba River provided in Yoshiyama *et al*. (2001) and noted accounts of appreciable salmon runs that occurred for many years in the Yuba River after its habitat was degraded by gold mining, and before construction of Englebright Dam. Yoshiyama *et al*. (2001) place the intensive hydraulic mining in the Yuba River as having occurred from 1853 to 1885, resulting in an immense influx of debris (sand and gravel) that filled the river channel, covered adjoining agricultural lands, and left the Yuba River discolored (yellow) and turbid. However, despite this severe habitat degradation, appreciable salmon migrations into the Yuba River persisted. For example, salmon were caught by PG&E workers in the North Yuba River (Bullards Bar area) during the 1898–1911 period of operation of the Yuba Powerhouse Project (Yoshiyama *et al*. 2001). Later, during the construction of PG&E's Bullards Bar Dam (1921-1924), so many salmon congregated and died below the Dam that their carcasses had to be burned (Yoshiyama *et al*. 2001). These accounts suggest that despite habitat impairments in the Yuba watershed due to gold mining, spring-run Chinook salmon ascended the North Yuba in considerable numbers until the Bullard's Bar Dam completely blocked their migrations into the higher gradient reaches (they are thought to have migrated beyond Sierra City to Loves Falls, about two miles above the FED1-41

24

Comment Letter FED1 (Continued)

juncture of Salmon Creek) (Yoshiyama *et al.* 2001). In 1941, Englebright Dam was completed and from that date forward has prevented upstream passage of fish to the upper Yuba River watershed. In 1971, Yuba County Water Agency's New Bullards Dam project was constructed and it blocks all fish passage to the upper North Yuba River. NMFS believes a broader historical perspective would allow all parties to place the relative effects of hydraulic mining and dams in context as restoration projects are considered. FED1-41 Cont'd

In the DHEP, the three proposed Lower Yuba River Habitat Enhancement Actions (p. 6-3) are:

1) Rehabilitate spawning habitat in the Englebright Dam reach of the lower Yuba River and augment gravel in lower Deer Creek;
2) Plan for, and if necessary, install a segregation weir at a location in the 6-mile reach between Englebright Dam and the Highway 20 Bridge;
3) Restore juvenile rearing habitat between the Highway 20 Bridge and the downstream extent of the Yuba Goldfields.

The DHEP emphasizes the importance of integrating these three separate sub-actions because they benefit from one another. However, NMFS finds that the portion of sub-action #1 (recommended spawning habitat rehabilitation in the Englebright Dam reach) should be considered within the scope of Existing Requirements and Commitments under the HEA – and therefore is not eligible and cannot be integrated with sub-actions #2 and #3. Several DHEP statements and discussions regarding eligibility appear inaccurate as related to the component to rehabilitate spawning habitat in the Englebright Dam reach (Page ES-5, Table ES-2, NMFS Approval Criteria Evaluation, Eligible. See also similar statements and discussions on pages ES-5 to ES-6; 5-3, Table 5-1; 5-5, Section 5.1.4; and 6-16, Section 6.4.8.1). Section 6.4.8.1 of the DHEP quotes a reasonable and prudent measure and term and condition from NMFS' final FED1-42

25

biological opinion concerning the effects of the U.S. Army Corps of Engineers' Operation of Englebright and Daguerre Point Dams on the Yuba River, California, issued November 21, 2007. In addition, this section discusses the Licensees' proposed spawning habitat rehabilitation program in the Lower Yuba River in comparison to this reasonable and prudent measure and term and condition. This section provides… "[i]n contrast, the Corps' responsibility is simply for gravel augmentation (i.e., long-term gravel injection similar to the pilot project initiated by the Corps in 2007)."

To the contrary, the NMFS Biological Opinion with the Corps of Engineers specifically states:

> "The Corps shall develop and implement a long-term gravel augmentation program to restore quality spawning habitat below Englebright Dam. The Corps shall utilize the information obtained from the pilot gravel injection project to develop and commence implementation of a long-term gravel augmentation program within three years of the issuance of this biological opinion."

FED1-42 Cont'd

The reasonable and prudent measure and term and condition do not limit the Corps' responsibility simply to gravel injection similar to the pilot project initiated by the Corps in 2007. The Corps' responsibility is to *"...restore quality spawning habitat below Englebright Dam."* Subsequent to the issuance of the biological opinion, two key sources of information regarding salmonid spawning habitat in the lower Yuba River were produced (Pasternak 2008; Pasternak 2009). One was a comprehensive study on the hydrology, geomorphology, and ecology in two reaches a short distance downstream of Englebright Dam (Pasternack 2008), and the other (Pasternack 2009) reported results of the Corps' pilot gravel injection. Through the two reports, it became known that in order to restore quality spawning habitat in the Englebright Dam Reach (the first 0.8 miles downstream of Englebright Dam to the Deer Creek confluence), shot-rock removal and related rehabilitation are likely required prior to a long-term gravel augmentation

26

Comment Letter FED1 (Continued)

program. Given that it is the Corps' responsibility is to restore quality spawning habitat below Englebright Dam, the Corps must take whatever steps necessary to accomplish this task, including spawning habitat rehabilitation (e.g., shot-rock removal). An additional factor supporting that the Corps should be responsible for removing the shot-rock is that one of the primary sources of the shot-rock was rock excavation during the construction of Englebright Dam, which the Corps owns and operates.

Although NMFS is not making a final determination on approval of the HEP at this point, the Licensees' recommended spawning habitat rehabilitation program apparently does not meet the NMFS' approval criterion in HEA section 4.2.3(e) regarding the requirements for eligible habitat expansion action(s) pursuant to Section 3 of the HEA. The NMFS' approval criterion in HEA Section 4.2.3(e) provides, "…meets the requirements for eligible habitat expansion action(s) pursuant to Section 3 of the Agreement[.]" HEA Section 3.1 provides, in relevant part, "Actions identified in other venues, including unfunded actions, are acceptable for consideration, provided that implementation of the Agreement results in a net expansion of habitat over any Existing Requirements and Commitments, whether by the Licensees or others." HEA Section 3.2 provides, in part, "…the term 'Existing Requirements and Commitment' is intended to encompass actions expected to occur in a timeframe comparable to implementation of habitat expansion action(s) under this Agreement." In addition, this section includes a non-exclusive list of what "Existing Requirements and Commitments may include," and (d) in that list specifically includes, "…reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions of any final Biological Opinion that has been issued at the time NMFS approves the habitat expansion action(s)." The Licensees' recommended spawning habitat rehabilitation program is within the scope of the actions required in the reasonable and prudent measure and

FED1-42
Cont'd

27

term and condition that is quoted in the DHEP. Thus, this recommended spawning habitat rehabilitation program should be considered within the scope of Existing Requirements and Commitments under the HEA.

FED1-42
Cont'd

A second component of sub-action #1 in the lower Yuba watershed is the augmentation of gravel substrates in Deer Creek to improve spring-run spawning habitat in lower Deer Creek and in the Yuba River at the mouth of Deer Creek (Section 6.4.1.3). It is unclear to NMFS if the DHEP recommends this component of sub-action #1 only if spawning habitat in the Englebright Dam Reach occurs concurrently. NMFS noted in the Questionnaire response for the Deer Creek Salmon and Steelhead Spawning Habitat Expansion Project (Appendix F) that passage of salmon and steelhead to the reach of Deer Creek upstream to Lake Wildwood Dam is a possibility if gravel placements in lower Deer Creek are sufficient to improve passage at Basher Falls. In principle, NMFS has a positive view of this possibility if access for anadromous fishes could be expanded into suitable historical habitats; Yoshiyama et al. (1996) cite an account of heavy runs of salmon up Deer Creek prior to the construction of Daguerre Point Dam, and personal communication indicating that steelhead migrated up Deer Creek a quarter of a mile where they were stopped by impassable falls. Given that impassable Lake Wildwood Dam has been constructed since the historical runs, it is likely that summer holding habitat potential for spring-run Chinook is lacking in Deer Creek, but restoration for steelhead spawning use may be possible. However, several outstanding issues need more discussion and evaluation, including the degree to which Basher Falls is an upstream migration impediment, the need to improve water quality, the need to provide a coarse sediment supply to areas downstream of Lake Wildwood Dam, the need for riparian vegetation restoration, and others.

FED1-43

28

Comment Letter FED1 (Continued)

Regarding sub-action #2 above (a lower Yuba River segregation weir), Table 6-1 (p. 6-10) provides a value for the segregation weir in the contribution to the HET. However, the discussion in Sections 6.5.3 and 6.5.5 imply that there would be some future determination about whether the segregation weir would be implemented as part of the Lower Yuba River Actions. NMFS requests clarification of whether the segregation weir is definitely part of the Lower Yuba River Actions discussed in Chapter 6 or whether it depends on some future determination, and how that determination would be made. If the segregation weir is not definitely part of the Lower Yuba River Actions, clarify in Table 6-1 that the value for the segregation weir in the contribution to the HET is not definitely part of the contribution of the Lower Yuba River Actions to the HET. Appendix G (p. 22) also describes additional information and analyses that are needed for the segregation weir component on the Lower Yuba River Actions and concludes, "[t]he segregation weir is not supported at this time." NMFS requests description of how and when the additional information would be collected and analyses would be done in relation to the recommended Lower Yuba River Actions. FED1-44

Appendix E includes contributions to the HET from use of a segregation weir; the entry for Segregation Weir under the column heading "Calculations/Assumption(s)," estimates that a segregation weir will improve the spatial segregation by 90%. However, it is unclear what this estimation of effectiveness assumes regarding the degree of temporal run-timing separation between spring-run and fall-run Chinook salmon in the lower Yuba River, and more study may be required to determine if temporal separation is discrete enough in the Yuba River so that a segregation weir could adequately spatially separate spring-run and fall-run Chinook. For example, preliminary results of a recent, genetically-based pilot study in the lower Yuba (Brian Ellrott, NMFS, personal communications) indicate that appreciable numbers of fall-run Chinook FED1-45

are entering the lower Yuba in the early (spring) season, and would therefore not be excluded from upstream areas by a segregation weir closed later in the season (summer or early fall); the result would be overlap in the spawning area used by spring-run and fall-run Chinook even if the mechanical separation efficiency were high once the weir was in place and closed. It is also possible that use of a segregation weir could exclude spring-run Chinook that enter the Yuba River later in the summer or early fall, and this possibility has not yet been studied. A recent, genetically-based investigation (Smith *et al.* 2008) in the upper Sacramento River (at Red Bluff Diversion Dam) was based on sampling that spanned spring through fall seasons, and its results indicate that spring-run Chinook were still present in the July and August-September samples (in addition, fall-run Chinook comprised the large majority of fish passing the dam during all sampling periods (May through September). Therefore, NMFS suggests more evaluation is required before the potential benefits of a segregation weir to spring-run Chinook described in Section 6.5.2 can be assumed. FED1-45 Cont'd

Another consideration is that a segregation weir would reduce the Yuba River habitat available to Central Valley fall-run Chinook, a federal species of concern with recent escapement numbers near historic lows; some such concerns are discussed in Section 6.5.8. This species historically used lower elevation habitats for spawning and rearing to a greater extent than did spring-run Chinook. Restriction of fall-run Chinook to the areas downstream of Timbuctoo Bend in the lower Yuba River would appreciably reduce the habitat area available to these fish, which currently spawn both upstream and downstream of this river reach. While the proximate cause of the recent declines in fall-run Chinook escapement numbers is believed to be poor ocean conditions, the ultimate cause of the longer-term declines is the loss and degradation FED1-46

Comment Letter FED1 (Continued)

of inland, freshwater habitats (Lindley *et al.* 2009). Thus, reducing the area of Yuba River habitat accessible to fall-run Chinook could further exacerbate such longer-term declines. FED1-46 Cont'd

Regarding sub-action #3, NMFS is not opposed in principle to restoration of rearing habitats in the lower Yuba River between the Highway 20 Bridge and the downstream extent of the Yuba Goldfields. However, we note that these actions propose enhancements of habitat within areas currently accessible to spring-run Chinook salmon and steelhead, not actions that expand access to habitats historically occupied by these species but now inaccessible; the latter actions are more highly preferred by NMFS. FED1-47

In our review of the DHEP, NMFS found that more evaluation and discussion is needed of the causes of the lack of suitable rearing habitat in the lower Yuba River, as well as rationale for how the actions proposed would contribute to long-term, sustainable habitat restoration (that would in turn contribute to the HET for adult spring-run Chinook). The proposed actions and sites are described in Section 6.6.1 of the DHEP as "initial concepts" that do not yet have site-specific designs completed (p. 6-22). For example, a South Yuba River Citizens League (SYRCL) proposal for restoration of off-channel rearing habitat below the Highway 20 Bridge is described as being in the initial phases of planning and design (NMFS assumes this proposed site is the same as Site 1, named "Upper Guilt Edge" (p. 6-23) proposed as an action in the DHEP). In reviewing the proposed lower Yuba rearing proposals, NMFS also noted reference to pilot studies either planned or underway, and we suggest that such studies should be completed and reviewed so their results can inform decisions about suitable restoration actions or sites. FED1-48

NMFS briefly reviewed the results of a study of the Timbuctoo Bend area (Pasternack 2008) of the lower Yuba River; the study clearly demonstrates the intensity of the effort required to FED1-49

31

understand the linkages between hydrology, geomorphology, and salmonid habitat. However, this investigation occurred upstream of the sites proposed for restoration of juvenile rearing habitat, and NMFS suggests that similar investigations may be required prior to moving forward on plans or designs for downstream actions. One important finding of Pasternack (2008) was that Yuba River floods (>10,000-20,000 cubic feet per second) are frequent and strong enough to drive significant change in the geomorphology of the lower Yuba River. This fact could bear on the degree to which boulder and large wood placements (to create side channels) (Sections 6.6.1.1, 6.6.1.2, pp. 6-23 to 6-28, Figures 6-4 to 6-11) would respond under various flows, or how these actions would persist over time. NMFS also noted the DHEP often links the dredge mining tailings in the lower Yuba (that constrict its channel in the Yuba Goldfields area) to the loss of habitat complexity. Assuming that channel constriction by tailings can be verified as a controlling factor causing the habitat loss, it is unclear how the restoration actions within the nine proposed sites address the cause (they don't appear to propose tailings removals). In addition to physical improvements, adequate stream temperatures are a required component of suitable juvenile salmonid rearing habitat (EPA 2003). The DHEP includes statements regarding cold releases from New Bullard's Bar Reservoir (Section 4.2.1, p. 4-7; Section 6.1.1, p. 6-1;) and the existing suitability of temperatures for all life stages of salmonids under the Yuba Accord flows (Appendix E, p. 2; Appendix G, p. 2, 4, 9, 22). However, the DHEP does not reference a document that contains temperature evaluations under the Yuba Accord flow regime. NMFS reviewed the information referenced in the DHEP (Kozlowski 2004), and found that summer temperatures downstream of the diversions at Daguerre Point Dam may be elevated above levels suitable for juvenile salmonid rearing (although we acknowledge that these data were collected before implementation or full implementation of the Yuba Accord flows). NMFS' concern is FED1-49 Cont'd

32

Comment Letter FED1 (Continued)

that this evaluation be performed to assure that juvenile rearing habitat objectives can be met based on water temperatures as well as physical habitat requirements. FED1-49 Cont'd

NMFS' review suggests that the proposed lower Yuba River actions are intended to incrementally improve existing anadromous habitat, but not to expand habitat into areas now inaccessible to anadromous fishes. Of the three sub-actions proposed, sub-action #1 (Englebright Dam Reach Spawning Habitat Rehabilitation) is not eligible under HEA Section 3. Because sub-action # 1 comprises the greatest estimated contribution to the HET (Table 6-1), the remaining eligible sub-actions fall far short of the HET threshold. A proposed action to physically segregate spring-run and fall-run Chinook would not expand habitat, but rather would divide existing habitat. Even if the segregation is effective, fall-run Chinook would experience decreased availability of habitat. It appears more information is needed to determine if run timing is discrete enough to allow a weir to meet its segregation objective. For these reasons, NMFS questions the HET contribution attributed to the segregation weir action. Lastly, the proposed lower Yuba actions to create/restore juvenile rearing habitat appear to rely on pilot studies not yet completed. In addition, NMFS suggests that a more comprehensive understanding of the linkages between hydrology, geomorphology, and salmonid habitat in the areas proposed for these actions is required. NMFS noted that the HET contribution for this sub-action is estimated to be the lowest of the 3 sub-actions. FED1-50

7.2 Comments on the "Three Creeks" DHEP Actions

7.2.1 Introduction

The Licensees identified a group of actions that, when combined, would meet the goals of the HEA and contribute to the HET. Collectively, these three sub-actions are referred to as the

33

"Three-Creek" Actions. This group of sub-actions consists of habitat expansion and enhancement actions in three watersheds: Antelope Creek, Big Chico Creek, and Battle Creek. Specifically, the individual sub-actions consist of the following:

1) Antelope Creek Habitat Expansion Action consists of replacing an instream ford-structure at Paynes Crossing on Antelope Creek with a bridge over the creek;

2) Big Chico Creek Habitat Expansion Action consists of rehabilitating the Iron Canyon Fish Ladder on Big Chico Creek; and

3) Battle Creek Habitat Expansion Action consists of providing partial funding for implementation of Phase 2 of the Battle Creek Salmon and Steelhead Restoration Project, specifically certain actions that would occur only on South Fork Battle Creek.

7.2.2 Comments on the Antelope Creek Sub-action

The proposed action is to construct a new bridge at Paynes Crossing, where Ishi Road intersects Antelope Creek in the California Department of Fish and Game Tehama Wildlife Area. The existing road crossing is described as a partial barrier to upstream fish migration at certain flows. NMFS requests that any existing biological or engineering evaluations of this site be identified for our review. FED1-51

"The quality and quantity of available habitat for spring-run Chinook salmon and steelhead spawning and holding habitat in Antelope Creek are essentially the same as historical conditions…" (p. 7-1). There is no supporting information for this statement. Please supply NMFS with any existing information or evaluations of spring-run Chinook and steelhead habitat upstream of Payne's Crossing. FED1-52

The DHEP discusses limiting factors other than passage at Paynes Crossing that affect upstream and downstream passage and habitat suitability in Antelope Creek. Although not FED1-53

34

Comment Letter FED1 (Continued)

mentioned with as much detail as found in the DHEP, Appendix D, these limiting factors quote NMFS' own "Co-Manager Review Draft" of the *Recovery Plan for the Sacramento River winter-run and Central Valley spring-run Chinook and Central Valley steelhead* (NMFS 2008). These include elevated water temperatures, insufficient attraction flows, stream braiding in the lower reaches that impairs upstream fish passage, and diversions that may cause entrainment, stranding and affect upstream passage. Diversions include Edwards Diversion Dam and others "…extending downstream of the Dam, to the confluence with the Sacramento River." The DHEP does not propose any actions to remedy the adverse effects of any "limiting factors" except the partial upstream barrier at Paynes Crossing (p. 7-2), but states that lower Antelope Creek actions are to be funded by the U.S. Fish and Wildlife Service's Anadromous Fish Restoration Program (AFRP) (p. 7-6). FED1-53 Cont'd

NMFS does not believe it is appropriate to count a gain of 250 adult spring-run Chinook (p. 7-5) due to a habitat expansion action that improves Paynes Crossing because this singular action does not address other limiting factors lower in the watershed. FED1-54

The reader is referred to Appendix E for the "Action-Specific Calculations of Contribution to the Habitat Expansion Threshold;" here, the modeling results are expressed in a highly condensed form (tabular and graphical), along with a summary table of model assumptions and sources. In this section, the result indicates the Paynes Crossing improvement would yield 264 adult spring-run Chinook salmon. Other information provided is that since 2000, the escapement of spring-run Chinook has ranged from 2 to 102 fish (p. 7-3), and a rounded average escapement from 1999 to 2008, using data from California Department of Fish and Game's (CDFG) GrandTab, is 50 fish (p. 7-4). Past estimates by CDFG suggest that FED1-55

35

Antelope Creek can support at least 500 spring-run Chinook salmon (CH2M Hill 1998) (p. 7-3). It is not clear if this number, or the HET threshold established in the HEA, are averages, medians, etc. FED1-55 Cont'd

Other information that should be considered is that *Lindley et al*. (2004) characterized the population of spring-run Chinook as dependent upon other populations (i.e. Butte, Deer, and Mill Creeks) for its existence. This will affect NMFS' approval decision toward the action under HEA section 4.2.3(c). FED1-56

The Payne's Crossing option will result in increased numbers of adult spring-run Chinook and steelhead only if:

1) It is correct that Paynes Crossing is an appreciable impediment at most flows;
2) Habitat upstream is indeed suitable;
3) A new bridge is correctly designed and installed, and allows effective passage; and
4) Lower Antelope Creek diversions and other lower watershed impairments can be adequately remedied to improve attraction flows, upstream passage, downstream passage, water temperatures, and water quality, in conjunction with the Paynes Crossing action.

Even if one accepts a net gain of 250 adult spring-run Chinook, the project is relatively small and cannot alone satisfy the HET of 2,000 to 3,000 fish. It would need to be implemented along with several projects or another large project. FED1-57

7.3.3 Comments on the Big Chico Creek Sub-action

The proposed action is to reconstruct the Iron Canyon fish ladder to facilitate the upstream passage of spring-run Chinook salmon and steelhead.

36

Comment Letter FED1 (Continued)

Section 8.2.1 describes the habitat as, "…the watershed is relatively pristine. The amount of available spawning and holding habitat for spring-run Chinook salmon and steelhead in Big Chico Creek is essentially the same as historical conditions…" (p. 8-2). However there is no supporting information for this statement. Please provide substantiating information that fish passage above this ladder will result in access to high quality habitat. It is very possible that the upstream habitat on Big Chico Creek may be so disturbed by human recreational use in the summer that its former (historical) value for summer holding of spring-run and steelhead is now degraded appreciably. It appears that the DHEP does not address this issue. FED1-58

The DHEP mentions several limiting factors in the lower watershed that affect upstream and downstream passage and habitat suitability in Big Chico Creek: "There is no summer holding habitat below Iron Canyon…" (page 8-1), "Big Chico Creek is a small watershed with substantial urban, agricultural, and flood control impacts in the lower watershed..." (page 8-2); "Low flows, mainly due to agricultural diversions, and high water temperatures are the primary limiting factors (BCCWA [Big Chico Creek Watershed Alliance] 2006)…"; "Low flows affect passage for both adults and juveniles and contribute to increased water temperatures…"; and "…loss of riparian habitat in the [lower] valley reach and diversion by flood control structures limit salmonid production (BCCWA 2006)"(page 8-3). The combination of these apparent impacts - elevated water temperatures, stream braiding in the lower reaches, groundwater pumping, and diversions at One-Mile and Five-Mile dams that may affect upstream passage – all these may be limiting factors in addition to the Iron Canyon fish ladder problem. Yet, the DHEP does not propose any actions to remedy the adverse effects of any of the above "limiting factors" except to fix the Iron Canyon fish ladder. Thus, the expense to fix this ladder may not FED1-59

37

be worth it if the listed salmonids will continue to have trouble even reaching Iron Canyon; this raises questions about the actual contribution to the HET and cost-effectiveness. FED1-59 Cont'd

Finally, *Lindley et al*. (2004) characterized the population of spring-run Chinook as dependent upon other populations (i.e. Butte, Deer, and Mill Creeks) for its existence. This will affect NMFS' approval decision regarding the proposed action under HEA section 4.2.3(c). An apparent positive factor is that the hatchery influence is low and there may be no need to introduce stocks of spring-run Chinook or steelhead. However, the ability of these listed salmonids to reach the fish ladder in sufficient numbers is questionable. Comprehensive watershed restoration actions in Big Chico Creek will require addressing other key limiting factors in Big Chico Creek, in addition to improved passage at the Iron Canyon site. FED1-60

In summary relative to this sub-action, NMFS comments positively on this project because it is obvious that fixing a fish ladder will help enable fish to access upstream habitats. However, human impacts will still occur downstream, in addition to the ubiquitous amount of summer recreation impacts upstream. These are limiting factors reducing the probability of substantial anadromous fish improvements from this action in isolation. This action will be beneficial and result in increased numbers of adult spring-run Chinook and steelhead only if: FED1-61

1) Habitat upstream is indeed suitable and human impacts can be limited;
2) The fish ladder is correctly designed and installed, and allows effective passage;
3) The lower creek diversions, groundwater pumping and other lower watershed impairments can be adequately remedied to improve attraction flows, upstream passage, downstream passage, water temperatures, and water quality, in conjunction with the Iron Canyon Fish Ladder action.

38

Comment Letter FED1 (Continued)

7.3.4 Comments on the Battle Creek Sub-action

DHEP statements and discussions regarding eligibility related to the Battle Creek Habitat Expansion Actions appear inaccurate (Page ES-7, Table ES-2, NMFS Approval Criteria Evaluation, Eligible. See also, similar statements and discussions on pages ES-8; page 5-12, Table 5-4; and 9-13 to 9-14, Section 9.3.8.1). As these discussions recognize, the Battle Creek Habitat Expansion Actions are part of Phase 2 of the Battle Creek Restoration Project, and NMFS' Biological Opinion on the Long-Term Central Valley Project and State Water Project Operation, Criteria, and Plan (OCAP Biological Opinion), issued on June 4, 2009, include these actions in the Reasonable and Prudent Alternative Action I.2.6. FED1-62

Although NMFS is not making a final determination on approval of the HEP at this point, the Licensees' recommended Battle Creek Habitat Expansion Actions apparently do not meet the NMFS' approval criterion in HEA section 4.2.3(e) regarding the requirements for eligible habitat expansion action(s) pursuant to Section 3 of the HEA. The NMFS' approval criterion in HEA Section 4.2.3(e) provides, "…meets the requirements for eligible habitat expansion action(s) pursuant to Section 3 of the Agreement[.]" HEA Section 3.1 provides, in relevant part, "Actions identified in other venues, including unfunded actions, are acceptable for consideration, provided that implementation of the Agreement results in a net expansion of habitat over any Existing Requirements and Commitments, whether by the Licensees or others." HEA Section 3.2 provides, in part, "...the term 'Existing Requirements and Commitment' is intended to encompass actions expected to occur in a timeframe comparable to implementation of habitat expansion action(s) under this Agreement." In addition, this section includes a non-exclusive list of what "Existing Requirements and Commitments may include", and (d) in that list specifically includes, "…reasonable and prudent alternatives, reasonable and prudent FED1-63

39

measures, and terms and conditions of any final Biological Opinion that has been issued at the time NMFS approves the habitat expansion action(s)." The Battle Creek Habitat Expansion Actions proposed in the DHEP are part of the reasonable and prudent alternative of NMFS' final OCAP Biological Opinion. Thus, these actions are Existing Requirements and Commitments under the HEA. FED1-63 Cont'd

On page ES-8 and in Section 9.3.8.1 of the DHEP, the Licensees argue that the reasonable and prudent alternative of NMFS' OCAP Biological Opinion "…does not ensure that such discretionary funds will be available, does not provide an alternate funding mechanism in the absence of such funds, as is presently the case, and ultimately does not secure full funding for Phase 2." In addition, the Licensees argue, "The biological opinion also does not provide a means for completing the project before 2019." However, there is no support under HEA Section 3 for Licensees' arguments. Funding and the means for completing the project are not part of the description of "Existing Requirements and Commitments" in HEA Section 3.2 and Subsection (d). In its reasonable and prudent alternative, NMFS has required that the project be completed within a timeframe comparable to implementation of habitat expansion action(s) under the HEA, and it has required reasonable conditions to follow implementation of the project and determine that it will be completed as required. FED1-64

NMFS has other concerns related the proposed Battle Creek sub-action. Table ES-2 of the DHEP (p. ES-7), Note (b), provides, "Additional funding partners would need to be identified in order to meet this estimated contribution to the HET." Note (c) provides, "Cost estimate includes partial funding for implementation of Phase 2 of the Battle Creek Salmon and Steelhead Restoration Project, and full funding for construction of Antelope and Big Chico FED1-65

40

Comment Letter FED1 (Continued)

Creek actions, as well as provisions for operations maintenance not already committed to by others." As these notes and similar or related discussions (pages 5-9, Table 5-3; 5-10, Section 5.2.1.1; 5-12, Table 5.4; 5-13, Section 5.2.1; 9-2, Section 9.1.1; and 9-10, Section 9.3.4.1) recognize, the estimated contribution to the HET for major components of the Three Creek Actions depend on unsecured funding from other sources. The estimated contribution to the HET should be based on actions that the Licensees propose to fund without reference to other actions that would require additional funding that has not been secured. In addition, these notes and similar or related discussions listed above raise the question of whether these proposed actions meet the selection criteria in HEA Section 4.1.2(c) (Feasibility (action(s) can reasonably be accomplished)) and (d) (Timing (action(s) can be accomplished in a reasonable period of time) as well as the NMFS' approval criterion in HEA Section 4.2.3(f) (expected to be implemented within a reasonable period of time). Table ES-2 of the DHEP (p. ES-7), Note (e), provides, "Criterion is not required for NMFS approval." The text of this note is inaccurate. See also notes with the same text on pages 5-3, Table 5-1, Note (d); 5-7, Table 5-2, Note (b); 5-9, Table 5-3, Note (e); and 5-12, Table 5-4, Note (b). HEA Section 4.2.4 provides, "NMFS may approve recommended habitat expansion actions(s) that meet at least [four specific approval criteria listed in that section]." Thus, NMFS may approve recommended habitat expansion action(s) that do not meet the other two approval criteria, but NMFS may decide not to approve habitat expansion action(s) that do not meet those other two approval criteria. In other words, the determination of whether these two approval criteria are "required" is left to NMFS' discretion. FED1-65 Cont'd

In the DHEP, Section 9.3.8.3 (p. 9-14) discussion of the recommended Battle Creek Actions, this section provides: FED1-66

41

> "A landowner abutting one of the construction sites near South Powerhouse and Inskip Diversion Dam on the South Fork Battle Creek has filed a lawsuit against DFG and the State Water Board related to their issuance of CEQA documents. The case is pending before the courts."

The Licensees should explain how this challenge may affect the expectation that this recommended action could be implemented within a reasonable period of time. See HEA Sections 4.1.2(c) and (d) and 4.2.3(f). FED1-66 Cont'd

In Appendix C4, in the line related to Phase 2 of the Battle Creek Restoration Project, the table provides "Maybe" under the column entitled, "Deal Killer (No/Maybe)." Explain why this action may be a "Deal Killer" and why the Licensees recommend this action in the DHEP despite having recognized that it may be a "Deal Killer." FED1-67

In summary on the Three-Creek sub-action, this project could provide true habitat expansion, and NMFS' supports the concept in principle. Unfortunately, there are two prevailing conditions that prohibit NMFS from accepting this option as an HEA action: (1) the Battle Creek action is subject to eligibility restrictions as described in HEA section 3.1 and 3.2; and (2) the Big Chico and Antelope Creek actions are geographically close to existing Mill/Deer/Butte Creek populations; thus they do not fully comport with the spatial diversity principles as described in Lindley et al. 2007. FED1-68

8.0 The Upper Yuba River Fish Passage Alternative

NMFS staff conferred and met regularly with the Licensees' HEA Steering Committee and other interested parties during the development phase of the Draft Habitat Expansion Plan. From the beginning, it was made clear to the Steering Committee that NMFS was interested in FED1-69

42

Comment Letter FED1 (Continued)

taking a hard look at the upper Yuba River watershed as a geographic region for potential reintroduction of spring-run Chinook and steelhead. We expressed this viewpoint because NMFS had already conducted considerable science to inform the Draft Central Valley Recovery Plan, and that science indicates to us that reintroduction of spring-run Chinook and steelhead in the upper Yuba River is a prime candidate for a meaningful recovery action. While the Steering Committee indicated that the upper Yuba River was given consideration as a potential HEA action, it chose not to score this option as highly as other options; therefore it did not make the final list of recommended actions. NMFS is concerned about this preliminary determination because we believe that the upper Yuba River offers great potential for realizing the goals of the Habitat Expansion Agreement and meeting (or exceeding) the targeted Habitat Expansion Threshold of 2,000-3,000 adult spring-run Chinook salmon. Furthermore, since our analysis shows that the DHEP' recommended actions raise concerns about eligibility and suitability issues under the HEA, NMFS reminds all Parties that the upper Yuba River anadromous fish reintroduction option remains a viable alternative in our considered opinion.

FED1-69 Cont'd

During the period of development of the DHEP (December 2008- November 2009), NMFS undertook independent studies of the upper Yuba River watershed to assess its potential for reintroduction of spring-run Chinook salmon and steelhead.[5] One of the drivers of this activity was the need to gain additional scientific information about habitat potential in the upper Yuba River to support NMFS' positions in the FERC-relicensing actions that are concurrently underway. Another driver is the recognition that NMFS' Draft Central Valley Recovery Plan identifies passage over certain Sierra Nevada rim dams as a key element needed for recovery of the ESA-listed evolutionarily significant units, i.e., - spring-run Chinook, winter-run Chinook,

[5] Two studies commissioned by NMFS in 2008-2010 are: (1) *Yuba River Fish Passage: Conceptual Engineering Project Options*, Montgomery-Watson-Harza, Inc. February 2010 and (2) Habitat Assessment and Reintroduction Planning for the upper Yuba River – study currently underway by Stillwater Sciences, Inc. and R2 Resources, Inc.

43

and steelhead. Notably, Englebright Dam on the Yuba River is specifically identified as one of those dams where anadromous fish passage could substantially contribute to the recovery of spring-run Chinook and steelhead. Moreover, reintroduction of anadromous fish into the upper Yuba River watershed is consistent with the seminal science underpinning NMFS Draft Central Valley Recovery Plan and our current management strategies.[6]

Because the results of the NMFS' sponsored studies were not available to inform the deliberations of the HEA Steering Committee during the formulation of the DHEP, it is appropriate at this time for NMFS to introduce these studies as new information - in addition to what is already known about the upper Yuba River – to help frame a new perspective of the upper Yuba River option as the potential solution for meeting the intent and criteria of the HEA.

The first study of importance is the newly published report by Montgomery-Watson-Harza, Inc.: *Yuba River Fish Passage: Conceptual Engineering Project Options.* This report focuses on conceptual engineering alternatives for restoring anadromous fish passage to the upper Yuba River watershed. It identifies realistic options for developing fish passage facilities capable of supporting long-term anadromous fish reintroduction to the upper Yuba River and its tributaries. The significance of this information is that it describes what engineered facilities could be constructed to support a variety of anadromous fish reintroduction strategies.

The second study of importance is the Anadromous Fish Habitat Assessment and Reintroduction Plan project that is currently underway. This NMFS- sponsored effort by Stillwater Sciences and R2 Resources has two components: (1) use of the GIS-based RIPPLE

[6] Two of the scientific documents that NMFS relies on to guide its decisions in matters related to salmonid management and recovery are: (1) *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units*, McElhany et al, NOAA Technical Memorandum NMFS-NWFSC-42, June 2000 and (2) *Framework for Assessing the Viability of Threatened and Endangered Chinook Salmon and Steelhead in the Sacramento-San Joaquin Basin*, Lindley et al., San Francisco Estuary and Watershed Science 5(1), February 2007.

44

Comment Letter FED1 (Continued)

computer model platform to assess reintroduction potential in each fork of the upper Yuba River basin, and (2) translate the new and existing information about habitat potential and engineering considerations into realistic options for reintroduction of anadromous fish. Because the results of this study are not yet available, more time is needed to allow the benefits of this forthcoming information to be considered in final HEA implementation decisions.

NMFS is aware of information that indicates the upper Yuba River offers vast areas of historic, higher elevation habitats where spring-run Chinook salmon and steelhead once thrived before the advent of large dams and water diversions. Although no quantitative population estimates are available for the Yuba River fisheries prior to the construction of Englebright Dam and New Bullards Bar Dam, anecdotal information indicates that Chinook salmon were abundant and in considerable numbers (Yoshiyama et al. 2001). Numerous informal field surveys by resource agency biologists, along with our long-standing participation on Yuba River management committees and in the FERC Integrated Licensing Process, has revealed that the upper Yuba River offers great potential for reintroduction of spring-run Chinook and steelhead. In addition, a recent field survey of the upper Yuba River by Stephanie Theis, a Montgomery-Watson-Harza senior biologist, produced a professional opinion that there is existing high quality salmonid habitat in parts of the upper Yuba River watershed.

In light of this existing and new information, NMFS believes it is wise for the HEA signatory parties and stakeholders to pause and carefully consider the upper Yuba River actions on the merits of their potential to satisfy all the elements of the Habitat Expansion Agreement.

45

9.0 Recommended Future Actions

In the interest of maintaining a collaborative approach toward the successful fulfillment of the HEA, NMFS recommends the following course of action to the Licensees and other interested Parties:

1) Licensees accept NMFS recommendation for a six month time extension
2) NMFS and Licensees develop a mutually acceptable, joint communication to the signatory parties informing them of the situation and a proposed approach for reconciling existing differences
3) Licensees and NMFS meet as required to explore specific areas in need of special consideration
4) Licensees and NMFS convene a special meeting (or meetings) among the signatory parties and directly affected third parties to explain the temporary impasse and enlist the other parties in seeking a solution
5) All interested parties direct their attention to the recent developments occurring in the Yuba River Multi-Party Forum arena to learn about the upper Yuba River anadromous fish reintroduction proposal, and whether there is a role for a Habitat Expansion Plan that can successfully fulfill all parties' expectations of the Habitat Expansion Agreement.

46

Comment Letter FED1 (Continued)

XII. REFERENCES

California Department of Fish and Game (CDFG). 2009. GrandTab. California Central Valley Sacramento and San Joaquin River Systems Chinook salmon escapement hatcheries and natural areas. Last revised: 2/18/2009. Available online: <nrm.CDFG.ca.gov/FileHandler.ashx?DocumentVersionD=26269>.

CH2M Hill. 1998. Central Valley Project Improvement Act Tributary Production Enhancement Report. Draft Report to Congress. Prepared for U.S. Fish and Wildlife Service. Sacramento, California.

Ellrott, Brian. Fisheries Biologist. National Marine Fisheries Service (NMFS), Protected Resources Division. Conversation with Larry Thompson, NMFS, Habitat Conservation Division, Sacramento, California. February 12, 2010.

Kozlowski, J. F. 2004. Summer distribution, abundance, and movements of rainbow trout (*Oncorhynchus mykiss*) and other fishes in the Lower Yuba River, California. M.S. Thesis (Ecology), University of California at Davis. Davis, California.

Lindley, S .T., R, Schick, B. May. J. J. Anderson, S. Greene, C. Hanson. A. Low. D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2004. Population structure of threatened and endangered Chinook salmon ESUs in California's Central Valley Basin. (NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-360). April 2004.

Lindley, S. T. and C. B. Grimes, M. S. Mohr, W. Peterson, J. Stein, J. T. Anderson, L.W. Botsford, , D. L. Bottom, C. A. Busack, T. K. Collier, J. Ferguson, J. C. Garza, A. M. Grover, D. G. Hankin, R. G. Kope, P. W. Lawson, A. Low, R. B. MacFarlane, K. Moore, M. Palmer-Zwahlen, F. B. Schwing, J. Smith, C. Tracy, R. Webb, B. K. Wells, and T. H. Williams. 2009. What caused the Sacramento River fall Chinook stock collapse? A Pre-publication report to the Pacific Fishery Management Council. March 18, 2009.

NMFS. 2008. Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segments of Central Valley Steelhead. Co-Manager Review Draft, May, 2008. Sacramento, California.

Pasternack, G. B. 2008. SHIRA-Based River Analysis and Field-Based Manipulative Sediment Transport Experiments to Balance Habitat and Geomorphic Goals on the Lower Yuba River. Prepared for the Cooperative Ecosystems Study Unit (CESU) 813326J002, University of California at Davis. Department of Land, Air, and Water Resources (in association with the UC Davis Center for Watershed Sciences). Final Report. August (Revised January 29, 2009).

47

Pasternack, Gregory. 2009. Current Status of an On-going Gravel Injection Experiment on the Lower Yuba River, CA. Report prepared for the U.S. Army Corps of Engineers. June. (26 pp.).

Smith, Christian T., LaGrange, Amanda R. and William R. Ardren. 2008. Run composition of Chinook salmon at Red Bluff Diversion Dam during gates-in operations: A comparison of phenotypic and genetic assignment to run type. Technical Information Leaflet No. AB-08-01, U.S. Fish and Wildlife Service, Abernathy Fish Technology Center, Applied Program in Conservation Genetics, Longview, WA. In Cooperation with Michael A. Banks and David P. Jacobson, Oregon State University, Hatfield Marine Science Center, Newport, Oregon (33 pp.).

U.S. Environmental Protection Agency (EPA). 2003. *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards.* EPA 910-B-03-002. Region 10 Office of Water, Seattle, Washington.

Yoshiyama, R.M., E.R. Gerstung, F.W. Fisher, and P.B. Moyle. 1996. Historical and Present Distribution of Chinook Salmon in the Central Valley Drainage of California. In Sierra Nevada Ecosystem Project: Final Report to Congress, Volume III: Assessments, commissioned reports, and background information. Pp. 309-362. Center for Water and Wildland Resources, University of California at Davis. Davis, California.

Yoshiyama, R.M., E.R. Gerstung, F.W. Fisher, and P.B. Moyle. 2001. Historical and Present Distribution of Chinook Salmon in the Central Valley Drainage of California *in* Contributions to the Biology of Central Valley Salmonids. Vol. 1. California Department of Fish and Game. Fish Bulletin 179. R.L. Brown, ed.

48

Responses to Letter FED1 (Rodney R. McInnis, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, February 18, 2010)

FED1-1

No language in the HEA indicates that the HEA was intended to restore salmon above the rim dams. Further, the HEA does not impose any obligation on the Licensees to recover ESA species, but only to be consistent with recovery efforts (HEA Section 4.1.1[j]). The actions recommended by the Licensees are consistent with ESA recovery because they are similar to actions called for in the *Public Draft Recovery Plan for Central Valley Chinook and Steelhead* (Public Draft Recovery Plan) issued by NMFS (2010).

The current proposals for reintroduction above rim dams call for trapping of adults, transporting them above the dams, and capturing and transporting juvenile progeny to below the dams. The Licensees argue that trap and transport is not consistent with the HEA language calling for "minimal human intervention … to achieve access to expanded habitat" and favoring "volitional passage over [actions] which require a high degree of human intervention" (HEA Section 4.1.1 [e]), cost effectiveness (HEA Sections 4.1.1 [d]) and 4.1.2 [b]) and timeliness of benefits (HEA Sections 4.1.1 [h], 4.1.2 [d] and 4.2.3[f]). Finally, because a trap-and-transport option would require extensive testing and development of facilities and operation, the Licensees argue that trap and transport must be considered experimental and is therefore discouraged under HEA Section 4.1.1(a).

FED1-2 and FED 1-3

While developing the Draft HEP, the Steering Committee did consider NMFS concerns, perspectives, and interests. Specifically, NMFS requested that the Steering Committee consider options for providing fish passage above Englebright Dam on the Yuba River (i.e., the Upper Yuba River Actions). This concept was first presented by NMFS during a Steering Committee meeting held on April 8, 2009. At the time, the Upper Yuba River Actions were not well defined. Studies to determine the feasibility of reintroduction above Englebright Dam were (and still are as of the release of the Final HEP) ongoing; a multi-party forum to consider reintroduction of spring-run Chinook salmon in the Upper Yuba River watershed was in the planning stages; and descriptions of the proposed Upper Yuba River actions were provided verbally rather than in a written document, such as the HEA questionnaire.

Following the April 2009 meeting, NMFS responded to phone calls and email correspondence from the Steering Committee requesting additional information on the Upper Yuba River Actions; however, not enough information was relayed to the Steering Committee to adequately evaluate the Upper Yuba River Actions. Using the information provided by NMFS, the Steering Committee evaluated the Upper Yuba River Actions using the HEA Evaluation and Selection Criteria. Based on the minimal amount of information that was provided, the Upper Yuba River Actions did not score as high (and were not as ready to implement) as some of the other potential habitat expansion actions that the Steering Committee was evaluating for the Draft HEP.

On numerous occasions, the Steering Committee requested additional information from NMFS in order to better evaluate this action. Specifically, the Steering Committee requested that NMFS complete a questionnaire on the proposed action(s) for the Upper Yuba River so that the Steering Committee could fairly evaluate this action similar to evaluation of other potential actions (i.e., for all other potential actions evaluated in the Draft HEP, questionnaires had been completed specifically describing the action and providing information to a uniform set of questions).

NMFS did not respond to requests from the Steering Committee for additional information on the Upper Yuba River Actions until after the Draft HEP had been completed and released for review. After release of the Draft HEP (in November 2009), NMFS provided the Steering Committee with the following documents:

- Yuba River Fish Passage, Conceptual Engineering Project Options, prepared for NMFS by MWH (completed in February 2010)
- completed HEA questionnaire prepared by NMFS on the Upper Yuba River Actions (submitted in June 2010)

Even after providing this information, results from the following related studies commissioned by NMFS that were referenced in the HEA questionnaire were not available for consideration while developing this Final HEP:

- RIPPLE modeling being conducted by Stillwater Sciences to determine the capacity of the Upper Yuba River watershed for spring-run Chinook salmon (anticipated completion date is November 2010; however, the modeling had not been completed by the release of the Final HEP); and
- a detailed reintroduction plan for spring-run Chinook salmon to the Upper Yuba River, to be conducted by R2 Resources, Inc. (anticipated completion date is December 2010).

With the additional information provided by NMFS, the Steering Committee used the same working definitions and scoring process developed for the Draft HEP to re-evaluate the Upper Yuba River Actions in the Final HEP. The results of the evaluation are described in Chapter 2 of the Final HEP. Table F-1 in Appendix F of the Final HEP presents the scores for the Upper and Lower Yuba River Actions that were developed for the Final HEP. For comparative purposes, scores for the Upper Yuba River Actions that were included in the Draft HEP and those that were provided by NMFS in their comment letter on the Draft HEP also are included in Table F-1.

See also response to Comment FED1-11.

FED1-4

The Steering Committee held several meetings with the HEA signatories to explain the process used to score the potential habitat expansion actions and to estimate their contributions to the HET. Specifically, the Steering Committee held meetings with the HEA signatories to review this process on June 15, August 12, and October 15, 2009.

The scoring process is described in detail in Chapter 3 of the Draft HEP. Based on additional information and comments received after the release of the Draft HEP, the Lower Yuba River and Upper Yuba River Actions were rescored for the Final HEP (see Table F-1 in Appendix F).

The process to determine the contribution to the HET is explained in Chapter 4 of the Draft HEP, and a summary of the results are presented in Appendix E of the Draft HEP. The working spreadsheets that were used to estimate the contribution to the HET for actions recommended in the Draft HEP were made available on the HEA website following distribution of the Draft HEP.

Although the process was well documented in the Draft HEP, several comments on the Draft HEP question how the Steering Committee determined the contribution of recommended actions to the HET. These comments are addressed in Master Response 1 regarding contribution to the HET and in Appendix N of the Final HEP.

FED1-5

The Steering Committee developed Working Definitions of Evaluation, Selection, and Approval Criteria to help with the process of evaluating, selecting, and recommending actions to fulfill the HEA. While developing these definitions, the Steering Committee submitted draft definitions to NMFS and asked for their review and input to ensure a common understanding of the HEA criteria. Although the Steering Committee did not receive formal comments from NMFS, the working definitions reflect discussions between the Steering Committee and NMFS staff (see Appendix F of the Final HEP). For Evaluation Criterion (f) (i.e., favorable spatial separation from other populations or runs to maintain genetic diversity by minimizing interbreeding), the Steering Committee focused on spatial separation of spring-run and fall-run Chinook salmon, not separation of different populations of spring-run.

The issue of spatial separation between different populations of spring-run Chinook salmon was largely addressed by Evaluation Criterion (g) (i.e., favorable spatial separation from other spawning streams to minimize population impacts of a stream-specific adverse event [geographic distribution is favored over centralization]). Under Evaluation Criterion (g), the Steering Committee focused on spatial separation of newly created spring-run populations from the recognized independent, self-sustaining populations in Mill, Deer, and Butte Creeks. Application of Evaluation Criterion (g) did not specifically look at the effects of spatial separation from the standpoint of interbreeding; rather, it addressed the value of creating expanded habitat with sufficient separation to avoid impacts of catastrophic events on multiple populations of spring-run. However, in effect, application of Evaluation Criterion (g) in this manner did address the issue of minimizing interbreeding of newly created populations of spring-run with the currently recognized independent, self-sustaining populations.

Thus, favorable spatial separation between spring-run and fall-run Chinook salmon, and between different viable self-sustaining populations of spring-run fish, was addressed through a combination of Evaluation Criteria (f) and (g).

FED1-6

According to the ESA recovery goals outlined in the NMFS Draft Recovery Plan, recovery of Central Valley spring-run Chinook salmon would be determined by the existence of at least two viable salmon populations in each of the four diversity groups outlined by Lindley et al. (2004). Given that Endangered Species Act (ESA) recovery as outlined in the NMFS Draft Recovery Plan is based on the viable salmonid population (VSP) concept, the four VSP parameters that are considered fundamental (abundance, productivity, biological diversity, and spatial structure) provide a useful metric in assessing the VSP/ESA consistency under Evaluation Criterion (j) for actions recommended in the HEP.

FED1-7

The Steering Committee concluded that the most favorable source for broodstock for any action would be an existing independent, self-sustaining population in the same stream as the proposed action; such actions would warrant a score of 5 for this criterion. This conclusion is consistent with available scientific thought supporting local adaptation of salmon populations, as well as general NMFS policy.

In any case, the difference in scoring makes no difference to the comparison of potential actions. Currently, the only independent, self-sustaining populations of spring-run Chinook salmon in the Central Valley are in Mill, Deer and Butte Creeks. Potential actions in these three streams only would have received a score of 5 for this criterion. However, the Steering Committee eliminated projects from streams with existing populations in an effort to expand habitat and support establishment of a new independent, self-sustaining population in other basins. Therefore, the highest score that any action evaluated could receive for this criterion is 4.

FED1-8

The Licensees included their actions outside of the HEA in the category of “Actions Taken by Others” when applying the scoring of this criterion to the potential actions. The definition has been revised in the Final HEP to clarify this point (see Chapter 2 and Appendix F of the Final HEP).

For Phase 2 of the Battle Creek Salmon and Steelhead Restoration Project, as described in the Draft HEP, the only potential action to be taken by others at that time was the potential for DFG to secure $12 million for Phase 2. PG&E has no funding obligation to Phase 2 other than providing increased instream flows and operation and maintenance of the facilities post construction.

Refer to Master Response 2 for an update on Actions Taken by Others for Phase 2 of the Battle Creek Salmon and Steelhead Restoration Project, which includes a commitment of funds from DWR under its Delta Fish Agreement.

FED1-9

See Master Response 3 regarding the eligibility of the Lower Yuba River Actions.

FED1-10

The Three-Creek Actions are not considered in the Final HEP. See Master Response 2 regarding the Three-Creek Actions.

FED1-11

The Licensees believe that a logical scoring process was applied, given the best available information at the time of scoring. The Upper Yuba River action was not well defined when the Draft HEP was released, and few studies were available for reference. The scores assigned to the Upper Yuba River Actions were reassessed based on pertinent information received during the 6-month extension to prepare the Final HEP. The scoring and rationale for each score are included in Appendix F of the Final HEP. Table F-1 in Appendix F compares the scoring of Upper Yuba River Actions during preparation of the Draft HEP and the Final HEP. The total score for the North Yuba River, which has been presented as the NMFS priority for reintroduction in the watershed, remains below that of the Lower Yuba River Actions. Therefore, the Lower Yuba River Actions remain the recommendation by the Licensees.

FED1-12

See response to Comment FED1-11.

FED1-13

See response to Comment FED1-11.

FED1-14

See response to Comment FED1-11.

FED1-15

See response to Comment FED1-11.

FED1-16

Comment noted.

FED1-17

See response to Comment FED1-11.

FED1-18

See response to Comment FED1-11.

FED1-19

See response to Comment FED1-11.

FED1-20

Comment noted.

FED1-21

See response to Comment FED1-11.

FED1-22

See response to Comment FED1-11.

FED1-23

See response to Comment FED1-11.

FED1-24

See response to Comment FED1-11.

FED1-25

Cost effectiveness, as scored for the Evaluation Criteria, is based on best professional judgment about the gain in population from an action (i.e., its estimated contribution to the HET) as it relates to the amount spent to achieve that gain. Under Selection Criterion (c), cost effectiveness is specifically a comparison with other potential actions that are also under consideration following application of the Evaluation Criteria. The Licensees believe that a primary factor in whether an action is feasible is the cost associated with the action. For example, if an action is cost-prohibitive, it can no longer be “reasonably accomplished” and should therefore not rank well under Selection Criterion (b). Consequently, Evaluation Criterion (h) remains a consideration for Selection Criterion (b).

FED1-26

See response to Comment FED1-11.

FED1-27

See response to Comment FED1-11.

FED1-28

See response to Comment FED1-11.

FED1-29

See response to Comment FED1-11.

FED1-30

See response to Comment FED1-11.

FED1-31

Comment noted. Section 1.1.2 in Chapter 1 of the Final HEP has been revised accordingly.

FED1-32

Comment noted. Section 1.3 in Chapter 1 of the Final HEP has been revised accordingly.

FED1-33

Comment noted. The text has been revised to include a definition for "consultation" as referenced in the HEA (see Appendix C of the Final HEP).

FED1-34

Comment noted. The actions were modified based on comments and new information received, as noted in Chapter 3 of the Final HEP.

FED1-35

The text found under Section 10.2.2 on page 10-3 of the Draft HEP has been revised accordingly. The revised text is now found under Section 5.1.1 on page 5-2 of the Final HEP.

FED1-36

Comment noted. The timeline presented in Appendix A of the Draft HEP has been revised and is now found in Appendix A of the Final HEP. A footnote has been added to the timeline related to Section 4.2.7 of the HEA and states that the timing for NMFS to make an approval decision is not defined in the HEA; however, for planning purposes, the Steering Committee assumed that an approval would be made by NMFS in approximately 90 days.

FED1-37

The HET evaluation methodology used in the Draft HEP was described in detail in Chapter 4 (Contribution to the HET) of the Draft HEP. The HET evaluation methodology has been refined and expanded in the Final HEP. The revised discussion is found in Chapter 4 of the Final HEP.

FED1-38

The Licensees have considered both access options to reach Sinoro Bar and Narrows Gateway for the spawning habitat expansion component of the Lower Yuba River Actions. Constructing an access road on PG&E's property on the north side of the river is possible but raises a number of environmental concerns (i.e., terrestrial resources and erosion issues). Accessing Sinoro Bar by crossing private property from the south side of the river appears to be the most feasible option. As a result, the Licensees have been coordinating with the private landowners regarding the use of their property to access these sites. The landowners have been very supportive of the spawning habitat expansion actions and have offered to help develop this component of the Lower Yuba River Actions by providing historical information related to the subject stream reaches. The Licensees have solicited temporary entry permits from the landowners and expect to receive the permits in the near future, based on positive communications. After receiving temporary entry permits from each landowner, the Licensees will secure more long-term entry permits and negotiate easements with the landowners, in particular for operation and maintenance activities.

The Licensees also have been coordinating with DFG regarding access to Sinoro Bar by crossing the Lower Yuba River at low flows. DFG has expressed support for the spawning habitat expansion component recommended for Sinoro Bar and has indicated that a Streambed Alteration Agreement for a temporary crossing from the Mullican/Butler property to Sinoro Bar would likely be issued in order to implement the expansion of spawning habitat at this location (Hill pers. comm.).

FED1-39

RMT members who indicated their support to the Steering Committee of the document *Habitat Expansion for Spring-Run Chinook Salmon and Steelhead in the Lower Yuba River* (Appendix G of the Draft HEP) include Tom Johnson (Yuba County Water Agency [YCWA]), Tracy McReynolds (DFG), Gary Reedy (South Yuba River Citizens League [SYRCL]), and Gene Geary (PG&E).

FED1-40

See Master Response 4 regarding the optional segregation weir component of the Lower Yuba River Actions.

FED1-41

Comment noted. Yoshiyama et al. 2001 provides a good context for current management of the Yuba River and the overall impact of development throughout the watershed. Yoshiyama is cited throughout the Final HEP.

FED1-42

Please refer to Master Response 3 regarding eligibility of the Lower Yuba River Actions.

To reiterate, the Licensees believe that both the Sinoro Bar and Narrows Gateway spawning habitat expansion actions are eligible under the HEA, as they are independent of and complementary to the Corps gravel augmentation project. The Corps gravel augmentation project is described in the recent *Draft Environmental Assessment for the Lower Yuba River Gravel Augmentation Project, Yuba and Nevada Counties, California* (Corps 2010).

FED1-43

In the Draft HEP, the Licensees recommended placement of gravel in lower Deer Creek to help rehabilitate spawning habitat in both Deer Creek and the Yuba River at the mouth of Deer Creek. Since issuance of the Draft HEP, the Licensees have worked toward more fully developing this action. Based on issues raised by NMFS and other signatories regarding limitations to expanding spawning habitat in Deer Creek, the Licensees have modified this action to focus solely on spawning habitat expansion in the Yuba River immediately downstream of Deer Creek (i.e., Narrows Gateway; see Chapter 3 of the Final HEP). Rehabilitation of spawning habitat in Deer Creek itself has been removed from consideration. The Final HEP contains two independent, but complementary, spawning habitat expansion actions: spawning habitat expansion at Sinoro Bar and at Narrows Gateway. Both actions are located in the Yuba River channel between Englebright Dam and the Narrows Pool.

FED1-44

See Master Response 4 regarding the optional segregation weir component of the Lower Yuba River Actions.

FED1-45

See Master Response 4 regarding the optional segregation weir component of the Lower Yuba River Actions.

FED1-46

See Master Response 4 regarding the optional segregation weir component of the Lower Yuba River Actions.

FED1-47

The HEA allows for both habitat expansion and habitat enhancement, as stated in Section 3.1 of the HEA. The juvenile rearing habitat restoration component described in the Draft HEP, referred to as the juvenile rearing habitat *expansion* component, has been modified and is defined in more detail in Appendix L of the Final HEP. This action is difficult to quantify, does not significantly contribute to the HET, and was not included in the recommended actions in the Final HEP. The Licensees would consider restoration actions such as the juvenile rearing habitat expansion as an alternative to the optional segregation weir. The action would benefit juvenile spring-run Chinook salmon by expanding the amount of quality rearing habitat in the Lower Yuba River.

FED1-48

SYRCL, with funding from the AFRP, commissioned a study on rehabilitation concepts for juvenile salmonid rearing habitat in the Parks Bar to Hammon Bar Reach of the Lower Yuba River (cbec 2010). The draft study concluded that rehabilitation actions to diversify rearing habitats in the Lower Yuba River are warranted. However, specific designs of rehabilitation actions would need to be developed with geomorphic considerations in mind to ensure proper functioning and maximize their potential for being sustainable throughout the range of flows in the Lower Yuba River.

The juvenile rearing habitat restoration component described in the Draft HEP, referred to as the juvenile rearing habitat *expansion* component, was modified during the development of the Final HEP. The Licensees identified suitable sites for expanded juvenile rearing habitat that are different from those proposed in the SYRCL report. Implementation of these actions would not involve pilot studies. However, the benefits of these actions are difficult to quantify and do not significantly contribute to the HET. Therefore they were not included in the recommended actions. The Licensees would consider these or other restoration actions in the event that the segregation weir option is not implemented. The modified juvenile rearing habitat expansion actions are described in more detail in Appendix L of the Final HEP. Also see response to Comment FED 1-47.

FED1-49

The potential juvenile rearing habitat expansion actions are not recommended in the Final HEP. The potential actions considered are described in Appendix L.

NMFS correctly points out the complexity of flow and channel dynamics in creating and maintaining riverine habitat features and the special complexity of conditions in the Yuba River. Potential actions considered by the Licensees included expansion of juvenile rearing habitat in the Lower Yuba River below Highway 20. The habitat could be expanded by creating groundwater-fed alcoves and side channels that connect to the main river during high flows. Clearly the location and nature of these potential actions would need to be carefully considered in light of the hydro-geomorphology of the Lower Yuba River. However, it should be pointed out that an unusual richness of information is available on the hydro-geomorphology of the Lower Yuba River, in excess of almost any other area of the Sacramento River Basin. Dr. Gregory Pasternack, a professor of watershed hydrology and geomorphology at UC Davis, has extensively mapped and studied the area above Highway 20 while the Yuba Accord River Management Team (RMT), USFWS, and others have studied the area below Highway 20.

FED1-50

See Master Response 3 regarding the eligibility of the Lower Yuba River Actions. As explained by this master response, the Sinoro Bar and Narrows Gateway spawning habitat expansion actions are eligible under the HEA and, therefore, will contribute to the HET. See Chapter 4 of the Final HEP for a discussion on the estimated contribution to the HET from the Sinoro Bar and Narrows Gateway spawning habitat expansions.

The recommended actions, including spawning habitat expansion at Sinoro Bar and Narrows Gateway, are eligible under the HEA and expand habitat for spring-run Chinook salmon into an area not presently used to a significant degree by spring-run Chinook salmon. Habitat expansion at Sinoro Bar and Narrows Gateway provide quantity and quality of habitat for spring-run Chinook salmon sufficient to achieve the HET. The Licensees have proposed a segregation weir as an optional measure that could be used to enhance separation of the spring-run and fall-run fish, if determined necessary by the resource agencies (NMFS, USFWS, and DFG). Regarding the juvenile rearing habitat expansion component, see responses to Comments FED1-47 and FED1-48.

The Lower Yuba River is one of the most extensively studied streams in the Sacramento River system. Lack of studies cannot be used as a rationale for inaction.

FED1-51

The Three-Creek Actions are not considered in the Final HEP. See Master Response 2 regarding the Three-Creek Actions.

FED1-52

See response to Comment FED1-51.

FED1-53

See response to Comment FED1-51.

FED1-54

See response to Comment FED1-51.

FED1-55

See response to Comment FED1-51.

FED1-56

See response to Comment FED1-51.

FED1-57

See response to Comment FED1-51.

FED1-58

See response to Comment FED1-51.

FED1-59

See response to Comment FED1-51.

FED1-60

See response to Comment FED1-51.

FED1-61

See response to Comment FED1-51.

FED1-62

See response to Comment FED1-51.

FED1-63

See response to Comment FED1-51.

FED1-64

See response to Comment FED1-51.

FED1-65

See response to Comment FED1-51.

FED1-66

See response to Comment FED1-51.

FED1-67

See response to Comment FED1-51.

FED1-68

See response to Comment FED1-51.

FED1-69

The Licensees did confer with NMFS and discussed the alternatives, including Upper Yuba River trap and transport. One of the primary reasons for requesting a 6-month extension to prepare the Final HEP was to evaluate the Upper Yuba River Actions proposed by NMFS. As a result, the Steering Committee devoted considerable attention to evaluation of the Upper Yuba River reintroduction proposal. See also responses to Comments FED1-1, FED1-2, and FED1-3.

The Steering Committee reviewed the science in the NMFS Draft Recovery Plan and found considerable support for the expansion of habitat in the Lower Yuba River, in addition to support for reintroduction in the Upper Yuba River. Using the working definitions of the HEA criteria (found in Appendix F of the Final HEP), the Steering Committee rated the Lower Yuba River Actions higher than the Upper Yuba River Actions primarily due to the experimental nature of trap and transport, cost effectiveness, and timeliness of benefits for spring-run Chinook. See response to Comment FED1-11. See also Master Response 3 regarding the eligibility of the Lower Yuba River Actions.

Comment Letter FED2 (Kathleen Wood, U.S. Fish and Wildlife Service, February 18, 2010)

United States Department of the Interior

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In Reply Refer To:

FEB 18 2010

FED2

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Subject: Comments on November 2009 Draft Habitat Expansion Plan for the Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead

Dear Licensees:

Thank you for the opportunity to comment on the November 2009 *Draft Habitat Expansion Plan* (DHEP) for the *Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead* (HEA). The U. S. Fish and Wildlife (Service) appreciates the work of the Licensees in identifying projects that may be of benefit to salmonids.

As described in the HEA, through this draft plan and consultation with Parties and with directly affected and responsive third parties, the Licensees are to complete identification, evaluation and recommendation of habitat expansion actions, in accordance with evaluation and selection criteria set out in the HEA (Section 4.1 of the HEA). The ultimate goal of the HEA, and thus of the eventual Habitat Expansion Plan, is to expand the amount of habitat with physical characteristics necessary to support spawning, rearing and adult holding of spring-run Chinook salmon (spring-run Chinook) and Central Valley steelhead in the Sacramento River Basin as a contribution to the conservation and recovery of these species (Section 2.1 of HEA). Ultimately, the specific goal of the HEA is to expand spawning, rearing and adult holding habitat sufficiently to accommodate an estimated net increase of 2,000 to 3,000 spring-run Chinook for spawning (Section 2.2 of HEA). The Service has reviewed the DHEP with these considerations in view.

The Service's primary concern with the DHEP is that, as presently constituted, it does not present recommendations that will achieve the goals set out in the HEA. Although we are on record for supporting many of the individual projects identified in the DHEP, we continue to have FED2-1

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2

concerns regarding the approach used to select the recommended alternatives in the DHEP and in the accounting used to estimate Habitat Expansion Threshold (HET) contributions. FED2-1 Con't

The DHEP identifies two sets of recommended actions to meet the goals, terms and conditions of the HEA: (1) the Lower Yuba River habitat expansion actions (Lower Yuba River actions) and (2) the Battle Creek, Big Chico Creek, and Antelope Creek habitat expansion actions (Three-Creek actions). After careful review of the DHEP, the Service believes that neither of these recommended actions, if implemented as described in the DHEP, are likely to achieve the HEA goal of expanding the amount of spawning, rearing and adult holding habitat for spring-run Chinook and steelhead in the Sacramento River Basin. Nor would the actions establish an independent run of spring-run Chinook or support the spring-run Chinook numbers identified for each set of actions. FED2-2

General comments. In our July 15, 2009, comment letter, we expressed concern that habitat expansion projects appeared to be disproportionately linked with the designation of "deal killer" in the June 10, 2009, *Habitat Expansion Agreement: Working Definitions of Evaluation, Selection, and Approval Criteria* (Working Definitions). We were also concerned that habitat expansion projects disproportionately fell out of the timing window of the Working Definitions and were designated as having a long "time to implement." We are concerned that the Licensees have prematurely eliminated habitat expansion projects from consideration, due to an inaccurate perception that such projects will take longer to implement than habitat enhancement projects. We continue to believe that some projects, such as those involving fish passage above rim dams, were eliminated from consideration too early in the development of the DHEP and deserve a more detailed examination of their benefits and limiting factors. We urge the Licensees to more thoroughly consider habitat expansion projects, such as fish passage on the Yuba River, in order to meet the spirit and intent of the HEA. FED2-3

The Service supports both restoring spawning habitat targeting spring-run Chinook salmon in the Englebright Dam reach and restoring juvenile rearing habitat in the lower Yuba River. However, the likelihood that these actions will lead to a geographically separate, self-sustaining population of spring-run Chinook salmon is uncertain in part because of the lack of clear temporal and spatial separation between spring- and fall-run Chinook salmon. Hence, these actions do not appear to meet the National Marine Fisheries Service's (NMFS) approval criteria for the Habitat Expansion Plan as described in section 4.2.3 of the HEA. FED2-4

Lower Yuba River Actions. The Lower Yuba River actions are comprised of riverbed work between Englebright and Daguerre Point Dams, an optional segregation weir, and restoration of juvenile rearing habitat between Highway 20 Bridge and the downstream extent of the Yuba Goldfields. These three actions all have merits, but their combined contribution to spring-run Chinook numbers appears to be overstated in the DHEP.

The primary example of overstated benefits is the riverbed work between Englebright and Daguerre Point Dams. Daguerre Point Dam is a known impediment to spring-run Chinook and steelhead, causing significant delays in migration, and perhaps increased overlap in spawning with fall-run Chinook salmon. Increasing spawning habitat is an important consideration in conserving all Chinook salmon; however, increasing spawning habitat without a commensurate increase in fish passage may not be expected to attain the numbers put forward in the DHEP. FED2-5

Comment Letter FED2 (Continued)

3

If additional adult spring-run Chinook are not able to access the habitat, then the enhanced habitat should not be considered expansion under the HEA. The HEA was careful not to burden the Licensees with responsibility for fluctuating salmonid populations; however, the proposed changes in the physical characteristics of the river should not be considered as adequate mitigation for blockage of fish passage, if blockage of fish passage continues to be an overriding consideration in habitat availability. FED2-5 Con't

In addition, the Army Corps of Engineers (ACOE) has an existing regulatory requirement for long-term gravel augmentation in this reach. The increases in spawning habitat expected to occur as a result of ACOE actions appear to be counted toward the HET. A very clear accounting must be done to assure that there is no overlap between obligations of the ACOE and incremental contributions of the DHEP actions. FED2-6

Three-Creek Actions. Actions identified in other venues are acceptable under the HEA, provided that their implementation results in a net expansion of habitat over any Existing Requirements and Commitments. It appears that the Licensees are counting habitat contributions made by other parties in the Three-Creek action area toward the estimated contribution of the DHEP actions to the HET. This is not consistent with Section 3.1 of the HEA. The Service bases this conclusion on the fact that the entire Battle Creek restoration, including both Phase 1 and Phase 2, is estimated to support approximately 2,500 spring-run Chinook (U.S. Bureau of Reclamation *et al*. 2004), but the DHEP contribution to Battle Creek Restoration will be toward Phase 2 only, and the maximum contribution from the HEA will be $16.9 million (36 percent of the Phase 2 total). FED2-7

The DHEP overstates the potential habitat expansion of the Three-Creek Actions. By our calculations, the Three-Creek Actions would support an additional 1,042 adult spring-run Chinook[1], rather than the 2,250 identified in the DHEP. The discrepancy in the numbers may be irrelevant in the final discussion, because it appears that parts of the Three-Creek actions overlap with regulatory requirements placed upon other agencies.

It also appears that Existing Requirements and Commitments from the NMFS' final OCAP biological opinion on long-term operations of the Central Valley Project and State Water Project (NMFS 2009) are being combined with mitigation needs under the HEA. Specifically, the Battle Creek Habitat Expansion Actions proposed in the DHEP are part of the reasonable and prudent alternative of NMFS' final OCAP biological opinion. These actions fall under the Existing Requirements and Commitments restriction in section 3.1 of the HEA. FED2-8

Section 6.2.3 (Limiting Factors). Two of the limiting factors identified in this section (*i.e.*, lack of temporal or spatial segregation of spawning spring-run and fall-run fish, and straying of hatchery fish) are potentially serious enough to render the contribution of the Lower Yuba River actions to the HET for spring-run Chinook salmon as smaller than estimated, or as not

1 The Battle Creek Phase 2 funding contribution would contribute to habitat for an additional 387 adult spring-run Chinook. The Antelope Creek Habitat Expansion Action at Paynes Crossing would support an additional 224 adult spring-run Chinook. The Big Chico Creek Habitat Expansion Action at Iron Canyon would support an additional 431 spring-run Chinook.

4

measureable. These limiting factors deserve further discussion, and, in particular, justification explaining why the Lower Yuba River actions should proceed in the face of these limiting factors. FED2-9 Con't

Section 6.4 (Spawning Habitat Rehabilitation). Both the Sinoro Bar Shotrock Removal project and Deer Creek Gravel Augmentation project will require the cooperation of landowners and continual post-project maintenance by other parties (as was noted). Although these are not limiting factors *per se*, the feasibility of implementing these projects hinges greatly on reaching appropriate agreements with complex entities. Multiple landowners will be impacted by project access, including the ACOE, for which budget constraints and priorities may impact the schedule of meeting the statutory requirements of the NMFS biological opinion on the operation of Daguerre Point Dam and Englebright Dam (Section 6.4.6). The DHEP should map out a more detailed strategy to provide some assurance that these agreements can be attained. FED2-10

Section 6.6 (Juvenile Rearing Habitat Restoration). In addition to a pilot restoration project, the Service's Anadromous Fish Restoration Program (AFRP) has funded a pre-project assessment that is addressing geomorphic, hydrologic, hydraulic and riparian conditions at different sites. The results of this study are expected to be available in April 2010 (Gary Reedy, SYRCL, personal communication). Recent preliminary results have indicated (1) the Yuba River is so dynamic that single-event substrate restoration actions should not be viewed as permanent (and certainly not maintenance-free), and (2) there are some places with appropriate soil conditions and summer water levels where riparian plantings of cottonwoods would be valuable and have a high likelihood of success. These are scientifically valid points and they differ from what is presented in this section of the DHEP. FED2-11

It would be optimal to have restoration actions last 10 to 15 years, at the very minimum. The Service is concerned that the Lower Yuba River actions may be short-lived (even returning to baseline within a year of implementation), if not maintained properly. Hopefully, juvenile habitat restoration will have some lasting value with maintenance, through contribution to instream woody material and new establishment of cottonwoods over the long term. A cost/benefit analysis is the key to determining whether it is acceptable to fund restoration projects that may have limited longevity. The issue of action longevity should be discussed in this section.

Conclusion. Although substantial progress has been made in preparing a foundation for decision-making, the Service finds the decision-making process of the DHEP to need further work. As outlined above, the DHEP is not consistent with the HEA, because it is not likely to contribute to a new population of spring-run Chinook, overestimates contribution to the HET, appears to overlap with the regulatory requirements and obligations of other parties, and does not give adequate consideration to in-kind mitigation. FED2-12 We recommend that increased fish passage on the Yuba River be re-examined and that a clear and thorough accounting of potential HET contributions be done on any recommended actions that are shared with other parties. FED2-13 We also recommend that the decision-making process be modified to address the concerns enumerated in this letter. FED2-14

Comment Letter FED2 (Continued)

5

If you have any questions regarding our comments, please contact Alison Willy at (916)414-6534. We look forward to continued involvement in this important process.

Sincerely,

for M. Kathleen Wood
Assistant Field Supervisor

Attachment

cc:
FERC Washington, DC
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6

Literature Cited

National Marine Fisheries Service (NMFS). 2009. Final biological opinion and conference opinion on the proposed long-term operations of the Central Valley Project and State Water Project in the Central Valley, California, and its effects on listed anadromous fishes and marine mammal species, and designated and proposed critical habitats. 844pp.

U.S. Bureau of Reclamation, Pacific Gas and Electric Company, National Marine Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Game. 2004. Draft Battle Creek Salmon and Steelhead Restoration Project, Adaptive Management Plan. April 2004. 238pp.

U.S. Fish and Wildlife Service. 2009. Comments on Draft Oroville Habitat Expansion Agreement Documents, FERC Project No. 2100. U.S. Fish and Wildlife Service, Sacramento, CA.

Responses to Letter FED2 (Kathleen Wood, U.S. Fish and Wildlife Service, February 18, 2010)

FED2-1

The Three-Creek Actions are not considered in the Final HEP. See Master Response 2 regarding the Three-Creek Actions and Master Response 1 regarding contribution to the HET.

Regarding the Lower Yuba River Actions in the Draft HEP, the Steering Committee has obtained independent estimates from Dr. Gregory Pasternack on the amount of available habitat (Pasternack 2010a) and consulted with biologists with local expertise in the watershed to further refine the results of the method used in the Draft HEP. Given the results of these efforts, the Licensees believe that the Lower Yuba River Actions are sufficient to meet the goals of the HEA, specifically the HET (Section 2.2 of the HEA). See Chapter 4 of the Final HEP for additional detail.

FED2-2

Currently, negligible spawning habitat is present in the Englebright Dam Reach of the Lower Yuba River. The Englebright Dam Reach contains large deposits of angular shot rock (Pasternack et al 2010) due to construction of the dam and sloughing of material from canyon slopes in the vicinity of the dam. Since construction of Englebright Dam and the resulting sediment entrainment, there is no opportunity for recruitment of the appropriate rounded alluvial gravels for spawning. Therefore, by creating appropriate spawning conditions in a reach where conditions are prohibitive to spawning, the Licensees will be expanding usable habitat for spring-run Chinook salmon and steelhead.

When the Yuba River is considered as a whole, the watershed is of adequate size and distance from other watersheds to support an independent population according to requirements specified in Lindley et al. (2004). Insufficient data are available to determine whether the Lower Yuba River alone is capable of supporting an independent population; however, the stated objective of the HEA is to *contribute* to the conservation and recovery of the species (Section 2.1 of the HEA), and according to NMFS Approval Criteria (c) to "help support establishment of a geographically separate, self-sustaining population" (Section 4.2.3 of the HEA). The HEA is not intended to establish an independent population on its own. The Licensees believe that the Lower Yuba River can support an independent population, defined by McElhany et al. (2000) as "any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period are not substantially altered by exchanges of individuals with other populations."

FED2-3

Fish passage above Shasta and Folsom Dams is addressed in the *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project* (NMFS 2009b); fish passage actions involving these dams therefore are ineligible under the HEA.

The Steering Committee evaluated fish passage above Englebright Dam on the Yuba River (i.e., the Upper Yuba River Actions) during preparation of the Draft HEP and in the Final HEP. As discussed in response to Comment FED1-69, trap-and-transport actions were not favored primarily due to the experimental nature of trap and transport, cost effectiveness, and timeliness of benefits for spring-run Chinook salmon. Additionally, the HEA was developed as an alternative to fish passage prescriptions above Oroville Dam on the Feather River.

FED2-4

It is not necessary under the HEA that the actions recommended by the Licensees lead to development of an independent, self-sustaining population of spring-run Chinook salmon. Instead, the HEA states that the Licensees actions should *support* establishment of a geographically separate, self-sustaining population of spring-run Chinook salmon and also *support* segregation of fall-run and spring-run Chinook salmon.

The Licensees believe that the recommended actions do indeed support development of an independent spring-run Chinook salmon population (1) by providing sufficient quantity of habitat to support an independent population; (2) by providing habitat with the biological needs of spring-run Chinook salmon in an area not presently used to any great degree by spring-run Chinook salmon; and (3) through the use of a segregation weir by the resource agencies (NMFS, USFWS, and DFG) if determined necessary to segregate fall-run and spring-run Chinook salmon.

FED2-5

See Master Response 1 regarding contribution of the Lower Yuba River Actions to the HET and Chapter 2 of the Final HEP.

FED2-6

The HEA-recommended spawning habitat expansion actions are independent of, and complementary to, the Corps gravel augmentation project. The spawning habitat expansion action at Sinoro Bar involves the removal of shot rock, replacement of the shot rock with gravel, and re-contouring of the streambed to create new spawning habitat for spring-run Chinook salmon. The spawning habitat expansion action at Narrows Gateway involves creation of additional spawning habitat immediately downstream of Sinoro Bar through removal of the armored surface layer of the streambed, replacement of the armored layer with gravel, and recontouring of the streambed. The purpose of these two recommended actions is to create spawning habitat where negligible amounts currently exist.

In contrast, the Corps' gravel augmentation project is designed to provide an annual injection of gravel to compensate for the loss of gravel recruitment caused by Englebright Dam. As described in the *Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River*, prepared for the Corps by Dr. Gregory Pasternack (Pasternack 2010b), and in the recent *Draft Environmental Assessment for the Lower Yuba River Gravel Augmentation Project, Yuba and Nevada Counties, California* (Corps 2010), the Corps' project involves injection of gravel in the vicinity of the Narrows 1 Powerhouse over the period of a few years. Pasternack (2010b) indicates that implementation of the full plan is designed to erase the current deficit of gravel in the Englebright Dam Reach; however, rehabilitation of Sinoro Bar is beyond the scope of the plan. The Corps' project would likely create new spawning habitat upstream of Sinoro Bar and potentially help to sustain the spawning habitat created downstream by the HEA-recommended actions. However, it is unlikely that the Corps' project would create any new spawning habitat in the vicinity of Sinoro Bar or Narrows Gateway, which are the targets of the HEA-recommended actions.

Thus, in terms of estimating contribution to the HET, there is no overlap between the HEA-recommended actions and the Corps' project. Estimates of contribution to the HET as presented in the Final HEP reflect contributions for the spawning habitat expansion actions at Sinoro Bar and Narrows Gateway. Any additional contribution that could be achieved by the Corps' project has not been included in these estimates.

FED2-7

The Battle Creek Actions are not considered in the Final HEP. See Master Response 2 regarding the Three-Creek Actions.

FED2-8

The Battle Creek Actions are not considered in the Final HEP. See Master Response 2 regarding the Three-Creek Actions.

FED2-9

See Master Response 4 regarding the optional segregation weir component of the Lower Yuba River Actions.

Straying of hatchery fish into the Yuba River is a potential concern for any project in the Lower or Upper Yuba River. In fact, NMFS has suggested the use of fish from the Feather River Hatchery to seed the Upper Yuba River as part of its proposed reintroduction program. Straying of Feather River Hatchery fish into the Yuba River is a function of hatchery practices outside the scope of the HEA that are likely to be addressed through future management of the hatchery.

FED2-10

The Licensees are committed to follow through with operation and maintenance of the recommended action(s) for the term of their obligation under the HEA (i.e., approximately 50 years). See response to Comment FED1-38 regarding access to the spawning habitat expansion sites, as well as successful coordination efforts with the landowners regarding access from their properties to these sites.

FED2-11

The Licensees have accepted the obligation of ensuring that actions implemented under the HEA are maintained over a 50-year period. Thus, with the help of stream geomorphology experts, the Licensees are planning to design actions that take advantage of natural geomorphic processes and are sustainable over the long term. Additionally, the Licensees are incorporating operation and maintenance funds into the recommended actions to allow for maintenance activities that may be required following catastrophic events (e.g., channel-changing flood flows).

The Licensees contracted with Dr. Gregory Pasternack to help evaluate and develop conceptual designs for the recommended spawning habitat expansion actions at Sinoro Bar and Narrows Gateway. With appropriate design considerations, Dr. Pasternack considers these actions sustainable (Pasternack 2010a, 2010c).

In relation to developing conceptual designs for juvenile rearing habitat expansion sites, the Licensees benefitted from the work of SYRCL and their contractor (cbec, inc. eco engineering) who have been evaluating concepts for rehabilitating the Lower Yuba River channel. Additionally, the Licensees have involved experts from ICF International to develop conceptual designs for potential juvenile rearing sites, with sustainability being an important objective. (See Appendix L for a description of the juvenile rearing habitat expansion sites.)

Finally, for the optional segregation weir, the Licensees are planning to rely on proven designs in use elsewhere to ensure the protection and longevity of any facility that may be installed seasonally in the Lower Yuba River.

FED2-12

See Master Response 1 regarding contribution to the HET, Master Response 3 regarding eligibility of the Lower Yuba River Actions, Master Response 5 regarding mitigation for unmitigated impacts on the Feather River, Chapter 4 of the Final HEP, and response to Comment FED 2-2.

FED2-13

Increased fish passage on the Yuba River (i.e., introduction into the North Yuba River) has been re-examined by the Licensees. Scoring of this action and rationales for each score are found in Appendix F of the Final HEP. The spreadsheets that were used by the Steering Committee to calculate the HET are posted to the HEA website (www.sac-basin-hea.com). The reports with Dr. Pasternack's estimates of the contribution to the HET for the habitat expansion actions at Sinoro Bar and Narrows Gateway are included as Appendices H and K of the Final HEP. Additional detail on the calculation method used by the Steering Committee to determine contribution to the HET is found in Chapter 4 of the Final HEP. All parties to the HEA have access to each of these resources, and each party will receive a copy of this Final HEP.

FED2-14

As documented in Appendix C, the Steering Committee consulted with the signatories to the HEA during development of the decision-making process. See responses to comments above and Chapters 2 and 4 of the Final HEP.

Comment Letter STA1 (John McCamman, California Department of Fish and Game, February 10, 2010)

California Natural Resources Agency
DEPARTMENT OF FISH AND GAME
1416 Ninth Street
Sacramento, CA 95814

ARNOLD SCHWARZENEGGER, Governor
John McCamman, Director

February 10, 2010

STA1

Ms. Liv Imset
Senior License Coordinator
Pacific Gas and Electric Company, Power Generation
245 Market Street
San Francisco, California 94105
Mail Code N11C
Post Office Box 770000
San Francisco, California 94177

Ms. Heidi Rooks
Environmental Program Manager
Department of Water Resources
Division of Environmental Services
901 P Street, 4th Floor
Post Office Box 94836
Sacramento, California 95814

Subject: Habitat Expansion Agreement, Draft Habitat Expansion Plan for Central Valley Spring-Run Chinook Salmon and Steelhead Trout

Dear Mss. Imset and Rooks:

Thank you for the opportunity for the Department of Fish and Game (Department) to provide recommendations regarding the subject Habitat Expansion Agreement, Draft Habitat Expansion Plan (HEP), dated November 2009. As described in the Habitat Expansion Agreement (HEA) steering committee letter to the nine signatories, dated October 28, 2008, the HEA was negotiated as an alternative to Federal Power Act (ACT) fish passage prescriptions as part of the Federal Energy Regulatory Commission (FERC) relicensing of Oroville, Poe, and Upper North Fork Feather River hydropower projects located on the Feather River. The overall goal of the HEA is to expand the amount of habitat with physical characteristics necessary to support spawning, rearing, and adult holding for an increase of between 2,000 and 3,000 spawning Spring-run Chinook salmon in the Sacramento River Basin.

As one of the nine signatories, our Department supports the goal of the HEA and recommends funds from the HEA be directed to achieve these goals as soon as possible. The HEP identified two groupings of habitat expansion and enhancement actions that each meet the goals, terms and conditions of the HEA: 1) the Lower Yuba River Habitat Expansion Actions (Lower Yuba River Actions); and 2) the

Conserving California's Wildlife Since 1870

Ms. Liv Imset and Ms. Heidi Rooks
February 10, 2010
Page Two

Battle Creek, Big Chico Creek, and Antelope Creek Habitat Expansion Actions (Three Creek Actions). The HEP concludes that one of these two groups of actions should be implemented under the HEA.

The Department agrees each of the groups of actions identified in the HEP meets the goals, terms, and conditions of the HEA. STA1-1 Furthermore, the Department believes that the Three Creek Actions is the preferred group of actions to meet the HEA goals. All of the actions in this group are essentially shovel-ready projects that could use HEA money to leverage other funds to begin construction and provide immediate and permanent access to habitat for the target species (Spring-run Chinook salmon and Central Valley steelhead trout) as identified in the HEA. STA1-2

Throughout the development of the HEA there has been concern regarding the eligibility of funding Phase 2 of the Battle Creek Salmon and Steelhead Restoration Project (Project), one of the actions identified in the Three Creek Actions, based on Section 3.1 of the HEA. Section 3.1 provides language indicating eligible habitat expansion actions must result "in a net expansion of habitat over any existing requirements or commitments". Further the National Marine Fisheries Service questions the eligibility of the Project in a letter to the Department of Water Resources (DWR) and Pacific Gas and Electric Company, dated November 10, 2009, stating that "All phases of the Battle Creek Salmon and Steelhead Restoration Program are part of the Reasonable and Prudent Alternative (RPA) included in the Biological Opinion (BO) on the long term operations of the Central Valley Project and State Water Project (OCAP BO)".

The OCAP BO Action I.2.6 requires the U.S. Bureau of Reclamation and DWR to direct discretionary funds to the Project. However, as the HEP clearly points out, this statement does not ensure that such discretionary funds will be available, does not provide an alternative funding source, and therefore does not secure enough funding to complete Phase 2 of the Project. Because of these uncertainties our Department believes Phase 2 of the Project clearly meets the eligibility requirements for the HEA, and funding the Three Creek Actions group will provide expeditious permanent habitat in three separate Sacramento Valley tributaries for both target species. STA1-3

The Department believes the Lower Yuba River Actions have elements that are desirable and should be pursued. These include spawning habitat rehabilitation of the Englebright Dam Reach, floodplain and riparian habitat restoration, and fish passage improvements at Daguerre Point Dam. However, we do have concerns with some of the proposed actions such as the installation of a segregation weir. STA1-4

Comment Letter STA1 (Continued)

Ms. Liv Imset and Ms. Heidi Rooks
February 10, 2010
Page Three

Over summer holding patterns of Spring-run Chinook salmon in the Lower Yuba River have not been clearly delineated. Without understanding of these holding patterns, the operation of a segregation weir could reduce available spawning habitat for those fish holding downstream of the proposed weir. This is potentially in conflict with overall HEA objectives. STA1-4 Cont'd

The Department will continue to work with the various State and federal agencies, corporations, and non-government organizations in the effort to recover Spring-run Chinook salmon and steelhead trout populations in the lower Yuba River.

If you have questions regarding our recommendations, please contact Staff Environmental Scientist Mike Berry at (530) 225-2131 or e-mail mberry@dfg.ca.gov.

Sincerely,

JOHN McCAMMAN
Director

Attachments

cc: Mr. Mike Berry
Staff Environmental Scientist
Department of Fish and Game, Northern Region
601 Locust Street
Redding, California 96001

Mr. Mark Stopher
Acting Regional Manager
Department of Fish and Game, Northern Region
601 Locust Street
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Mr. Kent Smith
Acting Regional Manager
Department of Fish and Game, North Central Region
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Ms. Liv Imset and Ms. Heidi Rooks
February 10, 2010
Page Four

cc: Mr. Chris Wilkinson
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Mr. Paul Kubicek
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Mr. Steve A. Edmondson
Northern California Habitat Supervisor
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ec: Mss. Kathy Hill, Donna Cobb, Tracy McReynolds, Colleen Harvey-Arrison, Tricia Bratcher and MaryLisa Lynch
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Responses to Letter STA1 (John McCamman, California Department of Fish and Game, February 10, 2010)

STA1-1

Comment noted.

STA1-2

Comment noted. See Master Response 2 related to the Three-Creek Actions.

STA1-3

Comment noted. See Master Response 2 related to the Three-Creek Actions.

STA1-4

See Master Response 4 related to the optional segregation weir.

Comment Letter LOC1 (John Waskiewicz, Yuba County Resource Conservation District, February 15, 2010)

LOC1

From: FlyingRancher@aol.com
To: hea@water.ca.gov;
cc: flyingrancher@aol.com; Larry.Lloyd@ca.nacdnet.net;
Subject: Lower Yuba River Comments
Date: Monday, February 15, 2010 7:49:51 PM

Dear Chief of Environmental Services, DWR

I am writing to you on behalf of the Yuba County Resource Conservation District. Our Board of Directors would like you to know that we support the HEA Central Valley Spring Chinook Salmon and Steelhead Draft for the Lower Yuba River.

LOC1-1

Our Resource Conservation District has been involved for a number of years in Watershed and habitat issues on the Yuba River, particularly in the stretch just below Englebright Dam and around Deer Creek. We believe that the Physical habitat enhancements proposed on the Yuba is the most cost efficient method for increasing salmon and steelhead spawning and holding habitat.

Our Resource Conservation District looks forward to working with you and your department in the future, if there is any further assistance we can offer please don't hesitate to contact me at the above email or phone, (5306399980)

Sincerely, John Waskiewicz
Chair, Yuba County RCD Board of Directors

Response to Letter LOC1 (John Waskiewicz, Yuba County Resource Conservation District, February 15, 2010)

LOC1-1

Your comment is noted in support of the Lower Yuba River Actions.

Comment Letter LOC2 (William J. Bennett, High Sierra Resource Conservation & Development Area, February 17, 2010)

HIGH SIERRA RESOURCE CONSERVATION & DEVELOPMENT AREA
251 AUBURN RAVINE ROAD, SUITE 105, AUBURN, CALIFORNIA 95603 (530) 823-5687

LOC2

February 17, 2010

To Whom It May Concern:

This letter is being sent to support the HEA Central Valley Spring Run Chinook Salmon and Steelhead draft. We support the proposed selection of the Lower Yuba River for the $20 million in funding.

The High Sierra Resource Conservation and Development Council is involved in activities supporting the proper management and conservation of our natural resource base in Yuba County through working with the Yuba Resource Conservation District and the Yuba River Watershed Protection and Fire Safe Council. LOC2-1

We believe physical habitat enhancements along the Lower Yuba River starting in the Deer Creek area, and then down river of the watershed would significantly improve the spawning and holding habitat, while being the most cost effective action in our opinion.

The local community has been actively working on this project for over six years and we feel they are ready for implementation. We therefore request that the Lower Yuba River Actions be favorably considered for funding by the National Marine Fisheries Service.

Sincerely,

/S/

William J. Bennett
President

Response to Letter LOC2 (William J. Bennett, High Sierra Resource Conservation & Development Area, February 17, 2010)

LOC2-1

Your comment is noted in support of the Lower Yuba River Actions.

Comment Letter LOC3 (Kelly Sackheim, KC Hyro, February 18, 2010)

LOC3

KC Hydro
a collaboration of Davis Hydro LLC
& Sackheim Consulting
5096 Cocoa Palm Way
Fair Oaks, CA 95628

February 18, 2010

Director Hydro Licensing, Power Generation
Pacific Gas and Electric Company
P.O. Box 770000
San Francisco, CA 94177

Chief, Division of Environmental Services
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

submitted via e-mail to hea@water.ca.gov
No Hard Copy Follows

Re: Comments on Draft Habitat Expansion Plan for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead

Dear Licensees of FERC Project Nos. 1962, 2100, 2105, and 2107:

KC LLC, a collaboration of Davis Hydro LLC and Sackheim Consulting, has reviewed the subject document, and offers the following comments for consideration by the Licensees for incorporation into the final Habitat Expansion Plan (HEP).

KC LLC understands that the Licensees expect to select and propose one of the two groups of recommended actions described in the HEP for approval by the National Marine Fisheries Service for implementation to comply with the Licensees responsibilities under the Habitat Expansion Agreement (HEA) that was created to complement licensed operations of the Oroville, Poe, Upper North Fork Feather River, and Rock Creek-Cresta hydropower projects, all located on the Feather River. It is understood that this program is anticipated to provide greater gains for the target species beyond project boundaries through identification, evaluation, selection, and implementation of the most promising and cost-effective actions. LOC3-1

LOC3-1 cont'd

KC LLC offers its comments in this letter in support of the Licensees reaching the following conclusions:

1. Both groups of recommended actions described in the HEP would contribute to reaching the Habitat Expansion Threshold (HET) specified in the HEA.
2. At least some of the Three-Creek Actions, based on the identified contribution to habitat expansion, could be selected to mitigate for any presently unmitigated impacts to fish species in the Sacramento River Basin, including those believed to be caused by the existence of the P-606 Kilarc Hydroelectric Development on Old Cow Creek. Consequently, given that there is now an adequate alternative available to maintain the Kilarc facilities in place, funds for the removal of the Kilarc facility would beneficially be allocated instead to implementation of the Three-Creek Actions.

KC LLC notes that the Three-Creek Actions identified in the HEA for Feather River impacts involve three totally discrete actions that may be implemented independently, while the Lower Yuba River Actions would involve an integrated program estimated to achieve a nearly 50% greater contribution to the HET. For these reasons, it would appear sensible to apply the available HEA funding to the integrated, more effective program, and seek alternative funding for the individual Three-Creek Actions.

KC LLC further notes that construction of the Segregation Weir proposed as part of the Lower Yuba River Actions would not occur unless and until there was evidence of its necessity and until its use was supported by the resource agencies and other stakeholders.

Funding earmarked for the Segregation Weir would not be utilized for some time, and could be allocated to other more beneficial programs, similar to the P-606 dismantling fund that is already being drawn down by a protracted and contentious hydropower license surrender process. KC LLC proposes that P-606 funds be utilized immediately for projects that have already been determined to be beneficial to fish and habitat. Additional funds can be generated by hydropower operations for on-going P-606 studies, and eventual demolition of P-606 facilities, should such be deemed warranted, can be funded from new sources as they emerge.

5096 Cocoa Palm Way
Fair Oaks, CA 95628
www.kilarc.info
KC Hydro
fax: 916/880-5597
ph: 916/962-2271

Comment Letter LOC3 (Continued)

The HEA serves as off-site mitigation for the Feather River projects, where a variety of actions are considered eligible for inclusion in the HEP. KC LLC is striving for a similar approach to maximize habitat enhancement as the P-606 license is surrendered, specifying as in the Feather River HEA, "Actions identified in other venues, including unfunded actions, are acceptable for consideration, provided implementation results in a net expansion of habitat over any existing requirements and commitments."

Whether or not the Lower Yuba River Actions are selected for implementation with the HEA funding, P-606 dismantling funds could be re-directed to unmet needs identified under the Three-Creek Actions.

Individually, the Big Chico Creek and Antelope Creek Actions represent relatively "shovel-ready," cost-effective, and well supported actions, that would complement a number of restoration efforts that are ongoing by others in these watersheds. The combined estimated cost of $3.7 million could be covered entirely by the P-606 dismantling funds, with immediate benefits.

The first element of the Three-Creek Actions provides partial funding for implementation of Phase 2 of an existing Restoration Project for which funding would still be inadequate, even including approximately $12 million identified by California Department of Fish and Game (CDFG) that may be obligated if additional funds can be identified to complete Phase 2. Funding of the Three-Creek Actions under the HEA, including $16.9 million for Battle Creek Habitat Expansion Action, would still fail to meet the total estimated cost estimate of $46.3 million for Phase 2. Funds earmarked for dismantling of the P-606 Kilarc facilities, which benefit has yet to be specifically estimated, could serve to help to bridge the remaining gap and secure funding for Phase 2 in its entirety,

In summary, KC LLC supports the overall biological goal to expand habitat with the physical characteristics necessary to support spawning, rearing, and adult holding of spring-run Chinook salmon and steelhead in the Sacramento River Basin as a contribution to the conservation and recovery of these species. KC LLC recognizes that the cost of the projects identified exceeds the amount of funds available under the Feather

LOC3-1
cont'd

River HEA. The projects are well-developed and justified, and could benefit from P-606 funding earmarked for the same goals, if the superior mitigation within the Sacramento River Basin were approved, notwithstanding that projects would be implemented outside the tributary Cow Creek Watershed. A comprehensive approach, directing all available funding to the best projects, will be most effective in achieving the goal of conservation and recovery of species.

LOC3-1
cont'd

Sincerely,

Kelly W. Sackheim

Kelly W. Sackheim, Principal
KC Hydro, a partnership of Davis Hydro LLC and Sackheim Consulting

Response to Letter LOC3 (Kelly Sackheim, KC Hyro, February 18, 2010)

LOC3-1

Comment noted. See Master Response 2 regarding the Three-Creek Actions. Decommissioning of the Kilarc-Cow Creek Hydroelectric Project is outside the purview of the HEA.

Comment Letter LOC4 (John Waskiewicz, Yuba County Resource Conservation District, February 18, 2010)

LOC4

Yuba County Resource Conservation District
1511 Suite B, Butte House Road, Yuba City, CA 95993 (530) 674-1461 ext.130

February 18, 2010

Director Hydro Licensing, Power Generation
Pacific Gas and Electric Company
P.O. Box 770000

San Francisco, CA 94177
Chief, Division of Environmental Services
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

Submitted via e-mail to hea@water.ca.gov
No Hard Copy Follows

Re: Comments on Draft Habitat Expansion Plan for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead

Dear Licensees of FERC Project Nos. 1962, 2100, 2105, and 2107:

I am writing to you on behalf of the Yuba County Resource Conservation District. Our Board of Directors would like you to know that we support the HEA Central Valley Spring Chinook Salmon and Steelhead Draft for the Lower Yuba River for the following reasons.

1. The first of the three actions has been the subject of years of research and is ready for implementation. Yuba County Resource Conservation District (YCRCD) has lead the development of a site-specific proposal to remove the shot rock as the first step in rehabilitation, that was deemed appropriate based on the results of the U.C. Davis studies led by geomorphologist Greg Pasternack.

LOC4-1

2. The estimated contribution to the Habitat Expansion Threshold (HET) for the Lower Yuba River Actions is the highest of all of the actions considered.

3. These actions appear to be the most cost effective, according to the draft HEP, and additional funding may also be made available, if necessary, from PG&E's Narrows Project mitigation fund, grants identified by the USFWS previously but then deemed premature, and/or grants administered by the Sierra Nevada Conservancy for which YCRCD has applied twice and been encouraged to re-apply (after the first application was deemed premature and the second application was never considered due to the state budget crisis). The Licensees note that they propose to continue working with the signatories and active watershed groups who have been considering these actions for a number of years, including the YCRCD and other participants in the Lower Yuba River Technical Working Group (LYRTWG).

LOC4-1 Cont'd

4. The YCRCD would be a willing landowner if the Stewardship Council were to select it as the recipient of the property upstream of lower Deer Creek, and would continue to support ongoing operations and maintenance of the site for habitat benefits.

5. The Lower Yuba River Actions could be implemented within a 5-year time frame, with a benefit to spring-run Chinook salmon realized within 10 years – when time, truly, is of the essence.

6. If the Three-Creeks Actions were selected, $16.9 million would be earmarked for the $46.3 million Phase 2 of the Battle Creek action, while the balance of necessary funding has not been identified and "Phase 2 will not be implemented unless and until funding is secured" – thus, a majority of the HEA funding could remain undisbursed for an indefinite period of time while the balance of funds are secured or another project is identified.

Our Resource Conservation District looks forward to working with you and you department in the future, if there is any further assistance we can offer please don't hesitate to contact me at the above email or phone, (530-639-9980)

Sincerely,

John Waskiewicz
Chair, Yuba County RCD Board of Directors

Responses to Letter LOC4 (John Waskiewicz, Yuba County Resource Conservation District, February 18, 2010)

LOC4-1

1. Your comment is noted in support of the Lower Yuba River Actions.
2. Your comment is noted in support of the Lower Yuba River Actions.
3. The HEA actions in the Lower Yuba River would be fully funded. The funds noted could be used by others for complementary actions.
4. Comment noted. The Stewardship Council Lands are outside the purview of the HEA.
5. Comment noted.
6. See Master Response 2 regarding the Three-Creek Actions.

Comment Letter NGO1 (Robert Baiocchi, California Fisheries and Water Unlimited, January 19, 2010)

NGO1

January 19, 2010

Chief Heidi Rooks et al
Department of Water Resources
Habitat Expansion Agreement et al

Re: Comments Regarding the Draft Habitat Expansion Agreement and Habitat Expansion Plan Committee by the California Fisheries and Water Unlimited

Chief Rooks:

Please place the California Fisheries and Water Unlimited on the mailing list for the Draft Habitat Expansion Plan and all submittals. Robert J Baiocchi is the president of the California Fisheries and Water Unlimited, a California Non-Profit Corporation. His e-mail address is enclosed. His background is enclosed. NGO1-1

The Habitat Expansion Agreement for the Sacramento River has some major significant discrepancies as follows:

1. **I was an interested party to the Department of Water Resources (DWR), Pacific Gas and Electric Company (PG&E), State Water Contractors, CDFG, and a few NGOs prevented the needed Spring-run Chinook Salmon and Steelhead Restoration Project that was recommended by the US NOAA Fisheries on the North Fork Feather River and also the Middle Fork Feather River above Oroville Dam. Clearly the issues for DWR, PG&E, and the State Water Contractors was the cost of mitigating the damages these parties caused from Oroville Dam and PG&E dams to the presently endangered spring-run salmon and threatened Steelhead. At that time I represented the California Salmon and Steelhead Association. I now represent the California Fisheries and Water Unlimited.** NGO1-2

2. **The Habitat Expansion Plan limits mitigation of pre-project spring-run Chinook salmon to 2,000 to 3,000 adults. That number of spring-run salmon to be mitigated in the Habitat Expansion Agreement is unreasonable and not in the public interest, and does not reflect the significant number of spring-run salmon that were damaged and harmed by dams in the Sacramento River watershed. Correct that discrepancy.** NGO1-3

3. **Most likely adult spring-run salmon exceeded 100,000s of thousands of salmon in the Sacramento River watershed before the Shasta Dam, Oroville Dam; Bullards Bar Dam; and other dams were constructed and cut off their historic spawning and rearing habitat** NGO1-4

1

areas above the dams. I was exposed to the historic significant salmon runs because I was born in 1931 among Italian commercial salmon fishermen in San Francisco. Unfortunately because of the lack of enforcement and adequate mitigation measures by the State of California and the federal government the commercial fishing fleet of the San Francisco area has been harmed and damaged because of the significant losses of salmon populations. NGO1-4 Cont'd

4. **Spring-run salmon were exterminated in the San Joaquin River watershed by water and hydropower projects because their historic spawning and rearing areas were cut over by the dams and very poor flow conditions. The responsible state and federal government overlooked the extermination of the San Joaquin River watershed salmon fishery because of politics.** NGO1-5

5. **The Habitat Expansion Agreement Committee is made of the California Department of Water Resources (DWR) and the Pacific Gas and Electric Company (PG&E). Both CDWR and PG&E have self-serving conflicts of interest to save money and not mitigate for the losses of spring-run salmon species and also steelhead species that were damaged by their projects. I reference you to the proposed mitigation measures for the restoration of endangered spring-run salmon and threatened steelhead trout developed by the US NOAA Fisheries for the North Fork Feather River (Truck and Haul). DWR; PG&E; State Water Contractors; CDFG, and a few NGO's prevented that restoration project from being implemented for self-serving reasons.** NGO1-6

6. **PG&E hydro dams on the North Fork Feather River prior to the construction of Oroville Dam adversely affected and damaged the <u>spring-run salmon</u> spawning and rearing habitat: above Big Bend Dam in the NFFR; above Poe Dam in the NFFR; above Cresta Dam in NFFR; above Rock Creek Dam in the NFFR and also in the East Branch NFFR above Rock Creek Dam; and above Canyon Dam in the NFFR.** NGO1-7

7. **PG&E hydro dams on the North Fork Feather River prior to the construction of Oroville Dam adversely affected and damaged the <u>steelhead trout</u> spawning and rearing habitat: above Big Bend Dam in the NFFR; above Poe Dam in the NFFR; above Cresta Dam in the NFFR; above Rock Creek Dam in the NFFR and also the East Branch NFFR above Rock Creek Dam; and above Canyon Dam in the NFFR.** NGO1-8

8. **The construction of Oroville Dam by CDWR prevented the upstream migration of adult spring-run salmon and steelhead trout to their historic spawning and rearing areas above Oroville Dam in the North** NGO1-9

2

Comment Letter NGO1 (Continued)

Fork Feather River watershed and Middle Fork Feather River watershed. The Feather River Salmon and Steelhead Hatchery has never mitigated for the losses to pre-project spring-run salmon. NGO1-9 Cont'd

9. Some of the losses to juvenile spring-run salmon and steelhead trout in the Sacramento River watershed were caused at DWR's State Pumps in the Bay Delta Estuary when juvenile fish migrate through the Bay Delta Estuary to the Pacific Ocean. 22 million striped bass, salmon, and steelhead trout were document by DWR lost at the State Pumps. That number does not include the length of time the State Pumps was operating and it is a very low number of fish being damaged and lost. Consequently the Habitat Expansion Agreement (HEA) is deficient because the Agreement failed to take into consideration the losses to juvenile endangered spring-run salmon and juvenile threatened steelhead trout at the State Pumps. A glaring conflict of interest by DWR as a member of the Committee controlling the Habitat Expansion Plan NGO1-10

10. PG&E's unlicensed and unmitigated Miocene Dam Hydro Project on the West Branch Feather River prevented the upstream migration of spring-run salmon and steelhead trout to their historic spawning and rearing areas in the West Branch Feather River before the construction of Oroville Dam because PG&E does not release or is not required to release daily year round flows from the Miocene Dam. Today the West Branch Feather River from the Miocene Dam to Oroville Reservoir is dewatered because of the greed of PG&E to not provide water for the river to satisfy the operation of their small hydropower projects associated with the Miocene Dam. A glaring conflict of interest by PG&E as a member of the Committee controlling the Habitat Expansion Plan. NGO1-11

11. The Habitat Expansion Agreement does not provide a specific number of adult steelhead to be mitigated in the Sacramento River watershed. As a starter I recommend a minimum of 50,000 adult steelhead, which includes their pre-project spawning, and rearing areas above Shasta Dam; above Oroville Dam; above Englebright Dam; above Bullards Bar Dam; above Folsom Dam and all other tributaries to the Sacramento River. i.e. Auburn Ravine. Correct this discrepancy. NGO1-12

12. What are the projected number of steelhead that will be mitigated in the Habitat Expansion Plan for the following rivers and streams? NGO1-13

(A) Below Oroville Dam; Feather River
(B) Above Oroville Dam; NFFR; WBFW; MFFR
(C) Above Shasta Dam; McCloud; Pit; Upper Sacramento et al

3

NGO1-13 Cont'd

(D) Below Shasta Dam; Sacramento River
(E) Below Englebright Dam; Yuba River
(F) Above Englebright Dam; Yuba River
(G) Below Bullards Bar Dam; North Yuba River
(H) Above New Bullards Bar Dam; North Yuba River;
(I) Below Folsom Dam; American River Watershed
(J) Above Folsom Dam; American River Watershed
(K) Bear River;
(L) Butte Creek;
(M) Big Chico Creek;
(N) Deer Creek;
(O) Mill Creek;
(P) Battle Creek;
(Q) Bear Creek;
(R) Cow Creek;
(S) Clear Creel;
(T) Cottonwood Creek;
(U) Paynes Creek;
(V) Antelope Creek;
(W) Elder Creek
(X) Thomes Creek
(Y) Stony Creek
(Z) Auburn Ravine

13. The California Fish and Water Unlimited recommends a bare minimum of 100,000 adult spring-run salmon are mitigated under the Habitat Expansion Agreement for the Sacramento River Watershed, which includes their pre-project spawning and rearing areas above Shasta Dam; above Oroville Dam; above Englebright Dam; above Bullards Bar Dam; above Folsom Dam and all other tributaries to the Sacramento River. NGO1-14

14. Spring-run Chinook salmon species are listed as endangered under the federal Endangered Species Act. All dam owners have an obligation to mitigate for losses to endangered spring-run salmon above their dams. That includes DWR and PG&E. All dam owners have the duty and responsibility to comply with the provisions of the federal Endangered Species Act. NGO1-15

15. Steelhead trout species are listed as threatened under the federal Endangered Species Act. All dam owners have an obligation to mitigate for losses to threatened steelhead trout above their dams. That includes DWR and PG&E. All dam owners have the duty and responsibility to comply with the provisions of the federal Endangered Species Act. NGO1-16

4

Comment Letter NGO1 (Continued)

16. The US NOAA Fisheries has the duty and responsibility to enforce the federal Endangered Species Act and protect and mitigate for all losses of endangered spring-run salmon and threatened steelhead trout caused by the construction and operation of all dams and diversions in the Sacramento River watershed. NGO1-17

17. There has been the "taking" of endangered salmon in the Sacramento River watershed. All dam owners must be required by the US NOAA Fisheries to acquire "a take permit" that mitigates for all damages and harm to spring-run salmon and their habitat. NGO1-18

18. There has been the "taking" of threatened steelhead in the Sacramento River watershed. All dam owners must be required by the US NOAA Fisheries to acquire "a take permit" that mitigates all damages and harm to spring-run salmon and their habitat. NGO1-19

19. The Habitat Expansion Agreement was not subject to public review and comments by the public and was agreed to privately and politically among state and federal agencies and one (1) NGO. A NEPQA and CEQA document that supported the terms and conditions in the Habitat Expansion Agreement were not prepared with full public participation and opportunity for comments. NGO1-20

20. There are several federal and state agencies that signed the Habitat Expansion Agreement without providing public notice to the public using their agency public review and participation processes before the agreement was signed. Those agencies were: (a) CDWR; (b) PG&E; (c) US NOAA Fisheries; (d) US Fish and Wildlife Service; (e) California Department of Fish and Game; (f) US Forest Service; and (g) State Water Resources Control Board (Art Baggett Jr.). NGO1-21

21. Art Baggett Jr. of the State Water Resources Control Board signed the Habitat Expansion Agreement without the SWRCB holding a hearing to receive evidence, testimony, and public comments whether the terms and condition of the Habitat Expansion Agreement were in compliance with the state statutes and also were reasonable considering the state of anadromous fisheries in California. NGO1-22

22. Three (3) state agencies signed the Habitat Expansion Agreement without preparing a CEQA document for public review and comment to justify the terms and conditions of the Agreement pursuant to the California Environmental Quality Act and its Guidelines. NGO1-23

23. Three (3) federal agencies signed the Habitat Expansion Agreement without preparing a NEPA document for public review and comment NGO1-24

5

to justify the terms and conditions of the Agreement pursuant to NEPA. NGO1-24 Cont'd

24. American Rivers who signed the Habitat Expansion Agreement did not represent the interest of the California Fisheries and Water Unlimited and most likely many other NGOs. NGO1-25

25. The State Water Contractor who signed the Habitat Expansion Agreement did not represent the interest of the California Fisheries and Water Unlimited. The interest of the State Water Contractors is self-serving. NGO1-26

The California Fish and Water Unlimited is formally requesting a combined NEPA (EIS) and CEQA (EIR) document is prepared for the draft Habitat Expansion Plan before it is finalized. Said combined draft EIS and EIR must have wide spread public distribution in the greater Sacramento River Watershed for public review and participation. I request a copy of the draft EIS/EIR document for my review and comment. NGO1-27

The California Fish and Water Unlimited is formally requesting the specific reasons why the US NOAA Fisheries; US Fish and Wildlife Service; and the California Department of Fish and Game are not members of the Habitat Expansion Agreement Committee. All three of these state and federal agencies have a duty and responsibility to protect endangered spring-run salmon and steelhead trout species and their habitat of the Sacramento River watershed. NGO1-28

The California Fish and Water Unlimited is formally requesting a signed copy of the Habitat Expansion Agreement from you. Please forward said agreement electronically to me. See attachment (HEA). NGO1-29

The California Fish and Water Unlimited is formally requesting the opportunity to review the draft Habitat Expansion Plan at this time and also in the future. Forward the draft Plan electronically to me. I reference the California Public Information Act Section 6250 et seq. The California Fisheries and Water Unlimited is a non-profit California Corporation. Consequently waive all fees for material forwarded to me NGO1-30

The California Fish and Water Unlimited is requesting the minutes that are taken of all committee meetings and that all Committee meeting minutes are published on the internet at a specific public website. Forward copies of all committee-meeting minutes held to date. Also forward past and future agendas, and agenda material to me. Also maintain a roll call of the people attending the meetings. NGO1-31

6

Comment Letter NGO1 (Continued)

The California Fish and Water Unlimited is also requesting a teleconference system is used so that the public can call in and take part at the committee meetings. Forward the teleconference telephone number to me with the password and also makes it available to the public. NGO1-32

Develop a mailing list of interested parties such as California licensed anglers and also California fishery organizations for the purpose of forwarding agendas, minutes, material et al. NGO1-33

I am disabled and cannot travel to Sacramento for Committee meetings. I am also hearing impaired so please use a sound system that assist hearing impaired persons pursuant to California disability statues and regulations. Thank you. NGO1-34

A written response is requested within 10 days pursuant to the California Public Information Act Section 6250 et seq.

Respectfully

Signed by Robert J, Baiocchi

Robert J. Baiocchi, President,
California Fisheries and Water Unlimited
California Non-Profit Corporation

cc: Mr. Steve Edmondson, Supervisor, US NOAA Fisheries

Interested Parties (California Licensed Anglers)

7

Responses to Letter NGO1 (Robert Baiocchi, California Fisheries and Water Unlimited, January 19, 2010)

NGO1-1

Comment noted.

NGO1-2

The HEA was developed "as an alternative to the Resource Agencies or other Parties seeking project specific Fish Passage prescriptions or license conditions in the New Project Licenses for the Licensees' Feather River Hydroelectric Projects" (HEA Section 1.2). The HEA parties (signatories to the HEA) agreed that satisfying the terms of the HEA "(a) fully mitigates for any presently unmitigated impacts due to the blockage of Fish Passage of all fish species caused by the Feather River Hydroelectric Projects; and (b) resolves among the Parties during the term of this Agreement issues related to regulatory conditions for Fish Passage associated with or related to any of the Feather River Hydroelectric Projects in excess of the action(s) contemplated under this Agreement [the HEA]…" (HEA Section 1.2).

Protection, mitigation, and enhancement measures identified in the Settlement Agreement for Licensing of the Oroville Facilities (Oroville Facilities Settlement Agreement) are intended to mitigate other impacts to salmonid production resulting from the Oroville Facilities, FERC Project No. 2100 (Oroville Facilities), as outlined in Chapter 1 of the Final HEP. Other impacts include operations of the Feather River Hatchery. Impacts related to other facilities of the State Water Project (SWP) and projects not part of the SWP are to be handled through other proceedings (e.g., the *Biological and Conference Opinion on the Long-Term Operations, Criteria, and Plan for the Central Valley Water Project and State Water Project* [NMFS 2009b] and other Federal Energy Regulatory Commission [FERC] licenses).

The signatories to the HEA (including PG&E, DWR, NMFS, USFWS, DFG, the U.S. Department of Agriculture Forest Service (Forest Service), the State Water Contractors, Inc., and American Rivers) agreed that habitat to support an estimated net increase of 2,000–3,000 spring-run Chinook salmon within the Sacramento River Basin was an adequate threshold to fully mitigate any presently unmitigated impacts due to the blockage of fish passage caused by the Feather River Hydroelectric Projects (HEA Section 2.2). (For more information on the HEA as mitigation for unmitigated impacts on the Feather River, refer to Master Response 5.)

During development of the HEA, it was decided that steelhead would benefit from habitat expansion for spring-run Chinook salmon due to similarities in habitat requirements of the two species, and no threshold was assigned to steelhead habitat (HEA Section 2.2). Under the HEP, the HET and ancillary benefits to steelhead will be accomplished via the Lower Yuba River Actions. Other potential actions in streams throughout the Sacramento River Basin were evaluated but did not provide adequate habitat to achieve the goals of the HEA. (See Appendix B in the Final HEP for more information on these potential actions.)

The Licensees and other signatories to the HEA have certain responsibilities and obligations under the Agreement. Unique among the signatories is Mr. Arthur Baggett, Jr., who signed not as a representative of the State Water Resources Control Board (State Water Board) but as an individual making a recommendation to the State Water Board. The State Water Board is not a signatory to the HEA.

Other responsibilities under the HEA include the requirement that the Licensees recommend actions in a Final HEP, following a 90-day comment period on the Draft HEP, at which time NMFS is required to approve or deny the plan (HEA Section 4). The terms of the HEA are not being renegotiated at this time. Once a plan is approved, the Licensees will fully comply with any required environmental regulations and permitting (e.g., California Environmental Quality Act [CEQA] and federal and State Endangered Species Act permits). Protection of listed species beyond the actions in the approved Final HEP will be handled through other proceedings.

NGO1-3

See response to Comment NGO1-2.

NGO1-4

See response to Comment NGO1-2.

NGO1-5
See response to Comment NGO1-2.

NGO1-6
See response to Comment NGO1-2.

NGO1-7
See response to Comment NGO1-2.

NGO1-8
See response to Comment NGO1-2.

NGO1-9
See response to Comment NGO1-2.

NGO1-10
See response to Comment NGO1-2.

NGO1-11
See response to Comment NGO1-2.

NGO1-12
See response to Comment NGO1-2.

NGO1-13
See response to Comment NGO1-2.

NGO1-14
See response to Comment NGO1-2.

NGO1-15
See response to Comment NGO1-2.

NGO1-16
See response to Comment NGO1-2.

NGO1-17
See response to Comment NGO1-2.

NGO1-18
See response to Comment NGO1-2.

NGO1-19
See response to Comment NGO1-2.

NGO1-20
See response to Comment NGO1-2.

NGO1-21
See response to Comment NGO1-2.

NGO1-22
See response to Comment NGO1-2.

NGO1-23
See response to Comment NGO1-2.

NGO1-24
See response to Comment NGO1-2.

NGO1-25
See response to Comment NGO1-2.

NGO1-26
See response to Comment NGO1-2.

NGO1-27
The HEP itself does not constitute a “project” under the guidelines of CEQA and the National Environmental Policy Act. Once a final plan is approved, all necessary permitting and compliance documents will be completed by the Licensees prior to beginning implementation of any of the actions contained in the plan.

NGO1-28

The HEA specifies that the Licensees (i.e., DWR and PG&E) are responsible for recommending the actions included in the Final HEP (Section 4). According to the HEA, which is legally binding, NMFS is the approving authority, and DFG and USFWS have been consulted throughout the process.

NGO1-29

An electronic copy of the HEA was forwarded to Robert Baiocchi with California Fish and Water Unlimited, as requested.

NGO1-30

A paper copy of the Draft HEP was forwarded to Robert Baiocchi with California Fish and Water Unlimited. An electronic copy of the Draft HEP is available on the HEA website at http://www.sac-basin-hea.com/Draft%20Habitat%20Expansion%20Plan/Forms/AllItems.aspx.

NGO1-31

Minutes that were subject to the Public Records Act were forwarded to Robert Baiocchi, as requested.

NGO1-32

A teleconference number has been, and will continue to be, provided to signatories, stakeholders, and affected third parties, as well as other interested parties, at all public meetings.

NGO1-33

All interested parties have been added to the HEA mailing list upon their request. A website is also available to the public at www.sac-basin-hea.com.

NGO1-34

Accommodations compliant with the Americans with Disabilities Act of 1990 will be provided for any future public meetings.

Comment Letter NGO2 (Chris Shutes, California Sportfishing Protection Alliance, January 22, 2010)

NGO2

California Sportfishing Protection Alliance
"An Advocate for Fisheries, Habitat and Water Quality"
Chris Shutes, FERC Projects Director
1608 Francisco St., Berkeley, CA 94703
Tel: (510) 421-2405 E-mail: blancapaloma@msn.com
Web: www.calsport.org

January 22, 2010

COMMENTS
Draft Habitat Expansion Plan

Director Hydro Licensing, Power Generation
Pacific Gas and Electric Company
P.O. Box 770000
San Francisco, CA 94177

Chief, Division of Environmental Services
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

Via e-mail (HEA@water.ca.gov)

Dear Sir(s) or Madam(s):

The California Sportfishing Protection Alliance respectfully submits these comments on the proposed measures on the draft Habitat Expansion Plan that was released in November, 2009.

1. The proposed actions do not mitigate for the loss of the Feather River salmon and steelhead fisheries upstream of Lake Oroville.

Historically, the Feather River boasted one of the largest salmon and steelhead runs in California's Central Valley. The proposed actions, to either enhance habitat in the Yuba River downstream of a rim dam, or to enhance habitat in two small watersheds (Big Chico and Antelope Creeks) and in a somewhat larger watershed where millions of dollars have already been committed and a project is well underway, does not come close to doing justice to the loss of the upper Feather River anadromous salmonid fisheries. NGO2-1

CSPA has previously commented on the severe inadequacy of the estimated dollar amount of the commitments under the Habitat Expansion Agreement. The goal of creating habitat for 2000-3000 spring-run Chinook is equally penurious. Yet even given these constraints, the proposed projects disregard the extent of the crisis of Central Valley salmon and steelhead and the extent of the measures that will be needed to turn around the present descent of these species into oblivion. NGO2-1 Cont'd

Over 90% of the historic freshwater habitat for Central Valley salmonids has been blocked by Central Valley rim dams, of which Lake Oroville is the second largest. The reservoir is the storage linchpin of the State Water Project, which supplies water to locations four hundred miles away. The draft HEP now proposes one or perhaps three niche projects, which spruce up few minor fisheries that have not been completely destroyed by water development. The presumption that this can mitigate for blockage of the Feather River and all the added damage done in moving its water around the state is deficient by orders of magnitude.

2. The proposed actions are not passage projects that will substantially increase the amount and diversity of habitat accessible to spring-run Chinook and Central Valley steelhead.

In order to recover Central Valley salmon and steelhead, these species need to be re-established upstream of rim dams in every major watershed to which passage has been blocked. The Habitat Expansion Plan should support this approach.

The message that is sent by the projects as proposed in the November draft is that safe, contained, and simple solutions will be sufficient to get the job done. They will not. NGO2-2

Any action undertaken to mitigate the loss of the upper Feather River to anadromous fish absolutely must be a passage project past a major rim dam. If not a mitigation in place, it must a least be a mitigation in kind. A fish ladder on Big Chico Creek, as much as it is needed, is simply inappropriate in the context proposed.

3. Priority should be given to actions in the Feather River watershed.

While some reasons have been provided for why hydropower projects on the North Fork Feather make a trap-and-haul program there problematic, we are unaware of good reasons why a trap-and-haul program that would move fish to and from the Middle Fork Feather is not feasible. The presumption should be that this option, which could move fish to over 40 miles of wild and scenic habitat, should be selected unless definitive proof is made that it cannot work. In this regard, it is important to note that the Wild and Scenic River Act does not prohibit structures that are consistent with the values of the Act, such as the promotion of fisheries restoration. NGO2-3

Prioritizing the Middle Fork Feather also fits with the imperative of restoring fish upstream of all major rim dams. It is not simply a question of choosing the best place to start a stand-alone program. It is rather a question of starting at the best time, which is now, and then expanding the first effort throughout the Valley.

Comment Letter NGO2 (Continued)

4. The proposed actions seek to improve remnant habitat rather than re-establish substantial habitat that has been lost to dams.

Improving remnant salmonid habitat fisheries in the Central Valley can at best create boutique fisheries. The appropriate goal is to restore reconnected upper watershed ecosystems, with fish populations that support both extensive sport fisheries and a robust commercial salmon fishery in the ocean. NGO2-4

5. The proposed actions do not meet the criteria of the HEA because they contemplate actions that should be undertaken as the result of other processes or actions.

The Yuba actions as proposed in the draft HEP should be addressed under a Biological Opinion for the operation of Englebright and Daguerre Dams. PG&E and others are obligated to complete restoration of Battle Creek, which is also mandated by a Biological Opinion for the Operations and Criteria Plan of the State Water Project and Central Valley Project. As suggested by the November 10, 2009 letter from Steve Edmondson of the National Marine Fisheries Service to Ralph Torres and Randal Livingston, these proposed actions should not be considered eligible for inclusion in the Habitat Expansion Plan, and should be withdrawn from consideration in this context. NGO2-5

Thank you for the opportunity to comment on the draft Habitat Expansion Plan.

Respectfully submitted,

Chris Shutes
FERC Projects Director
California Sportfishing Protection Alliance

Responses to Letter NGO2 (Chris Shutes, California Sportfishing Protection Alliance, January 22, 2010)

NGO2-1

As required by the HEA, the Licensees are responsible for expanding spawning, rearing, and adult holding habitat sufficiently to accommodate an estimated net increase of 2,000–3,000 spring-run Chinook salmon for spawning in the Sacramento River Basin. Under the HEA, the Licensees are not required to mitigate all salmon and steelhead impacts upstream of Lake Oroville. Additional mitigation for impacts to the Feather River is being addressed under other proceedings. See Master Response 5 regarding mitigation for unmitigated impacts on the Feather River and response to Comment NGO1-2.

NGO2-2

See response to Comment NGO2-1.

NGO2-3

The HEA does not specify that priority should be given to actions in the Feather River watershed. As provided for by the HEA, The Licensees' evaluation and selection process has targeted the best opportunities for expansion of habitat for spring-run Chinook salmon and steelhead in the Sacramento River Basin. See response to Comment NGO2-1.

Following an evaluation of the Middle Fork Feather River using the same method as all potential actions that were assessed, the Licensees determined that other more cost-effective and feasible actions could achieve the HET (see Chapter 2 and Appendix B in the Final HEP for more information on the evaluation of potential actions). In addition, the recommended actions would produce benefits that would be realized much sooner than a trap-and-transport program on the Middle Fork Feather River.

NGO2-4

Currently, negligible spawning habitat is present in the Englebright Dam Reach of the Lower Yuba River. The Englebright Dam Reach contains large deposits of angular shot rock (Pasternack et al. 2010) due to construction of the dam and sloughing of material from canyon slopes in the vicinity of the dam. Since construction of Englebright Dam and the resulting sediment entrainment, there is no opportunity for recruitment of the appropriate rounded alluvial gravels for spawning. Therefore, by creating appropriate spawning conditions in a reach where conditions are prohibitive to spawning, the Licensees will be expanding usable habitat for spring-run Chinook salmon and steelhead.

NGO2-5

See Master Response 3 regarding eligibility of the Lower Yuba River Actions.

Comment Letter NGO3 (W.F. "Zeke" Grader Jr., Pacific Coast Federation of Fishermen's Association, February 12, 2010)

NGO3

PACIFIC COAST FEDERATION of FISHERMEN'S ASSOCIATIONS

http://www.pcffa.org

Please Respond to:

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12 February 2010

Director Hydro Licensing, Power Generation
Pacific Gas and Electric Company
P.O. Box 770000
San Francisco, CA 94177

Via e-mail (HEA@water.ca.gov)

Chief, Division of Environmental Services
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

RE: Feather River/Lake Oroville Habitat Expansion Plan

Dear Sir(s) or Madam(s):

The Pacific Coast Federation of Fishermen's Associations (PCFFA) represents working men and women in the West Coast commercial fishing fleet, including California's organized salmon fishermen who depend on salmon production from the Central Valley rivers, including Feather River.

PCFFA respectfully submits these comments on the proposed measures on the draft Habitat Expansion Plan that was released in November, 2009.

1. The proposed actions do not mitigate for the loss of the Feather River salmon and steelhead fisheries upstream of Lake Oroville.
Yoshiyama et al. (2001) provide an historical narrative of the distribution of salmon in the Feather River:
"*Salmon originally ascended a considerable distance into the Feather River system, particularly the spring run which spawned in the higher streams and headwaters. They*

NGO3-1

2

went up theWest Branch at least to the site of Stirling City (F. Meyer, personal communication, see "Notes"), and also up along the entire length of the North Fork Feather River through the area now covered by Lake Almanor and into the surrounding tributary streams (> 4,200 ft elev.)."

NGO3-1 Cont'd

Historically, the Feather River boasted one of the largest salmon and steelhead runs in California's Central Valley. The proposed actions, to either enhance habitat in the Yuba River downstream of a rim dam, or to enhance habitat in two small watersheds (Big Chico and Antelope Creeks) and in a somewhat larger watershed where millions of dollars have already been committed and a project is well underway, does not come close to doing justice to the loss of the upper Feather River anadromous salmonid fisheries.

Central Valley spring-run Chinook salmon and California Central Valley steelhead have been eliminated or nearly eliminated on several Central Valley rivers. Populations on the Feather River have been heavily impacted by dam construction, and require further protection to prevent losses and changes to their genome. The lack of fish passage has altered the genotype of Central Valley spring-run Chinook salmon due to hybridization with Central Valley fall-run Chinook salmon, and has likely caused alterations in California Central Valley steelhead.

Over 90% of the historic freshwater habitat for Central Valley salmonids has been blocked by Central Valley rim dams, of which Lake Oroville is the second largest. The reservoir is the storage linchpin of the State Water Project, which supplies water to locations four hundred miles away. The actions proposed in the draft HEP are inadequate to meet the 2-3,000 criteria, create any "new self sustaining populations or achieve the agreed upon bargain by providing the same or more habitat than NMF'S section 18 fishway prescription. The presumption that this can mitigate for blockage of the Feather River is deficient by orders of magnitude.

2. The proposed actions are not passage projects that will substantially increase the amount and diversity of habitat accessible to spring-run Chinook and Central Valley steelhead.

In order to recover Central Valley salmon and steelhead, these species need to be re-established upstream of rim dams in every major watershed to which passage has been blocked. The Habitat Expansion Plan should support this approach.

The draft Habitat Expansion Plan is not consistent with NMFS VSP approach or the draft recovery plan. Because of this, it shold be considered invalid.

NGO3-2

Any action undertaken to mitigate the loss of the upper Feather River to anadromous fish absolutely must be a passage project past a major rim dam. If not a mitigation in place, it must a least be a mitigation in kind. A fish ladder on Big Chico Creek, as much as it is needed, is simply inappropriate in the context proposed.

3. Priority should be given to actions that provide passage to the Middle Fork of the Feather River and Upper Yuba Fish Passage over Englebright Dam.

NGO3-3

<u>Middle Fork</u>
Middle Fork While some reasons have been provided for why hydropower projects on the North Fork Feather make a trap-and-haul program there problematic, we are unaware of good reasons

Comment Letter NGO3 (Continued)

3

why a trap-and-haul program that would move fish to and from the Middle Fork Feather is not feasible. The presumption should be that this option, which could move fish to over 40 miles of wild and scenic habitat, should be selected unless definitive proof is made that it cannot work. In this regard, it is important to note that the Wild and Scenic River Act does not prohibit structures that are consistent with the values of the Act, such as the promotion of fisheries restoration.

Prioritizing the Middle Fork Feather also fits with the imperative of restoring fish upstream of all major rim dams. It is not simply a question of choosing the best place to start a stand-alone program. It is rather a question of starting at the best time, which is now, and then expanding the first effort throughout the Valley.

Upper Yuba

The Yuba River is the fourth largest river in the Sacramento River Basin. The river provides water for agriculture, domestic use, hydroelectric power generation, and recreation. In addition, the Yuba River downstream from Englebright Dam (lower Yuba River) supports numerous species of fish including Chinook salmon and steelhead. Englebright Reservoir is located on the Yuba River about nine miles downstream of New Bullards Bar Reservoir and about 26 miles east of Marysville. The dam was completed by the California Debris Commission in 1941 as a debris barrier and is now under the jurisdiction of the U.S. Army Corps of Engineers. Englebright Dam impounds the waters of the upper Yuba Rivers (North, Middle and South Yuba rivers), creating Englebright Lake, which serves as the afterbay for New Colgate Powerhouse and the forebay for power generation at the Narrows 1 and Narrows 2 powerhouses.

NGO3-3 Cont'd

The Yuba River watershed, composed of the lower mainstem river fed by its upper North, Middle, and South Fork branches and tributary streams, is identified as having historic habitat and populations of spring-run Chinook salmon, fall-run Chinook salmon and steelhead. Both spring-run Chinook salmon and steelhead historically migrated as far as they could into higher elevation habitats before reaching a passage impediment in the North, Middle and South Yuba rivers where they would hold, spawn and rear.

In the North Yuba, there are no apparent natural barriers upstream from New Bullards Bar Reservoir, so Chinook salmon were historically able to ascend a considerable distance. The historic upper limit of migration for spring-run Chinook, and possibly steelhead was about two miles upstream from the confluence with Salmon Creek (around RM 50) and their absolute upstream limit on the North Fork would have been Loves Falls (Yoshiyama et al. 2001). Deep pools are present throughout the North Fork Yuba River from its mouth up to Sierra City and likely provided prime holding habitat for spring-run Chinook salmon.

On the Middle Yuba, at about 0.4 miles upstream from the confluence with the North Yuba is a cascade totaling approximately 13 to 15 feet (Gast et al. 2005, and Vogel 2006 both in DWR 2007). This cascade is likely a partial barrier to anadromous fish passage at low flows, but may be passable by larger fish at higher flows (Gast et al. 2002005 in DWR 2007). In addition, there are apparently two (2) low-flow barriers (less than 200 cfs) that are located at RM 0.2 and RM 3.2 (Gast et al. 2005). These locations need additional evaluation by qualified fish passage engineer(s) and hydrologists to determine the exact extent and duration of fish passage impedance. Both Chinook salmon and steelhead were observed during a DFG survey in 1938 in the lower part of the Middle Yuba, near confluence with the North Yuba (DFG unpublished data

4

as cited in Yoshiyama et al. 2001). Steelhead were found as far upstream as the mouth of Bloody Run Creek (around RM 17.5) (DFG unpublished data as cited in Yoshiyama et al. 2001). Our House Dam, located at RM 12.7, was constructed in1969 without fish passage facilities. At 75 feet high, this dam currently constitutes a complete barrier to fish passage, but could be easily retrofitted with fish passage facilities to provide substantial habitat gains in the middle fork.

NGO3-3 Cont'd

The original distribution of Chinook salmon and steelhead in the South Yuba is uncertain. There are records of Chinook salmon within one to two miles upstream of the confluence with the South Yuba River (DFG unpublished data as cited in Yoshiyama et al. 2001). Two cascades with at least a 6-foot drop, located at RM 6.2 and at RM 20 (one-half mile below the juncture of Humbug Creek (Yoshiyama et al. 2001, Gast et al. 2005)), may have posed a significant obstruction to salmon migration in low flow conditions. Steelhead ascended the South Yuba as far as the juncture of Poorman Creek near the present town of Washington (DFG unpublished data as cited in Yoshiyama et al. 2001), and perhaps some spring-run Chinook salmon historically also reached that point.

The lower Yuba River currently sustains one of the few remaining natural (non-hatchery) Chinook salmon and steelhead populations in the Central Valley, although there is input of strays from the Feather River and other Central Valley hatcheries. There is a sustainable fall-run Chinook salmon population that is surveyed annually. It also has a sustainable Central Valley steelhead population, though the population size is relatively unknown due to the difficulty in quantifying steelhead population sizes. In addition, there is currently a small spring-run Chinook salmon population.

There are several field investigations and reports that vary in their identification of the upstream migration limits as well as descriptions of the natural barriers (Gast et al, 2005, Vogel 2006) current evidence indicates that well over 500 miles of historic salmon and steelhead habitat occur above Englebright Dam.

4. The proposed actions do not meet the criteria of the HEA because they contemplate actions that should be undertaken as the result of other processes or actions.

The Yuba actions as proposed in the draft HEP should be addressed under a Biological Opinion for the operation of Englebright and Daguerre Dams. PG&E and others are obligated to complete restoration of Battle Creek, which is also mandated by a Biological Opinion for the Operations and Criteria Plan of the State Water Project and Central Valley Project. As suggested by the November 10, 2009 letter from Steve Edmondson of the National Marine Fisheries Service to Ralph Torres and Randal Livingston, these proposed actions should not be considered eligible for inclusion in the Habitat Expansion Plan, and should be withdrawn from consideration in this context. Accepting these proposals would not provide any additional benefit to salmon and steelhead because the result would be to simply provide additional funds to existing mitigation requirements and on-going projects.

NGO3-4

5. The proposed actions do not meet the criteria of the numeric criteria of the HEA.

NGO3-5

Comment Letter NGO3 (Continued)

The draft Habitat Expansion Plan relies on the Ecosystem Diagnostic Treatment (EDT) model to determine actual numbers of fish generated under the proposed actions. However, these estimates are utterly invalid. According to the consultants that developed and are now practioners, of EDT, the EDT is a "wholly deterministic" model. Hence, confidence intervals or sensitivity analysis is irrelevant as the output of EDT does not represent numbers of fish or any other absolute value. The output provides a relative metric that can be compared to other model runs only. Accordingly, the estimates of fish numbers contained in the draft Habitat Expansion Plan are irrelevant and cannot be used as absolute values or estimates of fish numbers. NGO3-5 Cont'd

In closing, the proposed actions contained in the draft Habitat Expansion Plan do not meet the requirements of the HEA, do not deliver the "negotiated for bargain", are inferior to the current fishway prescriptions and should not be accepted by NMFS. Alternatively, providing passage to either the Middle Fork Feather River, or Upper Yuba above Englebright Dam, would meet the intent and letter of the HEA and substantially contribute to the recovery of steelhead and spring-run Chinook salmon .

Thank you for the opportunity to comment on the draft Habitat Expansion Plan.

Sincerely,

W.F. "Zeke" Grader, Jr.
Executive Director

cc: California Department of Fish & Game
National Marine Fisheries Service

Responses to Letter NGO3 (W.F. "Zeke" Grader Jr., Pacific Coast Federation of Fishermen's Association, February 12, 2010)

NGO3-1

See Master Response 5 regarding mitigation for unmitigated impacts on the Feather River and Master Response 3 regarding contribution to the HET.

The Licensees are proposing actions that will expand habitat in order to support establishment of a self-sustaining population, as specified in the HEA, specifically Approval Criterion (c). The goal of the HEA is to expand habitat as a contribution to the conservation and recovery of the species (HEA Section 2.1) rather than to specifically create a self-sustaining population. Many factors that influence creation of a self-sustaining population are beyond the scope of the HEA.

NGO3-2

The HEA does not require passage projects but rather expansion of habitat for spring-run Chinook salmon beyond what is available at the present time (HEA Section 2.2). The HEA allows a variety of measures, including enhancements of passage conditions, temperature and flow improvements, and "other physical habitat enhancements" (HEA Section 3.1). The Licensees are recommending actions to expand spawning habitat for spring-run Chinook salmon in the Lower Yuba River between Englebright Dam and the Narrows Pool. This area presently receives little use by Chinook salmon, presumably due to habitat limitations that will be addressed by the actions recommended by the Licensees. Because the project area is presently underutilized by Chinook salmon, the recommended Lower Yuba River Actions represent an expansion of habitat.

The Licensees considered the VSP criteria and the *Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead* (Public Draft Recovery Plan) (NMFS 2009a) when evaluating potential habitat expansion actions and believe that the recommended actions are consistent with each. As a result, the recommended actions received relatively high scores for Evaluation Criterion (j), which was largely based on meeting the four VSP criteria. The actions address the VSP concept by increasing abundance and productivity of Central Valley spring-run Chinook salmon. Also, by *supporting* development of a viable spring-run population, the recommended actions increase spatial diversity. Finally, the Lower Yuba River is identified as a Core 1 Project in the NMFS Public Draft Recovery Plan. For these reasons, the recommended actions are consistent with both the VSP concept and the Public Draft Recovery Plan.

See Chapter 4 in the Final HEP for additional discussion of consistency with the VSP criteria and the NMFS Public Draft Recovery Plan.

NGO3-3

See response to Comment NGO 2-3.

NGO3-4

See Master Response 3 concerning eligibility of the Lower Yuba River Actions.

NGO3-5

The actions recommended in the HEP provide habitat with ample potential to meet the HET. Evaluation of the actions relative to the HET is described in Chapter 4 and in Appendix N of the Final HEP. The Draft HEP did not use EDT, and EDT was not mentioned in the Draft HEP.

Comment Letter NGO4 (Glenn Nader, Yuba Watershed Protection & Fire Safe Council, February 12, 2010)

NGO4

From: Glenn Nader
To: hea@water.ca.gov;
Subject: HEA Central Valley Spring Run Chinook Salmon and Steelhead draft
Date: Friday, February 12, 2010 3:55:22 PM

Yuba Watershed Protection & Fire Safe Council

Department of Water Resources Division of Environmental Services Power Generation
PO Box 942836 PO Box 770000
Sacramento, CA 94236-0001

February 12, 2009

Dear California Department of Water Resources Department,

The Yuba Watershed Protection and Fire Safe Council have worked diligently since 1983 to implement measures and facilitate projects designed to protect foothill forests, watersheds and communities in the Yuba County Foothills.

This letter is being sent to support the HEA Central Valley Spring Run Chinook Salmon and Steelhead draft. We support the proposed Lower Yuba River to be selected over the Three creek actions. NGO4-1

Physical habitat enhancements along the Lower Yuba starting in the Deer creek area, and then down river of the watershed would significantly improve the spawning and holding habitat, while being the most cost effective action in our opinion. NGO4-1 Cont'd

We therefore request that the Lower Yuba River Actions be favorably considered for funding by the NMFS over the Three Creek Actions.

Sincerely,

Glenn Nader
Facilitator

Glenn Nader
Livestock & Natural Resources Advisor
University of California
Cooperative Extension
142-A Garden Hwy
Yuba City Ca. 95946
Phone 530.822.7515
Fax 530.673.5368

Response to Letter NGO4 (Glenn Nader, Yuba Watershed Protection & Fire Safe Council, February 12, 2010)

NGO4-1

Comment noted.

Comment Letter NGO5 (Terry Erlewine, State Water Contractors, February 17, 2010)

NGO5

STATE WATER CONTRACTORS SWC Served by the State Water Project FOUNDED IN 1982

February 17, 2010

Director Hydro Licensing, Power Generation
Pacific Gas and Electric Company
P.O. Box 770000
San Francisco, CA 94177

and

Chief, Division of Environmental Services
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

Re: Draft Habitat Expansion Plan for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead

The State Water Contractors (SWC) have reviewed the Draft Habitat Expansion Plan (HEP) developed by Pacific Gas & Electric (PG&E) and the California Department of Water Resources (DWR) pursuant to the Habitat Expansion Agreement (HEA) that was negotiated as part of the Oroville Facilities FERC Relicensing Settlement Agreement (SA). As one of many signatories to both the SA and HEA, the SWC are supportive of the efforts of PG&E and DWR to move forward with the development and eventual implementation of a suite of habitat expansion actions designed to meet the overall biological goal of the HEA, which is to expand habitat with the physical characteristics necessary to support spawning, rearing, and adult holding of spring-run Chinook salmon and steelhead in the Sacramento River Basin as a contribution to the conservation and recovery of these species. Specifically, the Habitat Expansion Threshold (HET) agreed to in the HEA is to expand habitat to accommodate an estimated net increase of 2,000-3,000 spring-run Chinook salmon for spawning in the Sacramento River Basin.

The Draft HEP is the culmination of a process outlined in the HEA involving the following steps:

- outreach to signatories and stakeholders to develop a list of possible habitat expansion actions (178 actions)
- evaluation and refinement of this list of possible actions based on the potential of each to contribute to the HET (106 actions)
- development of a short list of those possible actions that have the highest potential to contribute to the HET (18 actions)
- Application of the 17 evaluation criteria in section 4.1.1 of the HEA to this short list, resulting in a preliminary ranking of these 18 viable habitat expansion actions
- Application of the four selection criteria in section 4.1.2 of the HEA to select recommended habitat expansion actions for implementation

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February 17, 2010
Page 2

The SWC believe that the efforts of DWR and PG&E to date have met or exceeded the requirements of the HEA in terms of the schedule, deliverables, and process described in the HEA. The Draft HEP does an excellent job of describing how the first phase of the HEA has been implemented, presents the Licensees' recommended habitat enhancement actions and describes each action in detail, including its estimated contribution to the HET, a preliminary cost estimate for implementation, a proposed implementation schedule, the responsibilities of each Licensee, and the rationale for selecting each action. The Draft HEP also describes the outreach activities taken by the Licensees to keep stakeholders and HEA signatories informed about and involved in the HEA process, and explains the remaining phases for implementation of the HEA. Finally, the Draft HEP provides thorough documentation of every step in this process. NGO5-1

We understand that the NMFS has raised concerns regarding the two alternatives recommended by DWR and PG&E. We are hopeful that through discussions among the parties these concerns may be resolved. The SWC will be available to participate in these discussions if that would be helpful. However, we do believe that these discussions should be conducted in earnest prior to seeking dispute resolution as provided for under the HEA. NGO5-2

The SWC thank DWR and PG&E for their efforts to date to fulfill their contractual obligations under the HEA, and look forward to the next steps in this process.

Sincerely,

Terry Erlewine,
General Manager

Responses to Letter NGO5 (Terry Erlewine, State Water Contractors, February 17, 2010)

NGO5-1

Comment noted.

NGO5-2

Comment noted. During the 6-month extension for preparation of the Final HEP, the Licensees have been coordinating and consulting with NMFS in an attempt to resolve differing views on actions that will fulfill the HEA. Among other items, the Licensees and NMFS agreed to do the following during the 6-month extension period:

- The Licensees will review with NMFS the methodology used to estimate the contributions to the HET as described in Chapter 4 and Appendix E of the Draft HEP.
- The Licensees will further develop the actions recommended in the Draft HEP, informed by comments received; conferring with the HEA signatories, directly affected third parties, and other interested parties; and incorporating additional information that becomes available during the 6-month period.
- NMFS will clarify a proposed action in the Upper Yuba River watershed based on new and anticipated information being developed. The Licensees will re-evaluate the proposed Upper Yuba River action, in accordance with the terms and conditions of the HEA, and determine whether it should be included as a recommended action.

All of these activities have been accomplished, and their results are included in the Final HEP. The Licensees will continue to work with NMFS and the other HEA signatories in an attempt to resolve outstanding issues.

Comment Letter NGO6 (Gary Reedy, South Yuba River Citizens League, February 18, 2010)

NGO6

SYRCL SOUTH YUBA RIVER CITIZENS LEAGUE
216 Main Street, Nevada City, CA 95959
(530)265-5961 fax(530)265-6232 www.yubariver.org

February 18, 2010

Habitat Expansion Agreement Steering Committee
c/o Chief, Division of Environmental Services
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001

Re: Draft Habitat Expansion Plan

Dear HEA Steering Committee:

The South Yuba River Citizens League (SYRCL) is committed to the restoration of salmon and steelhead populations in the Yuba River watershed, and the greater Central Valley. This mission is not unique to SYRCL but shared among many organizations and agencies. I wish to acknowledge the contribution of your committee in preparing a Draft Habitat Expansion Plan which provides valuable information to support recovery actions. I submit these few comments and ask you to consider them in preparing a final plan.

One of the actions in the Draft HEP aims to expand rearing habitat for Chinook salmon and steelhead trout in the lower Yuba River. I appreciate the thorough consideration that you have given to this type of action, including the information I submitted by questionnaire, the information submitted by the Yuba Accord River Management Team and your outreach to landowners. This type of action is closely linked to a project funded by the Anadromous Fish Restoration Program which I manage. The project is in an assessment phase whereby the historic and current conditions, geomorphic and hydrologic processes are being studied for the development of concept projects or actions. I understand the timeline and requirements of the HEA which necessitated a description of a single type of action to be implemented in the next few years. Nonetheless, it is important to realize that while there are many promising types of projects to expand or enhance rearing habitat in the lower Yuba, the best will be borne out of a thorough process of development, scientific and otherwise.

The factors which have limited rearing habitat so dramatically include the artificial constriction of the floodplain, hydrologic alteration effects on riparian, and loss of a large wood supply by upstream dams. Creating or restoring side-channels within the existing floodplain – as proposed in the Draft HEP --- does little to mitigate these impacts. Successful rearing enhancement projects in the lower Yuba River will either remedy these factors or work in concert with physical and biological processes to add habitat value over time. The expansion of functional floodplain habitat may not be feasible within the schedule of the HEA, but it will be a part of a more far-reaching habitat restoration program. Riparian enhancements, including cottonwood sprigs, will also be a part of the restoration program, and this could be included or more emphasized as part of the existing HEP action. NGO6-1

The primary action for the lower Yuba River is the rehabilitation of spawning habitat in the one-mile reach from Englebright Dam to Deer Creek. While I strongly support this project concept, and collaboration for its design and implementation, I do not see sufficient evidence that the project will meet the biological threshold for habitat expansion or qualify as eligible given existing requirements. The Army Corps of Engineers must implement a gravel augmentation program under the terms of a 2007 Biological Opinion, and the opinion of NMFS seems to be that this would include rehabilitation. Certainly, the ACOE could be required by NMFS, congress or a judge to treat shotrock and place existing gravels. In such a case, only a small portion of the overall biological benefit of rehabilitation could be available as credit to the HEA. Incidentally, I am skeptical of the estimate that rehabilitation would provide for as many as 3000 additional spring-run Chinook salmon. NGO6-2

Section 5.1.2 (Springboard to the Upper Yuba) references the interest of NMFS in a reintroduction of salmon and steelhead above Englebright Dam. This is the interest of SYRCL and other organizations too, and considerable information exists to support reintroduction planning. As I submitted in a distinct questionnaire regarding reintroduction, it seems feasible for the HEP to include a preliminary phase of fish passage into the Upper Yuba involving trap and haul to North Yuba and Middle Yuba Rivers. This type of action seems much more eligible than other actions from the standpoint of the intention of the HEA and the capacity to meet or exceed the expansion threshold. NGO6-3

SYRCL is one of many organizations and stakeholders which will be disappointed if the final HEP involves only marginally successful actions, and does not provide access to habitats currently inaccessible due to dams. NGO6-4 We know the primary cause of extinction risk for spring-run Chinook salmon in the Central Valley and we know the bold type of actions required to recover spring-run. Lots of smart people with good intentions (including yourselves) have invested in the HEA. Let's make sure we don't settle for something less than satisfying and successful.

In closing, I wish to confirm my willingness to work with the HEA steering committee in further developing specific action details for the lower Yuba River, particularly if NMFS indicates support for such a HEP. I earnestly hope that the next Draft HEP will advance plans for reintroduction above Englebright, and can pledge much help for that endeavor. NGO6-5

Sincerely,

Gary Reedy

Responses to Letter NGO6 (Gary Reedy, South Yuba River Citizens League, February 18, 2010)

NGO6-1

The Licensees recognize the problems in the Lower Yuba River caused by deposition of mining debris and subsequent re-working of the tailings. Correction of these problems is far beyond the scope of the HEA. The Licensees considered juvenile rearing habitat expansion actions below Highway 20 to complement actions by SYRCL and other parties to restore conditions in the lower Yuba River but did not include these as recommended actions in the Final HEP. In the event that the optional segregation weir action is not approved for implementation, the Licensees would consider other restoration actions such as the juvenile rearing habitat expansion actions. These potential actions are described in Appendix L.

NGO6-2

See Master Response 1 regarding contribution to the HET and Master Response 3 regarding eligibility of the Lower Yuba River Actions.

NGO6-3

As stated in the HEP, the recommended actions fully support future reintroduction of spring-run Chinook salmon and steelhead into the Upper Yuba River. In fact, the recommended actions represent a reasonable first step in a reintroduction program by allowing development of a more robust Yuba River spring-run Chinook salmon population that represents the most genetically plausible source population for a reintroduction program.

NGO6-4

As stated elsewhere, the HEA was not developed to provide access to habitat above dams but rather to expand habitat for spring-run Chinook salmon in the Sacramento River Basin using a range of allowable types of actions. The HEP recommended actions meet the HET, significantly expand habitat, and are not properly characterized as "marginally successful."

NGO6-5

Comment noted. The recommended Lower Yuba River Actions can act as a springboard for reintroduction of spring-run Chinook salmon above Englebright Dam.

Comment Letter NGO7 (Steve Rothert, American Rivers, February 20, 2010)

American Rivers
Thriving By Nature

NGO7

February 20, 2010

Director Hydro Licensing, Power Generation
Pacific Gas and Electric Company
P.O. Box 770000
San Francisco, California 94177

Chief, Division of Environmental Generation
Department of Water Resources
P.O. Box 942836
Sacramento, California 94236

Via Electronic Mail

Subject: Response of American Rivers to the November 2009 Draft Habitat Expansion Plan developed by the California Department of Water Resources and Pacific Gas and Electric Company

Dear Licensees:

American Rivers appreciates the opportunity to review and comment on the Draft Habitat Expansion Plan (DHEP). We commend the Habitat Expansion Agreement (HEA) Steering Committee for its diligent investigation of potential projects for consideration to meet the requirements of the HEA. The importance of the success of the HEA and other recovery efforts is highlighted by the record or near-record low returns of Central Valley salmonids in 2009. Comments provided here are limited to the methodology for evaluating viable actions and the eligibility of the two proposed actions.

American Rivers was an active participant in the relicensing of the Oroville Hydropower Project (Project) and in negotiations of the HEA. Our goal for the HEA was to create a process that would identify and implement the project(s) that would most effectively mitigate for the ongoing impacts of the project, including the loss of more than 100 miles of salmonid spawning and rearing habitat, and contribute to the recovery of Central Valley Spring-run Chinook and Steelhead. American Rivers has followed progress of the Steering Committee, participated in

1

outreach meetings for signatories/stakeholders and provided written comments three times prior to these comments. For the reasons stated below, however, the recommended actions described in the DHEP would not meet the requirements of the HEA or contribute appropriately to the recovery of the target species. American Rivers cannot support the actions as proposed. We request an opportunity to meet with the Steering Committee and other signatories to discuss possible next steps at the earliest opportunity. NGO7-1

Methodology for Evaluation of Viable Actions

In previous comment letters, American Rivers has recommended changes in the way the Steering Committee evaluated the performance of potential actions against the evaluation, selection and approval criteria. We will not repeat those details here, but in summary, we had the following concerns: 1) several evaluation and selection criteria included in the HEA were further interpreted by the Steering Committee in ways that do not seem logical or appropriate; 2) the method developed by the Steering Committee to score projects under each criteria also seemed illogical or inappropriate in some cases; 3) the Steering Committee appeared to select the two proposed projects before it had undertaken the analysis and comparative scoring necessary to make selections. NGO7-2

The DHEP reveals further questions related to how the Steering Committee scored certain projects in relation the scores attributed to the two proposed projects. For example, Appendix C5 lists the viable actions scored for performance in each selection criteria. Yet for one of the most important selection criteria, Contribution to the Habitat Expansion Threshold (HET), it is impossible to determine why a certain action was assigned a particular score, unless it is one of the two options preferred by the Steering Committee. Aside from the two proposed options, the DHEP provides no explanation or documentation for assigning scores for all other projects.

For example, for Battle Creek Phase 2, which would open up less than 25 miles of habitat, the DHEP estimates it to have the potential to contribute ~1,650 fish and cites the 1999 Battle Creek Salmon and Steelhead Restoration Plan as evidence. However, the DHEP estimates that providing passage to the North Yuba River, which would provide access to more than 75 miles of mainstem and tributary habitat, would contribute only 1,750 fish. No explanation of the assumptions or analytical methodology is provided. Without substantiation of the scores for each potential project it is not possible to understand, let alone verify, how the analysis was conducted and how the Steering Committee reached the conclusions it did. NGO7-3

2

Comment Letter NGO7 (Continued)

Lower Yuba River Actions

The Lower Yuba River Habitat Enhancement Actions (Lower Yuba Actions) proposed by the DHEP are:

1. Rehabilitate spawning habitat in the Englebright Dam reach of the lower Yuba River and augment gravel in lower Deer Creek;
2. Plan for, and if necessary, install a segregation weir at a location in the 6-mile reach between Englebright Dam and the Highway 20 Bridge;
3. Restore juvenile rearing habitat between the Highway 20 Bridge and the downstream extent of the Yuba Goldfields.

NGO7-4

As stated in previous comment letters, American Rivers finds the first of the Lower Yuba Actions, i.e., rehabilitation of spawning habitat in the lower Yuba River, is ineligible pursuant to section 3.2 of the HEA because this action is required by the NMFS Biological Opinion with the Corps of Engineers for the operation of Englebright and Daguerre Point dams. HEA Section 3.2 includes a non-exclusive list of what "Existing Requirements and Commitments may include," that specifically includes, ". . . reasonable and prudent alternatives, reasonable and prudent measures, and terms and conditions of any final Biological Opinion that has been issued at the time NMFS approves the habitat expansion actions."

The DHEP attempts to distinguish the Lower Yuba Actions from the Biological Opinion by stating that the "Corps' responsibility is simply for gravel augmentation (i.e., long-term gravel injection similar to the pilot project initiated by the Corps in 2007)." This is incorrect. The Biological Opinion reads:

"The Corps shall develop and implement a long-term gravel augmentation program *to restore quality spawning habitat below Englebright Dam*. The Corps shall utilize the information obtained from the pilot gravel injection project to develop and commence implementation of a long-term gravel augmentation program within three years of the issuance of this biological opinion." (emphasis added).

Of the 3,459 Spring Chinook that the DHEP estimates would be the total contribution to the HET of the three Lower Yuba Actions, the proposed habitat rehabilitation element accounts for 2,523. In other words, less than 1,000 Spring Chinook would be produced by Lower Yuba Actions not precluded by sections 3.2 and 4.2.3(e) of the HEA.

3

Three Creek Actions

The DHEP also proposes the "Three Creek Actions" as a recommended action consisting of:

1. Replacing an instream ford-structure at Paynes Crossing on Antelope Creek with a bridge over the creek;
2. Rehabilitating the Iron Canyon Fish Ladder on Big Chico Creek; and
3. Providing partial funding for implementation of Phase 2 of the Battle Creek Salmon and Steelhead Restoration Project, specifically certain actions that would occur only on South Fork Battle Creek.

As the DHEP acknowledges, Phase 2 of the Battle Creek Restoration Project is included as a Reasonable and Prudent Alternative in NMFS' Biological Opinion on the Long-Term Central Valley Project and State Water Project Operation, Criteria, and Plan (OCAP) Biological Opinion, issued on June 4, 2009.

The DHEP argues that including Battle Creek Phase 2 as a reasonable and prudent alternative of NMFS' OCAP Biological Opinion ". . .does not ensure that such discretionary funds will be available, does not provide an alternate funding mechanism in the absence of such funds, as is presently the case, and ultimately does not secure full funding for Phase 2." In addition, the DHEP argues, "The biological opinion also does not provide a means for completing the project before 2019." Section 3 of the HEA does not recognize these arguments as means to qualify an otherwise ineligible action. Guaranteed funding and the specific means for completing an action by date certain are not part of the definition of "Existing Requirements and Commitments" in HEA Section 3.2.

As stated in previous comment letters to the Steering Committee, American Rivers continues to find that implementation of Battle Creek Phase 2 should be considered ineligible pursuant to section 3.2 of the HEA. NGO7-5

Based on the issues discussed above and others not addressed here, American Rivers cannot support the findings and recommendations of the Draft Habitat Expansion Plan. We would like to meet with the Steering Committee and other signatories at the earliest opportunity to discuss the status of the DHEP and next steps, including the possibility of extending the timeframe to complete a draft Habitat Expansion Plan. American Rivers suggested such an extension in June 2009 when it became clear that NGO7-6

4

Comment Letter NGO7 (Continued)

the HEA did not appear to provide adequate time for the Steering Committee to complete the work required by the agreement.

Thank you for your consideration of these comments and recommendations. Please do not hesitate to contact me at 530-277-0448.

Regards,

Steve Rothert
Director, California Regional Office
Regards,

Steve Rothert
Director

5

Responses to Letter NGO7 (Steve Rothert, American Rivers, February 20, 2010)

NGO7-1

Comment noted. The Licensees believe that the recommended actions meet the terms of the HEA and would contribute to the recovery of spring-run Chinook salmon.

NGO7-2

The Steering Committee developed an objective approach for identifying, evaluating, and selecting habitat expansion actions under the HEA, as described in Chapter 3 of the Draft HEP. Through a series of logical steps, Evaluation and Selection Criteria were applied to successive lists of potential habitat expansion actions, and each action was scored. To facilitate the application of the criteria and scoring of the actions, the Steering Committee developed a working definition and a scoring protocol for each criterion. During the process of evaluating and selecting actions, the Steering Committee shared the overall approach, working definitions, and scoring protocols with the HEA signatories and solicited comments. The Steering Committee took into consideration all comments received before completing the task of evaluating and selecting habitat expansion actions that were recommended in the Draft HEP.

No actions were pre-selected, as suggested by American Rivers in their comment letter. The selection process, as described in Chapter 3 of the Draft HEP, was followed to its conclusion before any actions were selected. It was the application of this objective process that resulted in the selection of actions recommended in the Draft HEP.

NGO7-3

As discussed in the response to Comment NGO6-2, the Steering Committee developed an objective scoring system that was applied to the potential habitat expansion actions. A Technical Team (comprised of Steering Committee members with technical expertise in aquatic biology and additional selected technical experts from PG&E, DWR, and ICF) scored the actions based on available information and professional judgment. During the scoring process, each action was treated in a similar manner. It should be noted that, for purposes of the Final HEP, the Technical Team rescored the Upper Yuba River Actions based on new information provided by NMFS that was not available when the Draft HEP was prepared. (See Appendix F of the Final HEP for a comparison of scoring for the Upper Yuba River Actions during preparation of the Draft HEP and the Final HEP.)

NGO7-4

See Master Response 3 regarding eligibility of the Lower Yuba River Actions.

NGO7-5

The Three-Creek Actions are not considered in the Final HEP. See Master Response 2 regarding the Three-Creek Actions.

NGO7-6

On May 18, 2010, the Licensees sent a letter to NMFS requesting a 6-month extension to complete the Final HEP. On June 1, 2010, NMFS responded to the Licensees request in a letter that granted the extension. The NMFS letter allows completion of the Final HEP by November 20, 2010. The Steering Committee held a conference call with American Rivers (Steve Rothert) on July 12, 2010, to discuss the status of development of the Final HEP, review the next steps to be taken in order to finalize the HEP, and answer any questions by American Rivers.

Comment Letter LYRL1 (Ralph Mullican, January 21, 2010)

LYRL1

Ralph Mullican

P.O. Box 265

Smartsville, Ca 95977

530-906-5542

yubablue@syix.com

River property address 12347 Mooney Flat Road-no mail here please!

Statement for Jan.21, 2010 meeting YCWA

Two things come to mind that are important to consider for local residents regarding the proposal to remove shot rock and replace with gravel below Englebright Dam.

First is PG&E has twenty million dollars to spend. The shot rock in question is in Yuba County and Yuba County has the one of the highest unemployment rates in California. LYRL1-1

Local businesses, contractors and at least some landowners will benefit by keeping this project here.

Regardless of the genetics of the salmon, spring run or fall run, the narrows area below Englebright Dam is short of gravel. The temperature of the river is twenty degrees below pre dam levels during summer months. The volume of summer river flows immediately below Englebright Dam are four to ten times pre dam amounts. Yet salmon have no place to spawn thereby negating all the efforts to save them. LYRL1-2

Exposing gravel already there or injecting gravel will replace the missing link in efforts to increase the salmon in this stretch of river.

Ralph Mullican

Responses to Letter LYRL1 (Ralph Mullican, January 21, 2010)

LYRL1-1

Comment noted.

LYRL1-2

Your comment is noted in support of the Lower Yuba River Actions.

Comment Letter LYRL2 (Letty Litchfield, February 5, 2010)

LYRL2

LAW OFFICES OF LETTY LITCHFIELD

716 D Street
Marysville, CA 95901
(530) 673-4616
(916) 485-4253
FAX (530) 742-8576

FEBRUARY 5, 2010

CHIEF, DIVISION OF ENVIRONMENTAL SERVICES
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001

Re: **COMMENTS ON THE DRAFT HABITAT EXPANSION PLAN REQUEST THAT LOWER YUBA RIVER ACTIONS BE SELECTED**

Dear Chief:

This letter is sent to provide comments on the draft "Habitat Expansion Plan for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead." Specifically, I am requesting that the National Marine Fisheries Service select the proposed Lower Yuba River Habitat Expansion Actions over the proposed Three-Creek Actions (the Battle Creek, Big Chico Creek and Antelope Creek Habitat Expansion Actions).

I am a long-time resident and property owner in Smartsville, Yuba County, California. The lower Yuba River runs through our community. I have walked this section of the river, and I have been in it. This section of the Yuba River remarkably endured the destructive forces of the California Gold Rush. Its wild fish have done the same. It should be our obligation to restore their habitat that we destroyed.

LYRL2-1

During the past couple of years, I have worked as part of the collaborative effort of the Yuba River Preservation Foundation, South Yuba River Citizens' League, Western Aggregates and Yuba Outdoor Adventures, in connection with the fisheries habitat restoration plans for a proposed 3-mile Conservation Easement from Parks Bar Bridge downriver. I have listened to the expert consultants in River Science, Geomorphology, Biology, the Native Americans and the Anglers.

It is important to me to see this river and its fisheries thrive. In order to grow the Spring-Run Chinook Salmon and the California Central Valley Steelhead more resilient, the habitat expansion that is outlined in the proposed Lower Yuba River habitat expansion actions, is vital. These fish need side-channels and vegetation protection.

LYRL2-1 Cont'd

As set forth in the proposed Plan document, "The estimated contribution to the Habitat Expansion Threshold for the Lower Yuba River Actions is the highest of all of the actions considered." The Lower Yuba River Actions also appear to be the most cost-effective.

The specific proposed Lower Yuba River Actions that cause me to give my support to the Lower Yuba River Actions over the Three-Creek Actions, include (1) rehabilitating spawning habitat in the Englebright Dam reach, and augmenting gravel in lower Deer Creek which is a tributary to the Yuba River; and (2) restoring juvenile rearing habitat between the Highway 20 Parks Bar Bridge and the downstream extent of the Yuba Goldfields.

I believe that these habitat expansion actions should be implemented on the lower Yuba River, and that such implementation will result in expanded spawning, rearing and adult holding habitat for Spring-Run Chinook Salmon and Steelhead in the Sacramento River basin.

I respectfully request that the National Marine Fisheries Service select the Lower Yuba River Actions over the Three-Creek Actions. Thank you for your consideration of this request.

Sincerely,

Letty Litchfield

Letty Litchfield

Response to Letter LYRL2 (Letty Litchfield, February 5, 2010)

LYRL2-1

Your comment is noted in support of the Lower Yuba River Actions.

Comment Letter LYRL3 (Kit Burton, February 12, 2010)

LYRL3

From: kitburton@hotmail.com
To: hea@water.ca.gov;
Subject: Lower Yuba
Date: Friday, February 12, 2010 12:41:06 PM

Gentlemen:

Please select the Lower Yuba River (as opposed to the 3 Creeks) to receive funding for the project to improve Salmon habitat. LYRL3-1

Kit Burton, Yuba County, CA

Response to Letter LYRL3 (Kit Burton, February 12, 2010)

LYRL3-1

Your comment is noted in support of the Lower Yuba River Actions.

Comment Letter LYRL4 (David A. Greenblatt, Western Aggregates, February 18, 2010)

WESTERN AGGREGATES LLC

LYRL4

February 18, 2010

VIA E-MAIL to hea@water.ca.gov

Chief, Division of Environmental Services
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001

Re: Habitat Expansion Agreement – Proposed Expansion of Spring-Run Chinook Salmon and Steelhead Habitat in the Lower Yuba River

Ladies and Gentlemen:

On behalf of Western Aggregates LLC ("Western"), I am writing in support of the habitat expansion actions being considered by the California Department of Water Resources ("DWR") and Pacific Gas & Electric Company ("PG&E") with respect to the Lower Yuba River Habitat Expansion Actions (the "Lower Yuba River Actions") described in the November 2009 Draft Habitat Expansion Plan issued by DWR and PG&E (the "Draft Plan"). We at Western are supportive of the actions being proposed by DWR and PG&E and, for the reasons set forth below, have no comments about the Three-Creek Actions but wish to register our strong support of the Lower Yuba River Actions described in the Draft Plan. LYRL4-1

I believe that it would be helpful to provide to you a little background about Western, and then I will turn to a discussion of our support of the Lower Yuba River Actions. Western is a wholly owned subsidiary of Eagle Materials Inc., a Dallas, Texas-based New York Stock Exchange-listed company in the building materials business (primarily, cement and gypsum wallboard, with operations also in recycled paperboard, concrete, and aggregates). Western was formed in 1987 and owns substantial surface acres and aggregate mineral interests in the Yuba Goldfields, located approximately 7 miles to the east of Marysville, California along the Yuba River. (In using the term "aggregate" or "aggregates", we refer to those words in their building materials context and thus mean sand, gravel, stone, rock, and other similar mineral resources; we often use the phrase "sand and gravel" as a short-hand for all aggregates.) Aggregates are used in all facets of construction, including pavement, roads, highways, bridges, buildings, and other infrastructure. Western's mineral resources in the Yuba Goldfields represent the largest reserves of minable sand and gravel in the State of California and constitute a crucial and valuable resource for the future construction and growth needs of Northern California. In addition to Western's mineral interests in the Yuba Goldfields, Western also owns substantial surface acres in the Yuba Goldfields, including riverfront property along the Yuba River.

About two years ago, Western commenced a dialogue with the South Yuba River Citizens League ("SYRCL") for restoration projects on the Lower Yuba River on land owned by Western. After much hard work and thought and planning, those discussions led to an announcement in October of 2008 of an Agreement in Principle among Western, SYRCL, and LYRL4-2

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several other project partners for the establishment of a permanent conservation easement on up to 180 acres of land owned by Western along the Yuba River for use in connection with the planning and implementing of habitat restoration projects on the Lower Yuba River. In short, Western's and SYRCL's Agreement in Principle contemplates a public-private partnership with Western burdening certain of its lands adjacent to the Yuba River with a conservation easement and SYRCL planning, designing, implementing, and monitoring habitat restoration projects for salmon, trout, and other native biota of the Yuba River on these lands. Western has found SYRCL to be an effective partner as well as a manager of the program conducting scientific analysis and planning for these restoration activities. Our project was announced publicly in October 2008, and, since such time, Western and SYRCL have continued to diligently work together towards completing the formal granting of the conservation easement. Moreover, SYRCL has actively pursued the pre-planning and design phases of the project since the announcement of the partnership and the project in 2008. SYRCL, founded in 1983, is a community-based public benefit organization (501c3) with a mission to protect and restore the Yuba Rivers and the greater Yuba Watershed. LYRL4-2 Cont'd

Western notes that a specific portion of the Draft Plan actually highlights certain areas conducive to restoring juvenile salmonid rearing habitat that involve areas that are the subject of Western's conservation easement and SYRCL's planned habitat restoration projects. Specifically, Figure 6-3 (which is immediately after page 6-24 of the Draft Plan) directs the reader to three sites, Site 1, Site 2, and Site 4, that are part of the planned areas of Western's conservation easement and the SYRCL habitat restoration and enhancement projects. Figure 6-4 (a close-up of Site 1) reflects a potential enhancement project on the Upper Gilt Edge Bar, which is a piece of land owned by Western and destined for our conservation easement; Figure 6-5 (a close-up of Site 2) describes a possible project involving lands on First Island and some restoration on lands of Western to the south across the river (which we call the Lower Gilt Edge Bar); finally, Figure 6-6 (a close-up of Site 4) depicts juvenile rearing habitat restoration on Silica Bar, another piece of land owned by Western and contemplated for inclusion in the conservation easement. We also note that additional projects for certain lands described in the Draft Plan, while not currently contemplated by Western and SYRCL for inclusion in the conservation easement, involve lands or interests owned by Western, including the South Bar above Daguerre Point Dam Site (Figure 6-8), the Waterway 13 Site (Figure 6-9), and the Goldfields Terminus Bar (Figure 6-11). While Western has had no discussions with SYRCL or others regarding these additional lands, Western is willing to consider additional lands it owns for inclusion in future habitat restoration and enhancement projects, such as those described in Figures 6-8, 6-9, and 6-11.

While SYRCL has obtained some initial limited funding in support of this project, including a $50,000 challenge grant issued by Western, additional funding will be necessary for the project to be properly funded, designed, implemented, and monitored. Accordingly, Western strongly supports the project contemplated by DWR and PG&E that directs funding for the projects included in the Lower Yuba River Actions. LYRL4-3

Comment Letter LYRL4 (Continued)

Chief, Division of Environmental Services
California Department of Water Resources
February 18, 2010
Page 3

Please feel free to contact me if I can provide any more supporting information or if you have any further questions about Western, our proposed conservation easement and the habitat restoration projects contemplated on Western's lands, or this letter. If you need to contact me, please do so by contacting me at my office in Dallas at Western Aggregates LLC, c/o Eagle Materials Inc., 3811 Turtle Creek Blvd., Suite 1100, Dallas, Texas 75219-4487, phone: (214) 432-2024, fax: (214) 432-2110, e-mail: dgreenblatt@eaglematerials.com. Finally, please revise Western's contact information on your distribution lists for this matter to send any materials for Western to my attention at the address listed in the previous sentence. LYRL4-4

Very truly yours,

David A. Greenblatt

David A. Greenblatt
Senior Vice President

cc: Lloyd Burns (Western Aggregates)
Jason Rainey (SYRCL)
Gary Reedy (SYRCL)
Curt Aikens (Yuba County Water Agency)

Responses to Letter LYRL4 (David A. Greenblatt, Western Aggregates, February 18, 2010)

LYRL4-1

Your comment is noted in support of the Lower Yuba River Actions.

LYRL4-2

Your comment is noted in support of the Lower Yuba River Actions.

LYRL4-3

Your comment is noted in support of the Lower Yuba River Actions.

LYRL4-4

Comment noted. The contact information for Western Aggregates has been revised as requested.

Appendix G
References

G.1 Printed References

cbec. See cbec, inc. eco engineering.

cbec, inc. eco engineering. 2010. Rehabilitation Concepts for the Parks Bar to Hammon Bar Reach of the Lower Yuba River. Review Draft. Prepared by cbec, inc. eco engineering, with assistance from McBain & Trush. Prepared for South Yuba River Citizens League. July 18.

Corps. See U.S. Army Corps of Engineers.

Lindley, S. T., R. Schick, B. P. May, J. J. Anderson, S. Greene, C. Hanson, A. Low, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2004. Population structure of threatened and endangered Chinook salmon ESUs in California's Central Valley Basin. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-360. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Santa Cruz, CA.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. NOAA Technical Memorandum, NMFS-NWFSC-42. U.S. Department of Commerce, Seattle, WA.

National Marine Fisheries Service. 2009a. Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead. Sacramento Protected Resources Division. October.

National Marine Fisheries Service. 2009b. Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project. Sacramento, CA.

National Marine Fisheries Service. 2007. Biological Opinion for the operation of Englebright and Daguerre Point Dams on the Yuba River, California. File Number, 151422-SWR-2006-SA00071:MET (PCTS #2007/01232. Sacramento, CA.

NMFS. See National Marine Fisheries Service.

Pasternack, G., A. Fulton, and S. Morford. 2010. Yuba River analysis aims to aid spring-run Chinook salmon habitat rehabilitation. California Agriculture 64(2):69-77.

Pasternack, G. B. 2010a. Estimate of the Number of Spring-Run Chinook Salmon That Could Be Supported by Spawning Habitat Rehabilitation at Sinoro Bar on the Lower Yuba River. Prepared for Habitat Expansion Agreement Steering Committee (California Department of Water Resources and Pacific Gas and Electric Company). July 2.

Pasternack, G. B. 2010b. Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River, CA. Prepared for U.S. Army Corps of Engineers. September 30.

Pasternack, G. B. 2010c. Estimate of the Number of Spring-Run Chinook Salmon Supportable by River Rehabilitation in the Narrows Reach of the Lower Yuba River. Prepared for Habitat Expansion Agreement Steering Committee (California Department of Water Resources and Pacific Gas and Electric Company). November 9.

U.S. Army Corps of Engineers. 2010. Draft Environmental Assessment for the Lower Yuba River Gravel Augmentation Project, Yuba and Nevada Counties, California Sacramento District. September.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 2001. Historical and present distribution of Chinook salmon in the Central Valley. Pp. 71–176 in R. Brown, Ed. Contributions to the Biology of Central Valley Salmonids. California Department of Fish and Game Fish Bulletin 179. Sacramento, CA.

G.2 Personal Communications

Berry, Mike. California Department of Fish and Game. Teleconference with HEA Steering Committee. June 2, 2010.

Bratcher, Tricia. California Department of Fish and Game. Teleconference with HEA Steering Committee. June 2, 2010.

Hill, Katherine. Program Manager – Fisheries, Hatcheries, and Fish Habitat Shop. California Department of Fish and Game North Central Region (Region 2), Rancho Cordova, CA Email to the HEA Steering Committee with a management goals statement for spring-run Chinook salmon in the upper Lower Yuba River. November 4, 2010.

Strachan, Susan. California State University, Chico. Email to Chris Wilkinson, California Department of Water Resources regarding funding for Iron Canyon fish ladder. October 11, 2010.

Wantuck, Rick. Regional Hydropower Program Supervisor. National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS). Southwest Region. Discussion of proposed reintroduction of spring-run Chinook salmon into the Upper Yuba River in a meeting with NMFS technical staff and the HEA Steering Committee in Santa Rosa, CA. July 21, 2010.

Appendix H

Estimate of the Number of Spring-Run Chinook Salmon That Could be Supported by Spawning Habitat Rehabilitation at Sinoro Bar on the Lower Yuba River

Estimate Of The Number Of Spring-Run Chinook Salmon That Could Be Supported By Spawning Habitat Rehabilitation At Sinoro Bar On The Lower Yuba River

(Photo of the area of potential river rehabilitation)

Prepared by

Dr. Gregory B. Pasternack, PhD, M.ASCE

July 2, 2010

Introduction

The Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead (HEA) seeks to expand spawning, rearing, and adult holding habitat for these salmonids in the Sacramento River basin. A key goal is to accommodate an estimated net increase of 2,000 to 3,000 adult spawning spring-run Chinook salmon as compared to the habitat available under any relevant requirement or commitment. This goal is referred to as the Habitat Expansion Threshold (HET).

A draft Habitat Expansion Plan (HEP) has been developed in which two different sets of actions are proposed to achieve the HET. One set of actions involves rehabilitating the lower Yuba River (LYR) between Englebright Dam and the confluence with the Feather River. Different parts of the LYR serve different salmonid species and their freshwater lifestages. Spring-run Chinook salmon (SRCS) are thought to migrate to the upstream limit of the accessible river at Englebright Dam and attempt to spawn there no matter what the conditions are. The canyon reach between the dam and the junction with Deer Creek (Fig. 1) is called the Englebright Dam Reach (EDR). At present the EDR is highly impacted and supports few SRCS. Further downstream, opportunities exist to enhance rearing habitat and adult SRCS migration.

The purpose of this report is to combine available information on the EDR with knowledge of spawning behavior and habitat rehabilitation in the Central Valley to obtain the best estimate of the population of adult SRCS spawners that can be accommodated by rehabilitating the downstream half of the EDR in the vicinity of a feature known as Sinoro Bar (see cover photo). In support of the estimate, a summary of the current status of the EDR is provided. Then key opportunities and constraints for rehabilitating the area are discussed. Finally, a set of specific estimates is provided based on different assumptions about the project area and SRCS occurrence and behavior in the Central Valley.

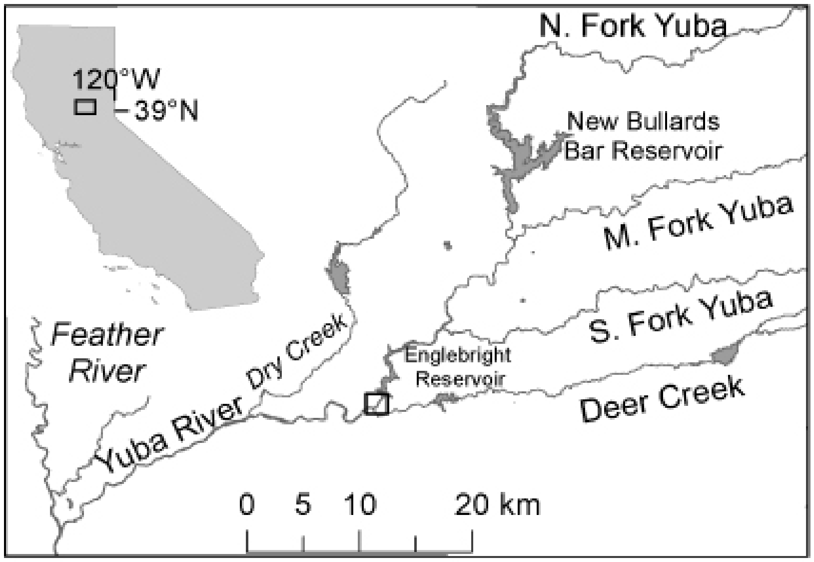
Current Status

EDR Fluvial Geomorphology

Based on a topographic map produced in 2007 (surveyed 2005-2007) with joint funding from the USFWS and the Yuba Accord River Management Team (RMT), the EDR is a relatively straight bedrock canyon with a veneer of “shot rock” debris (Fig. 2). Shot rock is irregular-shaped angular cobbles and boulders blasted or eroded from surrounding hillsides. In the EDR, shot rock was generated and spread by two distinct processes: rock excavation during the construction of Englebright Dam and hillside scouring during major floods. The EDR is also influenced by a backwater effect imposed by Deer Creek.

There are three shot rock deposits in the EDR. The largest is a mixture of angular cobbles and boulders deposited as a point bar on the inside of a gentle canyon meander bend upstream of the junction with Deer Creek on river right (i.e. the north bank). This point bar has recently been named Sinoro Bar to symbolize the lack of gold expected in it (Fig. 2). Sinoro Bar is located just upstream of the historic gold mining camp known as Malay Camp. Malay Camp was situated across the river from Lander’s Bar, a historic site of placer gold mining on the south bank that pre-dates hydraulic mining and no longer exists.

Figure 1. Location map of the Englebright Dam Reach (black box) in the Yuba catchment.



There are two notable geometric aspects to the shape of the EDR in the vicinity of Sinoro Bar. First, the width of the canyon walls (at the vertical boundary between the vegetated, soil-mantled hillside and the exposed bedrock) increases from 79-161.5 m (260-530') through the downstream half of the EDR. Second, over this same domain, the water surface elevation drops a significant height of 1.57 m (5.14'). A lot of the elevation loss occurs abruptly at a rapid formed at a significant channel constriction (Fig. 3, top image, green to orange color change). The USGS gaging station is located just upstream of this constriction, so the constriction acts as the hydraulic control for the gaging station. Velocities in the potential rehabilitation area presently range from 0-7 ft/s due to local flow constrictions and expansions (Fig. 3).

Pasternack et al. (2010) analyzed the physical geography of the EDR with a focus on the history and status of Sinoro Bar. No EDR aerial imagery pre-dates hydraulic mining, but the history of gold mining at a site in the vicinity called Landers Bar confirms that alluvium existed in the canyon. Historical photos from 1909 and thereafter show that hydraulic mining debris formed deep alluvial deposits, including multiple gravel-bedded riffles. Based on the size and shape of the riffles evident in the imagery, they would have provided Chinook salmon spawning habitat. Therefore, there is historical evidence to support rehabilitating the EDR to provide the physical processes and morphologies associated with SRCS physical habitat.

A key conclusion of Pasternack et al. (2010) was that mechanized gold mining on Sinoro Bar (beginning circa 1960) was responsible for degrading SRCS habitat. Prior to mechanized mining, glide-riffle transitions were gradual, enabling fish to select among a diverse range of local hydraulic conditions. Bulldozer debris constricted the channel significantly, induced abrupt hydraulic transitioning, and caused the main riffle at the apex of the bar to degrade into a chute unsuitable for SRCS spawning. In addition, mining operations evacuated the majority of alluvium at the mouth of Deer Creek, destroying what was likely a hotspot for biological productivity and SRCS spawning. Although shot rock

Figure 2. Topographic map of the Englebright Dam Rach of the lower Yuba River. The potential rehabilitation area is delineated by a polygon with an orange-dot fill, while the area of Sinoro Bar is delineated by a polygon with grey diagonal lines.

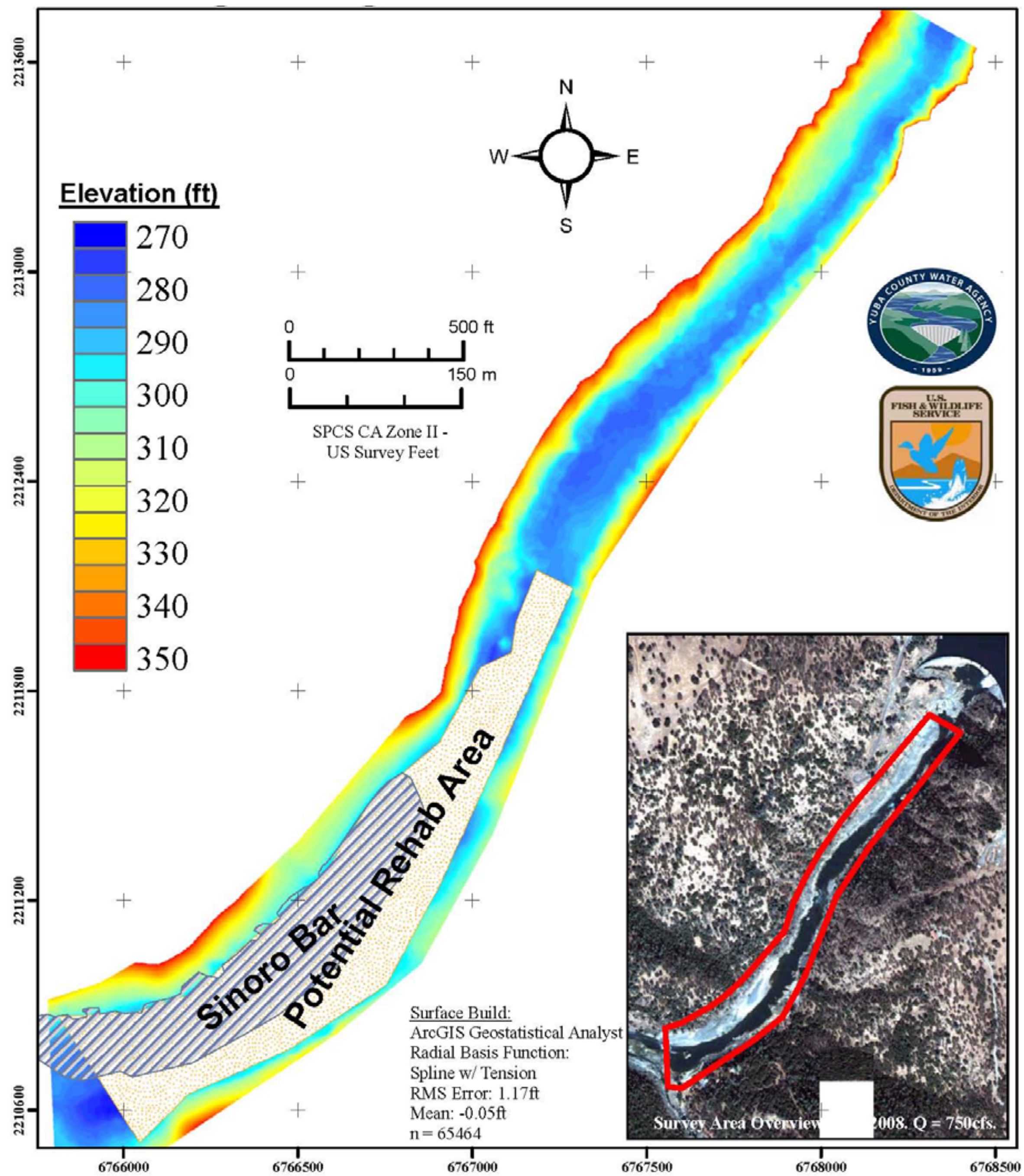
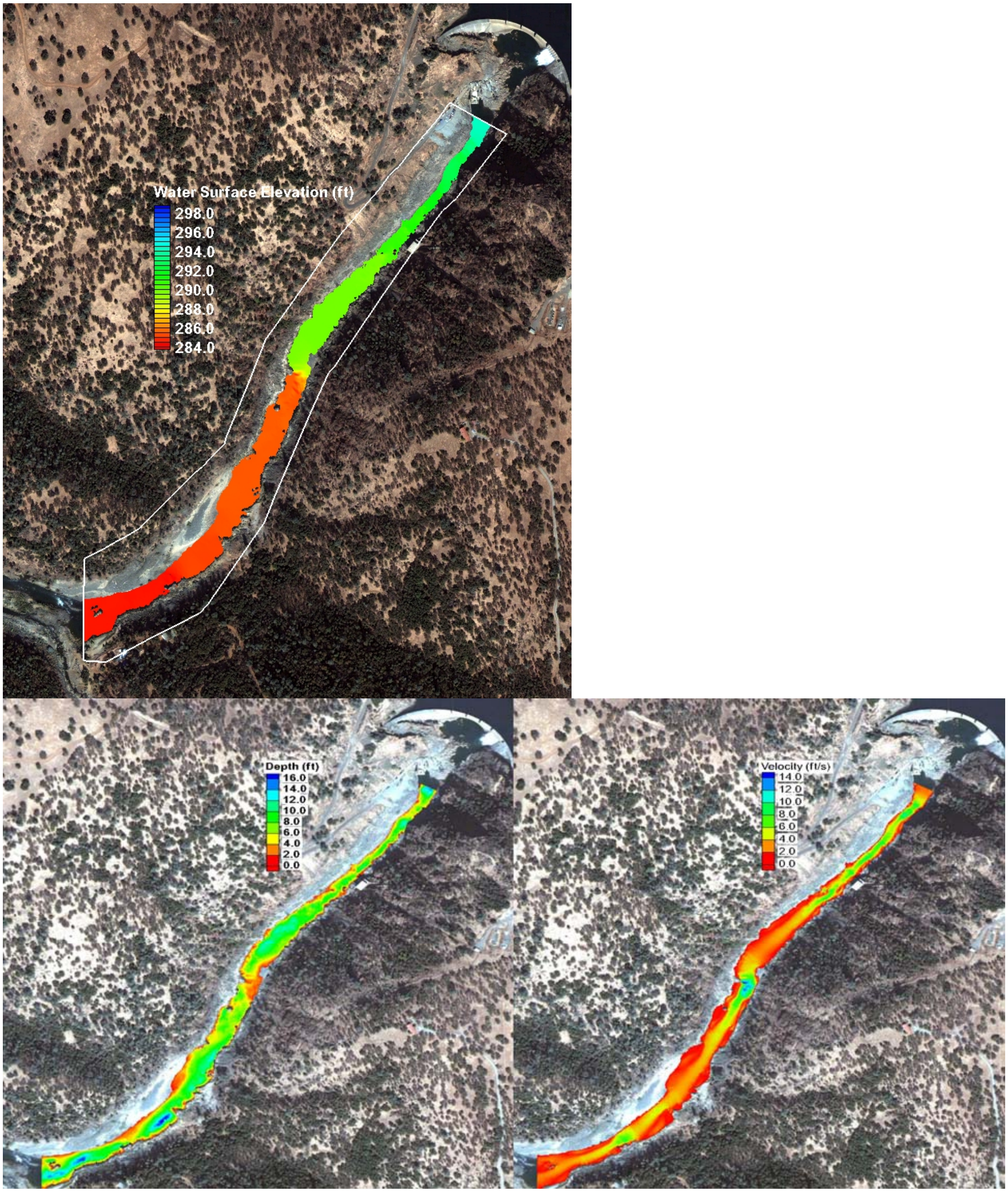


Figure 3. 2D hydraulic model results for 1600 cfs released into the EDR.



associated with Englebright Dam construction and hillside-scouring around the dam during the largest historical floods contributed to the problems at Sinoro Bar, the impact of mechanized instream mining was significantly greater than the impact of Englebright Dam on changing the structure of SRCS physical habitat in the vicinity of Sinoro Bar.

Pasternack et al. (2010) used topographic mapping and bedrock elevation assumptions to estimate that Sinoro Bar has an alluvial volume of 128,940 m^3 (168,650 yds^3). Fill depth was estimated to range between 0-12.1 m (0-30.7 ft). Test excavations could be performed to improve this volume estimate. They could also assess any value of the geologic materials present there.

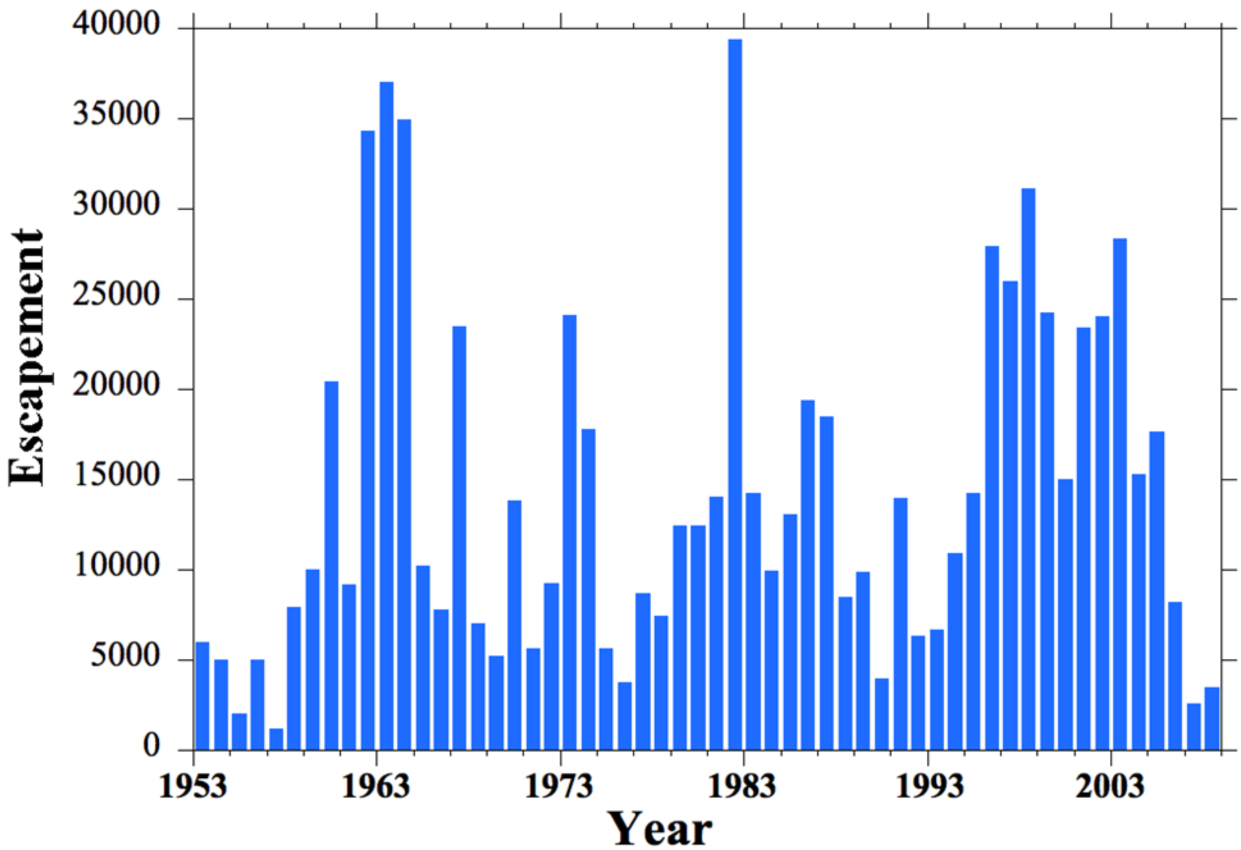
LYR and EDR Salmonid Populations

There are no quantitative estimates for pristine, historic salmonid populations on the Yuba River prior to hydraulic gold mining, but Yoshiyama et al. (1996) reported historic accounts suggesting large populations. For example, they cite Chamberlain and Wells (1879) as stating that the Yuba was so full of salmon that Indians speared them "by the hundred". However, during hydraulic gold mining much water was diverted away and the river valley was allowed to fill 20-80' high with mine tailings. A first-hand account of a miner at Long Bar on the LYR stated that the miner's diet primarily consisted of pancakes and there is no mention of fish at all (Lecouvreur, 1906). Even still, Yoshiyama et al. (1996) reported accounts of the construction of Bullards Bar Dam in 1921-1924 in which it was stated that so many salmon were blocked at the construction location that their carcasses had to be burned. SRCS and steelhead both were known to migrate far up into the North and Middle Yuba Rivers and several miles up into the South Yuba before reaching potentially impassable waterfalls. However, much of the spawning habitat in the upper watershed was badly degraded by mining debris, sand, and turbidity. If the SRCS population was in the hundreds of thousands of fish, then the riffles in the EDR during the mining era and early 20th century would likely have been used by such a large population. However, relative to the total abundance, this number of fish spawning in the EDR may not have drawn the attention of naturalists at the time, especially given the difficulty of getting to that area.

During the latter half of the 20th century, salmonid populations were estimated quantitatively (Fig. 4), but it is still difficult to isolate SRCS numbers. Yoshiyama et al. (1996) cite several estimates of the fall-run Chinook salmon population, but provide no enumeration of SRCS. They cite John Nelson as reporting that fall- and spring-run populations are mixed and that these mixed fish are now present in "minimal numbers". Table 2 of CDFG (1991) enumerates the annual estimate of fall-run Chinook salmon, with a range of 1000 in 1957 to 39,000 in 1982. For the SRCS, CDFG (1991) states that a remnant population exists and that it is composed of some in-river natural reproduction, strays from the Feather River, and restocked, hatchery-reared fish. Restocking of fingerlings and yearlings was done in 1980. CDFG (1991) reported that 20 pairs of Chinook salmon were observed to spawn at the Narrows powerhouse in autumn 1986 and due to passage barriers in the autumn, it was decided that these were SRCS that migrated during high spring flows. CDFG stopped conducting annual escapement surveys in 1989. No survey was done in 1990. The Yuba County Water Agency (YCWA) sponsored Jones and Stokes, Inc. to perform escapement surveys using the CDFG methodology for 1991-2004. For

2005-2007 CDFG took over the effort again, but beginning in 2008 the responsibility shifted to the RMT as part of its new Monitoring and Evaluation Plan. The RMT's 2008 escapement and redd reports used temporal modalities associated with fresh carcass observations and frequencies of redd observations to try to differentiate spring- and fall-run Chinook salmon. However, it was not possible to obtain a clear distinction and all data were analyzed together. In all of these modern enumerations, abundance estimates did not isolate SRCS or the subpopulation of all Chinook in the EDR; carcass counts were not made in the EDR due to challenging accessibility.

Figure 4. Adult Chinook salmon abundance for the LYR based on carcass surveys and coded-wire tagging.



For March 2007 through February 2008, the RMT operated a Vaki RiverWatcher video monitoring system on both fish ladders at Daguerre Point Dam (~12 miles downstream of the EDR). This system scans the side-view projected area of each fish and takes a color photo of each fish. From these data, staff counts the number of fish that pass and use characteristic morphometrics to identify the species of each fish (for ~70% of individuals). Of the 1,324 Chinook that were observed, 336 (25%) passed in March-August, which is the period that SRCS likely migrate.

Adult SRCS have been observed holding in pools in the EDR. Acoustic tracking of adult SRCS in 2009 by the RMT showed that some individuals migrate into and out of the reach until September at which point they stop migrating and attempt to spawn. In September 2007, UC Davis graduate student Aaron Fulton observed SRCS attempting to dig redds and spawn on bedrock covered with a thin veneer of angular gravel, causing them injury. Fulton (2008) investigated salmon spawning habitat conditions in the EDR and found the conditions to be very poor to nonexistent.

In November 2007, the U.S. Army Corps of Engineers (USACE) injected 450 metric tons of gravel/cobble into the Narrows II pool below Englebright Dam. Flows in winter and spring 2008 were too low to move the sediment out of the pool. In March and May 2009, there were two moderate floods that overtopped Englebright Dam and caused a short re-distribution of gravel into suitable depths and velocities for spawning. A report on this is available from the USACE. Preliminary observations of Chinook salmon redds in 2009-2010 by the RMT found that 120 redds were located in the EDR between September 7, 2009 and February 22, 2010. This response to limited gravel injection indicates that if more spawning habitat was present, a population of SRCS could be accommodated.

Rehabilitation Concepts

The goal of this report is to provide an estimate of the number of SRCS individuals that rehabilitating Sinoro Bar could support. There are many ways to calculate such an estimate. Ultimately, the actual population of supported fish is going to depend on exactly how habitat is created and how many SRCS adults enter the LYR. As a result, it is necessary to spend some time characterizing the opportunities and constraints of what the project would look like, based on lessons of other similar projects.

One mistaken notion that some people have is that gravel may be placed anywhere in a degraded spawning area and the adult salmonids will spawn at random over the suitable substrates, regardless of the suitability of the hydraulic and cover conditions. This line of thinking has led to worries about unusual substrate aspects, such as the “smell” of gravel. Spawning studies and gravel placement experiments on the Mokelumne, Yuba, and Trinity Rivers in California refute these notions. Elkins et al. (2007) reported that fall-run Chinook spawners occurred in lower quality hydraulic habitats prior to river rehabilitation, but they still did not spawn on gravels with depth and velocities outside the range of their depth and velocity habitat suitability curves. On the Trinity River below Lewiston Dam, when gravel was placed throughout the reach according to a designed pattern, spawners avoided building redds in fresh gravels in areas where the depths and velocities were outside the ranges of the habitat suitability curves. Gravel is placed in such locations to achieve geomorphic objectives and to serve different salmonid species’ lifestages. On the LYR, Pasternack (2008) reported that spawners avoided areas with gravel present, but unsuitable hydraulics. Dr. Hamish Moir and Prof. Greg Pasternack also observed Chinook salmon spawning in a deep pile of brightly colored blue gravels that were painted and installed into the bed in an area with high-quality hydraulics for a tracer experiment-suggesting that if hydraulics are high-quality, then “smell” is not a deterrent. Also, the gravels placed on the Trinity below Lewiston Dam came from out of basin and the fish spawned in it very intensively anyway, again suggesting that fish do not dislike the “smell” of out-of-basin gravels. It is likely that reports of statistical analyses of the effects of gravel “smell” are not accounting for other relevant variables in explaining habitat utilization. As a result, a project at Sinoro Bar is not just a matter of pouring gravel to create a big flat riffle; some thought should go into the structure of rehabilitated area to maximize SRCS spawning potential.

Wheaton et al. (2004) and Elkins et al. (2007) lay out a peer-reviewed framework for river rehabilitation below dams on regulated gravel-bed rivers (see http://shira.lawrucdavis.edu). The framework is called the Spawning Habitat Integrated Rehabilitation Approach (SHIRA). SHIRA has "spawning habitat" in its name based on the ecological concept of indicator species and its applicability to anadromous fishes (Willson and Halupka, 1995). The concept suggests that there are a few ecologically iconic activities whose abundance, productivity, and/or behavior is an indicator of ecosystem condition. For example, salmonid fisheries experts differ in their view as to what species and lifestage of organism is most limiting for each population's recovery, but agree that evaluating rearing lifestages is much more difficult and costly than evaluating the spawning lifestage-redds are discrete physical structures that can be readily mapped. Also, several studies of spawning habitat rehabilitation projects on the lower Mokelumne River have found that improving spawning habitat yields associated benefits to physico-chemical conditions in gravels (Merz and Setka, 2004), embryo incubation and emergence to fry (Merz et al., 2004), macroinvertebrate abundance and diversity (Merz and Ochikubo Chan, 2005), streamwood recruitment (for structural shade and cover), and channel-floodplain connectivity (that provides access to excellent rearing habitat). SHIRA advocates comprehensive pre-project assessment, planning and design phases followed by construction, post-project assessment, monitoring and hopefully adaptive management. During each of seven phases, four primary modes are used iteratively to collect and analyze data on which flexible and informed decisions can be based (Wheaton et al., 2004).

Based on lessons learned in applying SHIRA to the Mokelumne, Trinity, American, Feather, and Yuba Rivers, there are some important opportunities and constraints that should guide the conceptual design for Sinoro Bar and should be reflected in SRCS population estimates.

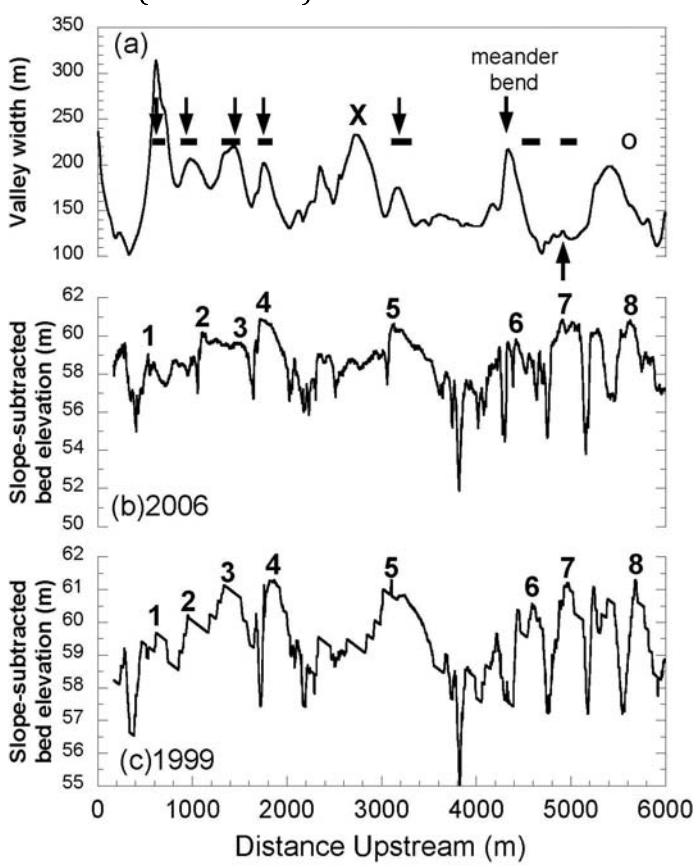
First, the domain of consideration for river rehabilitation should not be limited to the area of Sinoro Bar itself, but should go from the hydraulic constriction farther upstream to the end of Sinoro Bar (Fig. 2). The main reason for using this larger domain is that the rehabilitated area needs to have much more kinetic energy than is presently available at Sinoro Bar itself. The majority of the available energy is spent at the upstream rapid. There is a step just downstream of the bar that also uses some of the available energy. There is no way around making use of the energy spent in these two bounding steps to rehabilitate SRCS habitat, and the more one uses, the better habitat can be achieved. However, the area of potential rehabilitation should not be filled up with so much gravel as to back water up above the existing upstream constriction during flows of less than ~2,000 cfs. This will preserve the current USGS gaging station rating curve for low flows and minimize any other negative impacts on upstream habitat that will be created by future USACE gravel augmentation efforts.

Second, Elkins et al. (2007) reported that the best quality Chinook spawning habitat on the lower Mokelumne required a local riffle-to-riffle slope of ~0.004 (0.4 %). A similar value was found for the Trinity River, which has a similar size and spawning discharge. The EDR has more than double the spawning season discharge as the Mokelumne and Trinity Rivers, but that is offset according to mass conservation by having double the width, so velocities should be roughly similar for the same slope. For the EDR, the centerline length of the potential rehabilitation area between the upstream and downstream confining bed steps (Fig. 2) is ~2,130'. Given an upstream available elevation of 5.14' (Fig. 5, left photo), the site-averaged available slope is 0.2%. The height of the downstream step (Fig. 5, right photo) is unknown, but if it were at least ~1.3', then incorporating that amount into the design would yield a site-averaged available slope of 0.3%. It is possible that 0.3% is enough to yield good SRCS spawning habitat throughout the whole project area. To have one or more riffles with 0.4% slope for SRCS spawning habitat in the project area, then pool habitat could be incorporated for 158.5 m (520'), leaving 490.7 m (1,610') of spawning riffles. Incorporating 1-2 pools would provide holding habitat, and with the addition of boulders and streamwood, there would be adult spawner refugia in proximity to redd construction points and juvenile habitat. This analysis reveals that different SRCS spawning estimates are possible depending on the area that is assumed available for spawning. The highest estimate assumes the whole area is suitable habitat with a slope of 0.3 %, which is possible. An intermediate estimate accounts for having some pools for adult holding in the project domain, leaving optimal riffle habitat with a slope of 0.4%. A conservative estimate reserves an additional 20% of the area for glides, backwaters, and other mesohabitats that are not used for spawning.

Third, it appears that Sinoro Bar takes the form of a "point bar" (see cover photo), which is a sedimentary deposit that forms on the inside of a meander bend. There is definitely a gentle meander in the canyon at this location. As a result, the first instinct of a project designer might be to build the rehabilitated site as a point bar as well. This would severely restrict the amount of SRCS habitat that could be gained from the project. There are several lines of evidence that suggest that designing the site to remain a point bar would be an unnecessary mistake. First, White (2008) analyzed the historical (1937-2006) pattern of riffles and pools in Timbuctoo Bend downstream of the EDR on the LYR and found that only one out of eight persistent riffles was associated with the pattern of valley and channel meandering (Fig. 6). Some long-persistent riffles occur right in the middle of a meander where standard theory predicts a deep pool and point bar should be located. The reason why meandering was not important was due to the presence of longitudinally undulating valley walls. During floods, these undulating walls appear to cause a hydrogeomorphic mechanism known as "flow convergence routing" (MacWilliams et al, 2006). In essence, this mechanism involves the funneling of water like a jet through constricted parts of the valley and spreading it out in expansive areas. The locations of such constrictions are stage-dependent, but during floods it is undulations in the valley walls that drive where pools cut down fast and riffles grow or just cut down slower. Sawyer et al. (2010) and Pasternack (2008) demonstrated the occurrence of flow convergence routing for the pool-riffle-run sequence at the apex of Timbuctoo Bend. Pasternack (2008) demonstrated the absence of riffle sustainability in the upper half of the EDR due to canyon width undulations being in phase with bedrock bed undulations. The upshot is that for a wandering gravel-bed river like the lower Yuba River, wall undulations and flow convergence routing outweigh meandering as the primary control on riffle location and persistence. Thus, it is not necessary to assume that a large amount of area has to be used to form a point bar and thus not serve as SRCS habitat. Instead, Wheaton et al. (2010) demonstrated that flow convergence routing can be built into a site to insure riffle-pool sustainability.

Figure 5. Upstream (left) and downstream (right) rapids bounding the potential rehabilitation area. Redistribution of the elevation loss at these two locations provides the primary mechanism for obtaining optimal velocities for SRCS spawning throughout the project area.

Figure 6. Illustration of the connection between a) valley width and slope-subtracted longitudinal profiles for b) 1999 and c) 2006. Horizontal bars show the positional area of each persistent riffle location, vertical arrows show points of greatest valley width for each oscillatory cycle, open circle is location of persistent crest 8 at the head of the valley, X denotes a large oscillation with no persistent riffle crest, and numbers are the identifiers for each persistent riffle crest (1984-2006).



Fourth, the situation at Sinoro Bar is further confounded by the role of Deer Creek, which enters the LYR at an almost perpendicular angle right below Sinoro Bar. Flood water from Deer Creek can cause a strong backwater effect and work with valley wall undulations and local bedrock constrictions to promote deposition at Sinoro Bar. However, that only works if flows out of the two rivers are synchronous. Floods out of the smaller, lower-elevation Deer Creek are rain-driven and thus rise and fall quickly. Floods out of the Yuba catchment can be rain-driven or rain-on-snow events. The former are slower to develop than those on Deer Creek and tend to peak afterwards, out of phase. That limits the ability of Deer Creek to provide a significant backwater effect. During rain-on-snow events, warm rain appears to simultaneously produce floods on both rivers, enabling the backwater effect to promote deposition. Based on historical events, if no action is taken to mitigate shot rock generation at Englebright Dam and if no design elements account for the backwater effect of Deer Creek, then rehabilitated conditions at Sinoro Bar could be short-lived. As with the meandering factor, consideration of flow convergence routing should help yield a design to alleviate the problem, but that could come at the cost of some habitat area to serve this geomorphic purpose.

Fifth, there is no water temperature or water quality limitation in the EDR that would diminish spawning activity or jeopardize embryo development.

Overall, the above considerations suggest that there is a large area available for river rehabilitation in the vicinity of Sinoro Bar in support of a sizable SRCS population. There is a sufficient river elevation range to provide the necessary kinetic energy for excellent riffle habitat. There is sufficient canyon width to enable a range of options for controlling riffle-pool sustainability. Other factors, including channel meandering and a tributary junction can be managed without large loss of potential riffle area.

Redd Estimates

There is no single correct method for predicting what the SRCS population supportable by a rehabilitation project at Sinoro Bar would be at this stage of design development. Choices in the design process can enhance or detract from estimates. The approach used here is to evaluate the relation between site conditions and redd occurrence, and then relate redd occurrence to the supportable SRCS adult population. Making an estimate of the number of redds to occur in a channel area comes down to picking two things: redd density (sum of occupied and unoccupied channel surface area (m^2) per redd) and area of riffle habitat. In this section, I provide a table with 18 different redd occurrence estimates using six different redd density and three different channel area estimates.

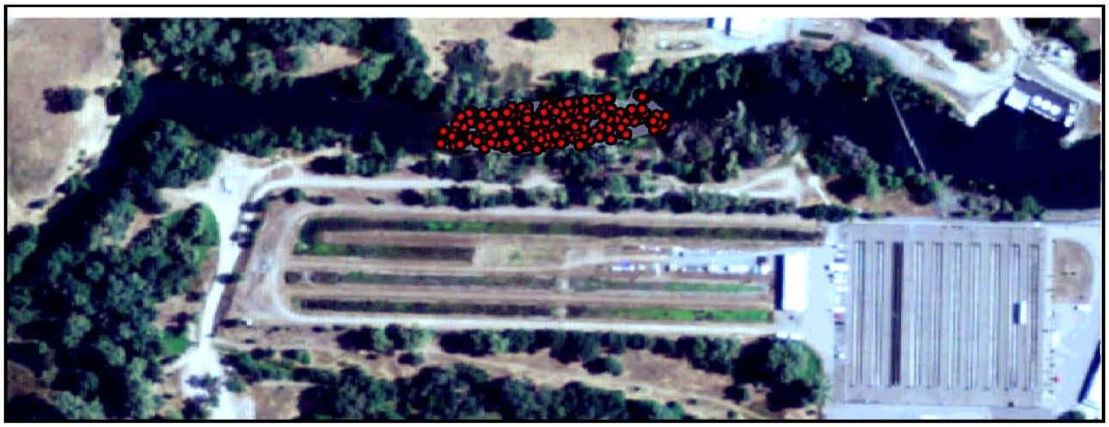
Redd density requires an estimate of individual redd size and unoccupied area, which were estimated together using six different approaches. In all estimates, the only available information on redd size and density was for all runs of Chinook, not just spring-run. Four estimates were based on observations of redd size in an index area near the upper end of Timbuctoo Bend in the LYR during almost-daily observations in autumn 2008 by the RMT. According to their measurements of 180 Chinook redds, the mean redd size was 5.55 m^2. They found that the mean plus one standard deviation was 8.60 m^2. The maximum size observed was 14.18 m^2. In comparison, Gallagher and Gallagher (2005) found the average Chinook redd to be 6.72 m^2 for several coastal streams in northern California. To go with these measurements, one can assume a redd density of 1 redd per each redd-sized area of the bed. This assumes complete coverage of the bed with redds and no superimposition. In fact, in the index-site study on the LYR there were unused areas around redds; however, there were also as many as 8 redds per redd area in some places, due to superimposition. Those confounding factors are hard to explicitly account for. If one were to assume an equal area of occupied and unoccupied space, then that would yield a redd density of 11.1 m^2 per redd. Increasing unoccupied space to a 2:1 ratio against occupied space yields a redd density of 16.65 m^2 per redd. Redd area also correlated directly with water depth in the index-area study, but without knowing the eventual depth-distribution of the rehabilitation site, this additional information cannot be applied; it might be useful in design evaluations at a later time.

Another way of estimating the likely density of redds is to take advantage of the experience at a similar site after rehabilitation. The lower Mokelumne River below Camanche Dam provides this opportunity (Fig. 7). However, there is a constraint on using this site in that the Mokelumne hatchery consumes a large percentage of potential spawners that enter the rehabilitated spawning habitat each year. In 2004, 91% of spawners were taken, which is typical (Elkins et al., 2007). As it turns out, 2005 was a banner year for escapement and it was a year in which an agreement was implemented for the hatchery to reduce its take. Their final take was only 36% of escapement. As a result, 10,406 spawners made use of the in-river spawning habitat, of which 31.9 % chose to spawn on any one of several rehabilitated riffles. Looking at the riffle that had been the focus of habitat expansion and rehabilitation that summer, there were 241 redds observed in weekly surveys by EBMUD in autumn 2005. The area of the spawned over site was 4,401 m^2. That yields a redd density of 18.3 m^2 per redd. The only problem with this estimate, is that it does not account for superimposition, and in a year with as many spawners as were present in such a small area, superimposition was highly likely. If an assumption is made that there was 10% additional redds that were missed due to superimposition, then that would yield a redd area of 16.60 m^2. That is very similar to the estimate of redd density from the LYR index site using an unoccupied:occupied area ratio of 2:1.

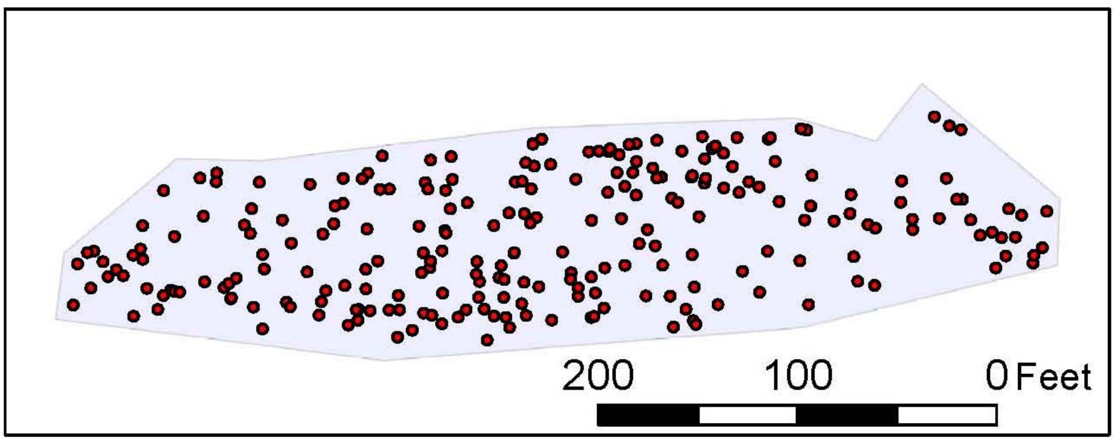
To estimate the area of riffle habitat that could be created for spawning at Sinoro Bar, three different calculations were made. First, the total potential rehabilitation area was estimated. This was done by drawing a polygon around the area in a Geographical Information System (Fig. 2) and using GIS to calculate the area of the polygon, which was found to be 46,486 m^2. Using this area assumes that the entire project area will be spawnable riffle habitat. Given a large spawner population, a higher than expected available slope, better velocities than anticipated for the expected slope, and aided by wood and boulder placements that give resting refugia and structural diversity, such a high value for spawnable habitat might be obtained; it is unlikely to be so high, but it is not beyond consideration.

Second, this area was divided by the centerline length of 650 m to obtain an average width of 71.5 m. Earlier it was stated that if a suitable length of the area was set aside for pools, then an optimal 0.4% slope could be achieved for 490.7 m of river length. Multiplying (490.7*71.5) yields 35,090 m^2 of riffle habitat of optimal slope.

Figure 7. 2005 Chinook Redds on one rehabilitated riffle on the lower Mokelumne River in the spawning season immediately after rehabilitation, which happened to be a year with a high escapement and low hatchery take. Top aerial image shows context of site adjacent to hatchery in a width-constricted channel. Bottom image shows an overlay of individually mapped redds on the area of riffle spawning.



Red dots are redds
Shaded area is rehabilitated riffle



Finally, a conservative estimate was made by holding back an additional 20% of the remaining riffle area for other geomorphic and habitat goals. That yielded a low estimate of spawnable area of 28,072 m^2.

The estimated numbers of redds produced under all combinations of redd density and spawnable habitat area are provided in Table 1. The range of estimated SRCS redds supported is 1534-8376. A tighter range could be estimated by using the LYR index site's mean redd size with an equal unoccupied area coupled with a rehabilitation area that excludes design pools, with and without an additional reserve. That range is 2529-3161. Perhaps a 10% area reserve (60x60 m^2) would be sufficient, yielding a middle ground estimate of 2,845 redds.

Table 1. Estimated Number of Redds Produced for Sinoro Bar Using Different Sets of Assumptions.

	redd density (m^2 per redd)	Total rehab area (m^2)	Rehab area minus design pools (m^2)	Rehab minus design pools with 20% extra area reserve (m^2)
Riffle SRCS habitat area (m^2)	n/a	46486	35090	28072
LYR index site mean redd size	5.55	8376	6323	5058
LYR index site mean redd size + 1 SD	8.60	5404	4079	3263
LYR index site max redd size	14.18	3278	2475	1980
LYR index site mean redd size with equal unoccupied area	11.1	4188	3161	2529
LMR rehabilitated riffle area redd occurrence density assuming 10% superimposition missed	16.60	2800	2114	1691
LMR rehabilitated riffle area redd occurrence density	18.3	2540	1917	1534

Green values indicate the most reasonable estimates

Adult SRCS Abundance Estimate

Knowing the number of redds likely to occur in the rehabilitated area enables an estimate of the likely adult SRCS supported by the project. The key variable to enable the calculation is the number of adults per redd. By some accounts, an individual female can create 1-3 redds during her spawning period. Meanwhile, the eggs in an individual redd may be fertilized by 1-3 adult males. These numbers are offsetting. In 2006 and 2008, LYR escapement and redd surveys were done to characterize the reach-stratified distribution of spawners. For the 2006 surveys, 1906 Chinook adults were estimated to occur upstream of Highway 20 bridge and 469 redds were observed in that area. The numbers for 2008 were 1849 and 473, respectively. These yield spawner:redd ratios of 3.9:1 and 4.1:1, with a mean of 4.0:1. Applying this observation-based ratio of 4:1 to the redd estimates yields a range of adult SRCS supported by the project of 6,136-33,504, with the most reasonable estimates ranging from **10,116-12,644**. A more conservative approach would be to apply a 2:1 ratio (the minimum required to have fertilized embryos produced), which yields the most reasonable estimates ranging from 5,058-6,322. Applying the conservative spawner ratio and the most conservative redd abundance estimate yields the minimum adult SRCS supported estimate of 3,068.

Accounting For Regional Limiting Factors

Based on the annual escapement surveys for 1953-2008 cited earlier, the average number of adult Chinook spawners of all runs in the LYR averaged 14,249, with a maximum estimate of 39,000. Yet the analysis performed in this report suggests that EDR alone *could* support no less than 3,068 and more likely 10,116-12,644 SRCS adults, with a maximum potential population as high as 33,504. The reason why the project can support so many fish is that the lower half of the EDR is actually a large section of river with a moderate slope and relatively high width. Historically there were likely hundreds of thousands of Chinook spawning in the Yuba, and even 33,504 would have been perhaps just 10% of that total run. Thus, relative to current conditions the project's results seem surprisingly large, but relative to historical conditions it is likely still small.

Since 1953 (56 years), there have only been 14 years when the LYR's Chinook escapement has exceeded 20,000 and just 5 years when it has exceeded 30,000. Without going into a detailed "limiting factors" analysis, it is evident that the quantity and quality of freshwater habitats is not the only factor constraining population size. For example, the sharp decline in salmonid populations throughout the Central Valley for the last few years is a systemic phenomenon that has been tentatively linked to oceanic conditions. Therefore, it would be helpful to provide another way of estimating what the SRCS population would be in light of existing constraints beyond habitat conditions. To begin this analysis, assume that the maximum Chinook salmon population size likely to occur under the existing suite of limiting factors is 40,000, which is slightly bigger than the roughly estimated 39,000 reported for 1982. Also, in the absence of any other characterization, assume that the 2006 mesohabitat distribution and spawning habitat electivity (i.e., forage ratios) reported for Timbuctoo Bend by Pasternack (2008) hold for the whole LYR (Table 2); specifically, that 69% of Chinook salmon preferentially use riffles for spawning and that riffles account for 18% of the total channel area. Also, recall that the total length of the LYR is 38 km. Using these values, the following calculation provides an estimate of spawning density in riffles for the maximum Chinook salmon population size:

[0.69*40000] / [0.18*38] = 4,035 Chinook spawners per km of riffles on the LYR

Assuming the same spawning density for the proposed 0.49-0.65 km of riffle habitat created under the EDR rehabilitation project, an estimated **1,977 to 2,623** [0.49*4,035 to 0.65*4,035] Chinook salmon could be supported in the proposed project area under the existing conditions that regionally constrain Central Valley populations of all Chinook runs.

Considering the assumptions above, probably the most uncertain one is the percent of area for the whole LYR that is riffles. Timbuctoo Bend has a steeper slope and thus likely more riffle length than the rest of the river downstream. If the actual areal percent of riffles in the entire LYR was half the value for Timbuctoo Bend (9%), then the number of Chinook per km would double to 8,070, and the range of Chinook likely to be supported by the project would also double to **3,954 to 5,246**. So the calculation has uncertainty. The actual area of riffle habitat will be determined by the RMT under its Monitoring and Evaluation Plan in the near future.

The important point about this computation is that it has nothing to do with the local physico-chemical potential of the project area to support SRCS and instead considers the larger problem of regional limiting factors on population size to get at the likely amount of individual Chinook salmon served by the site.

Table 2. Timbuctoo Bend Mesohabitat Availability and Utilization (from Pasternack 2008)

Mesohabitat	Area (Ha)	% Total Area	Redds	% Redds	Electivity
Backwater	0.35	0.73	0	0.00	0.00
Chute	0.68	1.42	0	0.00	0.00
Forced Pool	2.19	4.56	0	0.00	0.00
Glide	11.45	23.82	22	4.69	0.48
Pool	6.27	13.04	0	0.00	0.00
Recirculation	0.12	0.26	0	0.00	0.00
Riffle	8.64	17.97	322	68.66	9.38
Riffle Entrance	3.09	6.43	53	11.30	4.31
Run	2.54	5.28	39	8.32	3.87
Secondary Channel	1.37	2.84	19	4.05	3.50
Lateral Bar	6.46	13.44	7	1.49	0.27
Medial Bar	2.26	4.70	4	0.85	0.45
Point Bar	2.64	5.50	3	0.64	0.29
TOTAL	**48.06**	**100**	469	100	

Other Design Considerations

A common concern with spawning habitat rehabilitation is that project designs are not natural and may be destroyed quickly. There is an environmental, psychological mindset that suggests that it is not possible for designers to get it right. So far, evidence from the lower Mokelumne River refutes that (Elkins et al., 2007; Wheaton et al., 2010). For the EDR, the historical deposition of mining debris and shot rock at Sinoro Bar proves that the site is naturally depositional and could yield sustainable riffle habitat in the face of large Yuba floods. If the USACE takes actions to reduce hillside erosion and shot rock transport as well as to inject gravels into the Narrows II pool annually, then floods could sustain the HEA rehabilitated area, not destroy it.

Literature Cited

CDFG. 1991. Lower Yuba River Fisheries management Plan. California Department of Fish and Game, Stream Evaluation Report No. 91-1.

Chamberlain, W.H. and H.L. Wells. 1879. History of Sutter County, California. Thompson and West, Oakland, California. 127 pp. Reprinted by Howell-North Books, Berkeley, California. 1974.

Elkins, E. E., Pasternack, G. B., and Merz, J. E. 2007. The Use of Slope Creation for Rehabilitating Incised, Regulated, Gravel-Bed Rivers. Water Resources Research 43, W05432, doi:10.1029/2006WR005159.

Fulton, A.A. 2008. Gravel for Salmon in Bedrock Channels: Elucidating Mitigation Efficacy Through Site Characterization, 2D-Modeling, and Comparison Along the Yuba River, CA. M.S. Thesis, University of California, Davis, CA, 110pp.

Gallagher, S. P., and C. M. Gallagher. 2005. Discrimination of chinook and coho salmon and steelhead redds and evaluation of the use of redd data for estimating escapement in several unregulated streams in northern California. North American Journal of Fisheries Management 25:284-300.

Lecouvreur, F. 1906. From East Prussia to the Golden Gate. Angelina Book Concern, Leipzig.

MacWilliams, M. L., Wheaton, J. M., Pasternack, G. B., Kitanidis, P. K., Street, R. L. 2006. The Flow Convergence-Routing Hypothesis for Pool-Riffle Maintenance in Alluvial Rivers. Water Resources Research 42, W10427, doi:10.1029/2005WR004391.

Merz, J.E., and Setka, J.D. 2004. Evaluation of a Spawning Habitat Enhancement Site for Chinook Salmon in a Regulated California River. North American Journal of Fisheries Management 24:397-407.

Merz, J. E., Setka, J., Pasternack, G. B., Wheaton, J. M. 2004. Predicting benefits of spawning habitat rehabilitation to salmonid fry production in a regulated California river. Canadian Journal of Fisheries and Aquatic Science 61:1433-1446.

Merz, J.E., L.K. Ochikubo Chan. 2005. Effects of gravel augmentation on macroinvertebrate assemblages in a regulated California river. River Research and Applications 21:61-74.

Pasternack, G. B. 2008. SHIRA-Based River analysis and field-based manipulative sediment transport experiments to balance habitat and geomorphic goals on the lower Yuba River. Cooperative Ecosystems Studies Unit (CESU) 81332 6 J002 Final Report, University of California at Davis, Davis, CA, 569pp.

Pasternack, G. B., Fulton, A. A., and Morford, S. L. 2010. Yuba River analysis aims to aid spring-run Chinook salmon habitat rehabilitation. California Agriculture.

Sawyer, A. M., Pasternack, G. B., Moir, H. J., Fulton, A. A. 2010. Riffle-Pool Maintenance and Flow Convergence Routing Confirmed on a Large Gravel Bed River. Geomorphology 114:143-160.

Wheaton, J.M., Pasternack, G.B., and Merz, J.E. 2004 Spawning habitat rehabilitation – I. Conceptual Approach & Methods. International Journal of River Basin Management 2:1:3-20.

Wheaton, J. M., Brasington, J., Darby, S., Merz, J. E., Pasternack, G. B., Sear, D. A., Vericat, D. 2010. Linking geomorphic changes to salmonid habitat at a scale relevant to fish. River Research and Applications 26:469-486.

White, J.Q., 2008. Valley width controls on riffle location and persistence on a gravel bed river. Masters Thesis, University of California at Davis.

Willson,M. F. and Halupka, K. C. 1995. Anadromous Fish as Keystone Species in Vertebrate Communities. Conservation Biology, 9:3:489–497.

Yoshiyama RM, Gerstung ER, Fisher FW, Moyle PB. 1996. Historical and present distribution of Chinook salmon in the Central Valley drainage of California. UC Centers for Water and Wildland Resources, Davis. In: Brown RL (ed.). Contributions to the Biology of Central Valley Salmonids. Vol. 1. California Department of Fish and Game, Fish Bulletin 179, p 71–176.

Appendix I

Questionnaire Received from the National Marine Fisheries Service on the Upper Yuba River Actions

Habitat Expansion Agreement

for

Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead

Questionnaire Instructions

The attached questionnaire is intended to solicit information needed by the Steering Committee to review projects relative to the criteria established in the Habitat Expansion Agreement. For each proposed action (project), please complete the questionnaire to the fullest extent possible. Please provide citations where applicable and provide a full reference for each citation at the end of this questionnaire (Section X. Supporting Documents). Specific instructions follow.

I. Contact Information

Provide the name of the agency or group making the proposal as well as a contact person for the project. Include contact information such as mailing address, phone number, and email address.

II. Project Description

Provide a descriptive name for the action (project). If the action is listed in the *Working List of Potential Habitat Expansion Actions* (provided during the January 2009 meetings of HEA parties), please include the reference number associated with the action. The project location should specify the watershed or subwatershed (e.g., Deer Creek, Beegum Creek) as well as specific areas within the watershed where the project will be located and what portions of the watershed will benefit from the project. Please include geographic coordinates of the project location(s), if applicable. The project description should be a narrative that provides as much detail as possible about the project.

III. Species Limiting Factors

In this section, indicate the factors that currently limit production of spring-run Chinook salmon and/or steelhead in your watershed. The intent is that the environmental and biological objectives of your project address these limiting factors in some way. Please check one or more of the limiting factors that apply to your watershed. In the second column, describe how and where the factor limits spring-run Chinook salmon and/or steelhead. For each factor that you check, please rank its effect on spring-run Chinook salmon and/or steelhead using the drop-down box in the last column. Finally, we also ask that you describe the source of your conclusions, such as a watershed assessment or other document. Please provide enough information that we can find the document if we need it.

IV. Project Objectives—Environmental

Environmental objectives describe how the project is intended to address the limiting factors to achieve the biological objective described in the next section. Environmental objectives should be as specific and quantitative as possible (e.g., reduce gravel embeddedness in the watershed from 75% to 25% by fencing riparian areas to exclude cattle and allow riparian forest to reestablish). Describe how you think environmental objectives relate specifically to the biological objectives. In the last column, we ask you to describe the environmental objectives as either the primary or secondary focus of the project. For example, a project to plant trees might have a primary focus on riparian/floodplain function with a secondary focus on temperature or water quality.

V. Project Objectives—Biological

Biological objectives describe the anticipated biological response from the project and should be as quantitative as possible. Indicate which species and life stages are the focus of the project. Describe specifically the general condition of the target species in your watershed relative to the historical abundance. The condition of the species should be indicated using the categories in the drop-down box. Species condition categories are defined on the last page of this form. Biological objectives should include the following information: (1) an estimate of the expected contribution of the project in terms of potential adult returns, to the extent possible (and an explanation of how the estimate was developed); and (2) an explanation of how the biological objective for the species is addressed by the action relative to the environmental limiting factors (e.g., the biological objective of an action might be to increase egg incubation survival in a watershed that is currently limited by sediment levels).

VI. Project Cost

To the extent possible, estimate the capital cost of the project, the annual operating and maintenance (O&M) cost, a description of annual O&M activities, and the project lifetime (i.e., how many years O&M activities are expected, including indefinitely, and how long until you expect the project to provide benefits). Provide any confirmed or potential funding partners, or opportunities for cost sharing with other funders or between projects. Also, identify any confirmed or potential partners that might provide maintenance support for the project (funding support or labor support).

VII. Schedule

Describe the project schedule, including a potential start date, construction period, and environmental and biological response times (i.e., the expected time to realize environmental and biological benefits). The last points refer to the maturation period for the project during which time environmental conditions develop. For example, it may take 50–100 years before full environmental benefits (e.g., shading, channel stability, water quality) of planting riparian trees are realized.

VIII. Feasibility

Describe the feasibility and challenges of the project. Feasibility issues should include primarily technical issues, success of projects utilizing similar technology, and particular challenges posed by the specific project. Other issues of feasibility that may be included are challenges associated with property ownership, permitting, zoning, and other social-economic-legal issues.

IX. Project Support

Describe the support or potential conflicts associated with the project. Specifically, provide supporting and cooperating entities (e.g., agencies, non-governmental organizations). Are there cooperating agencies or groups, aside from the potential funding partners mentioned previously? Describe the degree of local support and any known opposition or conflicts with other parties.

X. Supporting Documents

Provide full references for each citation used to support the information presented in this questionnaire for your project. At a minimum, a reference should include the author(s) name; name of agency/organization (if applicable); title of the document; volume and title of journal, if the document is taken from a professional journal; and publisher, date, and location of publication.

Questionnaire

for

Information on Potential Projects to Support Spring-Run Chinook Salmon and Steelhead in the Sacramento River Basin for the Habitat Expansion Agreement

DUE: Thursday, April 30, 2009

Send completed questionnaires to hea@water.ca.gov

I. Contact Information

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II. Project Description

Project Name: Expansion of Yuba River Salmon and Steelhead Habitat by Reintroduction and Habitat Restoration into the Upper Yuba Watershed

Reference No. or New: New

Project Location: Upper Yuba River upstream of Englebright Dam

Project Description:

Project Description: Upper Yuba River Reintroduction Options

The following information is provided to the California Department of Water Resources and Pacific Gas & Electric (HEA Licensees) to generally describe a comprehensive anadromous fish reintroduction program for the upper Yuba River watershed, and how the 2007 Habitat Expansion Agreement can be fulfilled by becoming a key component of a collaborative, watershed-based program dedicated to successful reintroduction of anadromous salmonids to the upper Yuba River basin. While certain details and commitments necessary to fully carry out such a program are as yet unknown and subject to future agreements and adaptive management, the overall goal of such a program- attaining a robust and sustainable reintroduction of spring-run Chinook and steelhead in the upper Yuba River - shall remain constant. It is NMFS' intent to proceed with development of a Reintroduction Plan in a collaborative fashion with those stakeholder parties who express genuine interest in helping to achieve the overall goal. The HEA Licensees are invited and encouraged to join with NMFS in a leadership role in this endeavor.

The HEA Licensees have specific requirements under the 2007 Habitat Expansion Agreement (HEA) to accomplish an expansion of Central Valley spring-run Chinook (and Central Valley steelhead) habitat sufficient to meet a Habitat Expansion Threshold (HET) of 2,000 – 3,000 adult spring-run Chinook salmon. The program described herein contains some elements that may be applicable to the HEA Licensees alone, and some elements that may be accomplished via a phased development- in collaboration with NMFS and other parties who have interests and responsibilities for anadromous fish conservation in the Yuba River. It is recommended that the HEA Licensees engage with NMFS (and consultants R2 Resources, Stillwater Sciences) to craft an HEA-specific component of the overall reintroduction plan. This effort should also be developed in concert with other activities among the various parties engaged in the recently formed watershed group: the "Yuba Multi-Party Forum." However, in NMFS view, it is not necessary to gain full commitment from all of the other stakeholder parties because certain discrete "HEA actions" can be undertaken without causing any immediate alterations in land use or water management practices.

This proposal involves a phased, collaborative project for the reintroduction of spring-run Chinook salmon and steelhead in targeted reaches of the upper Yuba River watershed - upstream of project dams (Englebright, New Bullards Bar, and Our House), and in the South Yuba River, approximately up to the major tributaries of Canyon Creek and Poorman Creek. The Project will formally begin in 2011 with the adoption of a final Habitat Expansion Plan, subject to NMFS acceptance, that incorporates or substantially accommodates the key elements described herein, and is consistent with the (forthcoming) Upper Yuba River Reintroduction Plan for spring-run Chinook and steelhead.

An "Upper Yuba River Reintroduction Program Steering Committee" shall be convened to oversee and direct the implementation of the phased reintroduction program. Representation on the committee shall consist at a minimum of: HEA Licensees (PG&E and CDWR), NMFS, and CDFG. Other Agency or non-governmental representatives may be included upon the recommendation of NMFS and the HEA Licensees, and with expressed interest of these other parties. For example, other prospective members of the Program's Steering Committee are: Yuba County Water Agency, Nevada Irrigation District, Pacific Gas & Electric, U.S. Army Corps of Engineers, U.S. Forest Service, U.S. Fish &Wildlife Service, members of the existing "River Management Team," Native Tribes, and Conservation Groups. The Steering Committee shall appoint a technical advisory committee to assist with matters of science, engineering, technology, operations, and evaluations and monitoring.

The project's phases will proceed as follows:

Phase 1: Conduct Fish Passage Research, Habitat Modeling Assessments, and Development Operational Reintroduction Plans

Phase 1 is currently underway via three NMFS-sponsored contracts:

- Conceptual engineering plans - Montgomery-Watson-Harza, Inc. (2/2010)
- Habitat modeling and assessments - Stillwater Sciences, Inc. (11/2010),
- Anadromous salmonid reintroduction plan - R2 Resources, Inc. (12/2010)

Fish Passage Engineering:

The Montgomery-Watson-Harza, Inc. study (Yuba River Fish Passage: Conceptual Engineering Project Options) is completed. This information was made available to the HEA Licensees in February 2010. The purpose of the study was to perform a conceptual survey of habitat suitability and fish passage opportunities in the Upper Yuba River basin; and to identify an array of potential engineering options that may be applicable to future volitional or 'collection and transport' fish passage operations.

Habitat Assessments and Modeling:

II. Project Description

Stillwater Sciences, Inc., in collaboration with NMFS, is currently performing a more detailed, science-based habitat assessment of the upper Yuba basin - including the North, Middle, and South Yuba Rivers, and their major tributaries. This assessment features the application of a salmonid population dynamics model ("RIPPLE") as a tool to help inform salmonid population restoration and recovery planning. (www.stillwatersci.com/tools.php?tid=24). Additional existing information, including that which was developed in the Upper Yuba Rivers Studies Program and other relevant sources, is also being considered in connection with modeling development and results.

The expected completion date for the habitat assessment component is November 2010.

Comprehensive Upper Yuba Reintroduction Plan:

R2 Resources, Inc., along with support from Stillwater Sciences (and other collaborating parties), is currently developing a reintroduction plan for anadromous salmonids in the upper Yuba River. The expected completion date is December 2010. At this stage, NMFS views the development of the reintroduction plan as a "living document," in the sense that it will provide a scientific foundation - upon which others may build future, collaborative reintroduction implementation efforts. Other relevant information, from previous watershed studies, on-going FERC-relicensing studies, and planned field work, is also being assembled and considered in the formulation of the Reintroduction Plan.

The Anadromous Salmonid Reintroduction Plan for the Upper Yuba River is envisioned by NMFS as a "living document," and shall be updated as appropriate in light of new information and developments affecting the direction and implementation of the fish passage reintroduction program.

Anticipated Timeline: September 2009 - December 2010

Phase II: Early Pilot Reintroduction Experiments; Planning and Permitting for Short Term and Long Term Reintroduction Program

NMFS and R2 Resources, Inc., in cooperation with other collaborators to the reintroduction plan, will provide a detailed plan for a program that can begin to reintroduce anadromous fish into targeted areas of the upper watershed within 1-2 years. The goal of this “experimental reintroduction phase” is to commence strategic fish passage and reintroduction activities on a limited scale to test, develop, and refine effective program elements in support of future habitat expansion actions and full-scale fish passage facilities. The experimental phase will use a combination of pre-determined techniques and adaptive management, in such a way as to allow for: (a) controlled deployments of fish passage technologies and human resources, (b) use of experimental (hatchery) fish stocks, (c) use of temporary fish passage technologies and existing infrastructure, (d) extensive evaluation and monitoring of fish movements and behaviors, in order to evaluate reproductive, rearing, migrating, and escapement success, and e) development of collection, transport, and survival metrics, and other barometers of success, e.g.- meeting the HEA’s Habitat Expansion Threshold.

The Reintroduction Plan document will determine the specific elements of the pilot reintroduction experiments, including such details as identifying suitable fish stocks, transport and collection methods, and the sequencing and scheduling of experiments. The plan will describe detailed approaches, methods, and materials required to accomplish the goals of the experiments. While early pilot experiments are not necessarily intended to result in full life-cycle reproduction (i.e.- spawning to escapement of discrete cohorts), marking and monitoring techniques will be employed to track and enumerate experimental fish in all life stages, as necessary to provide science-based management information.

The project(s) will involve engineering design and implementation of "collection and transport" fish passage operations - in order to facilitate the movement of both Chinook salmon and steelhead in an efficient and coordinated fashion. While specific and detailed fish passage facility designs and operational schemes need to be further developed by the HEA Licensees' and others, NMFS has already produced conceptual level engineering plans that offer a variety of conceptual options for passage in the upper Yuba River (Montgomery-Watson-Harza, Inc. 2010). It is possible that certain collection and transport operations in the upper Yuba River may be supplanted by future volitional or semi-volitional fish passage methods; but these are not within the immediate scope of responsibility of the HEA Licensees, and therefore are not further discussed in this brief program overview.

In parallel development with this pilot reintroduction phase, contracts will commence for engineering designs of full-scale, operational fish passage facilities, and when final design of facilities is accepted by both HEA Licensees and NMFS-Engineering Branch, the project will go out for bid and construction. Also during this period, the Steering Committee will begin assembling information and documentation needed for NEPA/CEQA analysis, as well as other relevant regulatory approval processes, including ESA coverage for future introduction of naturally spawning stocks of listed species, as required by NMFS.

Preliminary Target Reintroduction Experiment Areas:

(i) North Yuba River - upstream of New Bullards Bar Dam (estimated suitable mainstem habitat: 32 miles)

(ii) Middle Yuba River - upstream of Our House Dam to the Kanaka and Wolf Creek reaches (estimated potentially suitable mainstem habitat: 13 miles)

(iii) South Yuba River - upstream from Englebright Lake confluence to the Poorman Creek and Canyon Creek reaches (estimated potentially suitable mainstem habitat: 35 miles)

(iv) North Yuba and Middle Yuba River Reaches- downstream of New Bullards Bar Dam – in particular, the (approximate) one mile reach immediately downstream of the Colgate Powerhouse, and the (approximate) nine mile reach upstream of Colgate Powerhouse to New Bullards Bar Dam

Note: The preliminary target areas were selected based on best available scientific information, watershed analysis conducted on numerous site visits, and NMFS' best professional judgment regarding the potential immediate and incremental benefits of discrete and combination actions; actual targeted reintroduction areas will be determined after the Reintroduction Plan is more fully developed. In the interim, there is an opportunity for DWR and PG&E to join NMFS in a leadership role to pursue some of these potential actions as elements of the Final Habitat Expansion Plan.

These preliminary target areas are divided into distinct component “action areas” representing specific reaches of interest in the upper Yuba River that may offer opportunities for both immediate results and incremental, science-based program improvements over time. Exploiting some or all of these target areas would result in greater salmonid populations more quickly and over time, as well as optimize the cost-benefit ratio and overall programmatic effectiveness. Other reintroduction priority actions may be introduced for consideration during the further development of Phase I and Phase II activities.

At this time, the anticipated role of the HEA Licensees in Phase II of the reintroduction implementation plan is to:

1) Obtain easements from the U.S. Army Corps of Engineers, and permission of CDFG and NMFS, to utilize the existing ladders at Daguerre Point Dam for purposes of capture of upstream migrating adult spring-run Chinook and steelhead; and for collection, enumerating, marking, tracking, and monitoring of downstream migrating smolts

2) Manufacture a temporary collection facility to operate in conjunction with the existing Daguerre fish ladder(s). Manufacture and construct interim holding, counting, handling, marking, and transport facilities adjacent to the Daguerre fish ladder structure

3) Make other site improvements as necessary to conduct effective collection and transport operations

4) Obtain arrangements with DFG’s Feather River Fish Hatchery (or Coleman Fish Hatchery) to secure anadromous fish eggs, fingerlings, and adults for transport and strategic placement in the upper Yuba River in support of the Reintroduction Plan goals and objectives. All arrangements for fish stocks pursuant to Phase II experimentation will be conducted under an ESA S10(a)1(a) research permit, where applicable, or as otherwise authorized by NMFS.

5) Collect hatchery stock – fertilized eggs, fingerlings, or adults – and transport to specific locations in the upper Yuba River in accordance with Phase II of the Reintroduction Plan.

6) Collect Chinook or steelhead adults, at the Daguerre location, for purposes of obtaining adults for

spawning and fertilized eggs. In preparation for hatch box out planting in designated areas of the upper watershed, or, if and when directed by NMFS as part of the Reintroduction Plan, collect and transport adult spring-run Chinook and/or steelhead into the specified upper reaches of the Yuba River. These actions must be in accordance with the forthcoming, NMFS authorized Reintroduction Plan.

7) Construct or otherwise ensure suitable conditions exist for release of adults or juveniles in the designated areas of the upper watershed; or ensure that hatch box placements are conducted according to best scientific practices, and as approved by NMFS and CDFG. Conduct annual redd surveys and habitat assessments, including fluvial geomorphic and hydrology studies in spawning and rearing reaches.

8) Establish interim collection and marking facilities in the upper Yuba River for emigration of smolts

9) Establish state-of-the-art fish transport systems to carry salmonids to destinations and release in good condition

10) Establish monitoring site in the lower Yuba River, near confluence with the Feather River capable of assessing smolt annual and steelhead (kelt) outmigration

11) Establish a state-of-the-art monitoring, marking, tracking system to assist in the evaluation of the program, and to ensure that reliable and accurate management information is available to guide adaptive management decisions. The system will be developed in collaboration with NMFS, CDFG, and other relevant parties as part of the larger Reintroduction Plan protocol.

12) Other production or validation actions, not adequately captured here, consistent with the forthcoming Reintroduction Plan as necessary for program success, and within the boundaries of the HEA requirements of meeting and sustaining a habitat expansion to meet the HET.

Actions or operations not completed at the end of the Phase II timeline shall be adopted for implementation and continuation during Phase III, to the extent that they are: a) subject to ongoing adaptive management modifications, b) relevant in terms of the most updated version of the Reintroduction Plan, and c) continue to meet with NMFS acceptance.

Anticipated Timeline: January 2011- December 2013

Phase III: Short Term Reintroduction Plan Implementation with Adaptive Management Elements

Following Phases I & II, the program will shift its emphasis from a pilot reintroduction experiment to the actual build out and operation of state-of-the-art, permanent fish passage facilities. This transition will mark the end of experimental reintroduction efforts and the beginning of a full-scale production fish passage program. Phase III will begin servicing specific reaches of the upper Yuba River according to the adjusted time line and scheduling considerations in the updated Reintroduction Plan. The extent of operations and selection of specific reaches required for fulfillment of the HEA Program will be clarified after further analysis by the HEA Licensees and NMFS, using information that will become available from the aforementioned studies, adaptive management considerations, and with the final approval by NMFS within the context of the HEA section 4.2.3, NMFS approval criteria. The goal of meeting or exceeding the HET for spring-run Chinook and steelhead must be substantially met during this phase.

This phase will take place during years 3-6.

The Short Term Reintroduction Implementation Program will place its emphasis on the most feasible and productive reintroduction efforts as identified by the existing scientific information, the results of the earlier Pilot Reintroduction Program, and other adaptive management considerations. Determination of the “most feasible and productive reintroduction efforts” will be made as a result of either: validated enumeration from accepted monitoring results or, in absence of acceptable validation -NMFS professional judgment. The Steering Committee will make recommendations regarding the specific reaches and actions to be undertaken (subject to approval by NMFS). The Reintroduction Plan will include consideration of not only existing viable habitats, but also contingency plans that may yield additional or expanded suitable habitats should restoration actions be undertaken to expand the capacity for anadromous fish habitat in the upper Yuba River, e.g.- negotiated supplemental in-stream flow releases, reservoir facilities modifications and/or management actions that improve downstream thermal conditions, spawning substrate rehabilitation actions, fish passage improvements at existing partial barriers, constructed fish passage facilities or enhanced capabilities, technological advances, or other habitat restoration actions, etc.

At this time, the anticipated role of the HEA Licensees in this phase of the Reintroduction Plan is to:

1) Implement any actions not completed from previous Phases that remain relevant and necessary for Program success and/or contribute to verifiable attainment of the HET.

2) Implement a production fish passage program to begin meeting the goal set by the HEA's Habitat Expansion Threshold (HET) - featuring interim fish collection and transport operations for effective upstream and downstream passage of adult and juvenile spring-run Chinook and steelhead into the following areas:

(a) Upper North Yuba River (upstream of New Bullards Bar reservoir);

(b) Middle Yuba River (upstream of Our House Dam in the Kanaka and Wolf Creek reaches)

(c) North Yuba River – (downstream of Colgate Powerhouse) – candidate reach for on-going actions; contingent upon results of Phase I & II studies and experimentation, a coordination or support role with other parties is envisioned at this time

(d) North Yuba River – (downstream of New Bullards Bar Dam) – candidate reach for on-going actions; contingent on negotiated or regulated in stream flow releases from the Dam over the course of the hydropower relicensing process or within the context of a negotiated settlement.

(e) Potential Purchase of North Yuba, Middle Yuba, or South Yuba in-stream supplemental flow alternatives – within the context of the Yuba Multi-Party Forum - or other direct multi-party negotiations. This might involve negotiated payments in exchange for supplemental cold water flow releases from any of the YCWA or YBDS project reservoirs. To the extent the hydropower licensees wish to engage in such novel approaches to habitat restoration, NMFS agrees that water purchases may be explored and may be acceptable as a partial contribution toward the HET, provided NMFS deems that:

- sufficient cold water flow releases can be guaranteed from the facilities currently controlled by Yuba County Water Agency with proper frequency, magnitude, duration, and timing

- An aggressive and scientifically sound habitat restoration program is undertaken to rehabilitate the reach between New Bullards Bar Dam and the Colgate powerhouse. This includes the restoration and maintenance of suitable spawning substrates and in-stream wood and other natural

In-stream structures for habitat enhancement.

- Agreement and commitment on the part of the HEA Licensees, or another capable and responsible party or parties, to ensure safe, timely, and effective fish passage is maintained in perpetuity within this reach.

These proposed habitat enhancement areas where either substantial evidence points to the existence of suitable spring-run Chinook habitat conditions; or there is potential for reasonable and realistic negotiated and cooperative agreements to effect necessary habitat improvements – potentially yielding large, near term returns benefits at relatively reduced costs. The forthcoming Reintroduction Plan will further help inform and refine these designations and contingencies. The Plan is expected to be available before the end of 2010.

3) Participate in, or support on-going, collaborative activities involving reintroduction feasibility in the South Yuba River, depending on progress toward additional fish passage as generated by the Yuba Multi-Party Forum, or other regulatory or voluntary reintroduction programs. While the South Yuba may or may not prove to support substantial spring-run Chinook under current flow management regimes, NMFS considers the South Yuba as potentially suitable habitat for steelhead reintroduction, given the information available at this time. Future information from FERC licensing studies, more extensive habitat assessments, modeling results, or other legitimate sources may improve our understanding of the South Yuba habitat potential. The HEA Licensees may assist in the initiation of a South Fork reintroduction effort, but a long-term juvenile salmonid collection operation (downstream

migrations) from South Fork progeny would likely require additional resources beyond the scope of the HEA's requirements.

Anticipated Timeline: January 2013 - January 2016

Phase IV: Long Term Reintroduction Implementation and Management Program with Adaptive Management Elements

Using adaptive management lessons, established operations frameworks, cooperative partnerships, and management information gained from previous phases, the Comprehensive Program will evolve into a permanent operation beginning in years 6-10. The operations and management framework will require an on-going commitment of resources for operations and maintenance, oversight and technical committees, qualified and trained personnel, and an adequate budget to continue fish passage activities and key program functions into the indefinite future.

- Management functions will involve: annual planning, permitting, performance metrics, budgeting, scheduling, reporting, evaluations, outreach, education, and other similar activities.

- Operations functions will involve: safe, timely, and effective collection and transport operations to and from designated permanent sites and facilities, adaptation of new or improved technologies or techniques over time

- Maintenance functions will involve the preventive and corrective maintenance of facilities and equipment necessary to maintain full operational capabilities

- Regulatory functions will involve the adherence to any lawful regulatory mandates that may be in effect

The HEA component of the long-term, comprehensive reintroduction plan will be responsible for on-going operations, maintenance, and other activities such that a minimum population of 2,000-3,000 spring-run Chinook salmon are maintained at all times , based on the independent actions attributable to the HEA Licensees, and not other reintroduction or habitat restoration actions by others. The specifics of how multiple, concurrent, or additive fish passage and habitat restoration actions will be quantified or measured will need to be developed more fully over time; but it is likely that many actions described herein can be undertaken with discrete and separable results, provided adequate monitoring and evaluation measures are put in place by the HEA Licensees or others. Regardless of any of these perceived or real ambiguities at present, there is enough quality salmonid habitat in the upper Yuba River watershed – either immediately accessible or reasonably recoverable- to ensure that the HET will be met and the HEA obligations can be fulfilled, provided the measures described are ambitiously and professionally implemented without undue delay.

Actions or operations not completed at the end of the Phase III timeline, shall be adopted for implementation and continuation during Phase IV, to the extent that they are: a) subject to ongoing adaptive management modifications, b) still relevant in terms of the most updated version of the Reintroduction Plan, and c) continue to meet with NMFS acceptance.

Anticipated Timeline: 2016-2057 (and beyond)

Disclaimer: This preliminary HEP-Project Description is supplied for information and planning purposes at this time. The reintroduction planning process is in development; thus the specific elements are subject to change or modfications. Nothing in this document shall be construed to exempt PG&E from any additional protective or conservation measures as may be prescribed or set forth in other regulatory proceedings pertaining to the Yuba River. It is subject to further review and comment by the HEA Licensees and modifications by NMFS as appropriate; so that the information herein can be translated into a final Habitat Expansion Plan that is supported by both Licensees and ultimately accepted by NMFS. The intention is that the final HEP - involving anadromous fish passage to and from the upper watershed - will become a first, major action not only to satisfy the requirements of the Feather River habitat Expansion Plan, but also to serve as a catalyst for implementation of additional actions within the framework of the Comprehensive Anadromous Salmonind Reintroduction Plan for the Upper Yuba River.

III. Species Limiting Factors

In this section, describe the limiting factors for spring-run Chinook salmon and steelhead <u>in your watershed</u>. The last page of this questionnaire defines the limiting factors.

Limiting Factors	Description (from back page)	Rank
☒ **Channel Form**	Channel incision and simplification are likely due to inhibition of the highest magnitude channel-forming flows in all but the wettest of seasons, when spills occur from New Bullards Dam over appreciable duration. Moderate and smaller floods are less likely to be inhibited due to the much smaller capacity of the Middle and South Yuba dams.	Select Rank
☒ **Channel Unit Types**	Supply of large woody material from the upper watershed is likely inhibited by several upper Yuba dams, and then its transport to the lower Yuba is interrupted by Englebright Dam. Reductions of large woody material throughtout the upper and lower watershed affects fish cover availability. Loss in side-channel habitats of the lower Yuba River contributes to loss of channel complexity.	Select Rank
☒ **Substrate**	Recruitment of coarse substrates is interrupted to the lower North Yuba by New Bullards Dam, and to the lower Middle Yuba by Our House and Log Cabin dams. Probably to a lesser extent in the upper Middle Yuba by Jackson Meadows and Milton dams, and in the South Yuba by Spaulding Dam. Abundant coarse sediments were placed in the lower Yuba River during hydraulic gold mining prior to construction and retention behind Englebright Dam. Lack of supply recruitment to the uppermost 1-mile reach downstream of Englebright Dam is likely.	Select Rank
☒ **Structure**	Channel simplification in the lower Yuba, due to incision.	Select Rank
☒ **Flow**	Inhibition of the highest magnitude channel-forming flow contributions from the North Yuba occurs in all but the wettest of seasons, when spills occur from New Bullards Dam over appreciable duration. Floods of moderate and smaller magnitude are less likely to be inhibited due to the much smaller capacity of the Middle and South Yuba dams. However, the South Feather, Yuba-Bear, and Drum-Spaulding hydroelectric projects Spring attraction flows, and flows to maintain holding and spawning water are natural limiting factors for spring-run Chinook populations. The Yuba-Bear and Drum-Spaulding projects divert more than 400 TAF annually from the Middle and South Yuba watersheds thus constraining the spatial and temporal habitat in these streams.	High
☒ **Temperature**	Water temperature in lower reaches of all three forks of the Yuba, as well as the upper Main Yuba above Colgate, currently exceeds thresholds of suitability for summer rearing, summer holding and early fall spawning habitat. Long reaches of the upper North Yuba remain suitable, as do upper reaches of the Middle Yuba. The Middle and South Yuba, as well as the upper Main could be made more suitable through flow augmentation.	High
☐ **Water Quality**		Select Rank
☒ **Passage**	Englebright Dam and the Narrows I &II hydropwoer facilities	Critical

III. Species Limiting Factors

constitute a complete barrier to the entire upper watershed. New Bullards Bar Dam is a barrier to the North Yuba at RM 1. Our House Dam is a barrier to the Middle Yuba at RM 20

☐ **Riparian/Floodplain** Select Rank

Source Documents:

Upper Yuba River Watershed Chinook Salmon and Steelhead Habitat Assessment (UYRSP 2005). SYRCL temperature monitoring data and unpublished watershed assessment products were used as the basis for some statements.

Additional Notes:

The Upper Yuba Studies Program Habitat Assessment identified that the only natural barriers to migration at flows greater than 400 cfs in were at RM 34 in the Middle Yuba and RM35 in the South Yuba

IV. Project Objectives—Environmental

In this section, describe how your project will affect one or more of the limiting factors for spring-run Chinook salmon or steelhead described above.

Limiting Factor	Description and Objective	Focus
☐ **Channel Form**		Select Focus
☐ **Channel Unit Types**		Select Focus
☐ **Substrate**		Select Focus
☐ **Structure**		Select Focus
☒ **Flow**	Augmentation of flows (as needed in the upper Main, Middle and South Yuba) for migration, holding, spawning and rearing habitat.	Secondary
☐ **Temperature**		Select Focus
☐ **Water Quality**		Select Focus
☒ **Passage**	To provide passage (up and down) between the lower Yuba River and any combination of the North, Upper Main, Middle and South Yuba river segments where suitable habitat exists to support viable populations.	Primary
☐ **Riparian/Floodplain**		Select Focus

V. Project Objectives—Biological

In this section, describe the objective(s) of your project relative to the goal of providing habitat for spring-run Chinook salmon and steelhead. Indicate the species and life stage that are targeted by the project. (It is okay to have more than one species/life stage target).

Target Species: ☒ Spring-Run Chinook Salmon

Population Status Specific to Watershed: Extirpated

Target Life Stages:

☒ Spawning ☒ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☒ Juvenile Emigration ☒ Adult Immigration ☒ Adult Holding

Description of Project Objectives:

Establish a viable and self-sustaining population (totaling at least 2000-3000 adults on average) utilizing at least two segments of the upper Yuba Watershed. Note: remnant population of spring-run Chinook exists in Lower Yuba River below Englebright.

Target Species: ☒ Steelhead

Population Status Specific to Watershed: Extirpated

Target Life Stages:

☒ Spawning ☒ Egg Incubation ☒ Summer Rearing ☒ Winter Rearing

☒ Juvenile Emigration ☒ Adult Immigration

Description of Project Objectives:

Establish a viable and self-sustaining population (totaling at least 2000-3000 adults on average) utilizing at least two segments of the upper Yuba Watershed.

VI. Project Cost

Capital Cost:	Unknown pending preferred alternative of a Reintroduction Plan
Annual Operation and Maintenance Cost:	Unknown pending preferred alternative of a Reintroduction Plan
Annual Operation and Maintenance Description:	Unknown pending preferred alternative of a Reintroduction Plan
Project Lifespan:	HEA could be used for the first period of a project to proceed at least a long as new FERC licenses.
Project Partners (Funding):	PG&E< Nevada Irrigation District, Yuba County Water Agency, and others may partners as per outcome of current relicensing actions or future settlement agreements.
Project Partners (Maintenance):	Army Corps of Engineers and YCWA own structures involved. PG&E and Nevada Irrigation District (as well as possibly YCWA) will need to be responsible for delivery of augmented flows.

VII. Schedule

Proposed Start:	2011
Expected Time to Completion:	2013-2016
Expected Time to Realize Environmental Benefits:	2013-2016
Expected Time to Realize Biological Benefits:	2016-2020

VIII. Feasibility

Technical Feasibility:	Appears feasible according to conceptual engineering studies and perliminary habitat assessments. To be further identified in additonal fish passage studies, habitat assessments and modleing, and Reintroduction Plans.
Technical Challenges:	Many specifics are known, others to be answered by additional studies, pending a preferred alternative in the Final Habitat Expansion Plan, consistent with the development of a Comprehensive Reintroduction Plan
Related Projects:	Yuba Spawning Habitat Rehabilitation project would provide means to increase natal spring-run salmon population prior to major reintroduction program.
Ownership or Permitting Challenges:	Army Corp of Engineers is not currently proactive. YCWA relicensing to officially begin this summer.
Conflicts with Cultural, Zoning, or Other Issues:	None determined. Calling Back the Salmon Committee represents coalition of tribal and non-tribal groups with mission of restoring salmon populations to the Upper Yuba

IX. Project Support

Supporting Entities:	In addition to NMFS, other likely supporting entities are: USFS, USFWS, CDFG, SYRCL, Foothills Water Network, Tribes
Cooperating Entities:	To be determined
Degree of Local Support:	Calling Back the Salmon Committee and SYRCL have held several events over the last 4 years putting this project goal into the public forum. These events, including the Calling Back the Salmon Ceremony and the Spring-run Salmon Symposium indicate a broad degree of local support.
Known Opposition:	To be determined

X. Supporting Documents

Please provide a full reference for each citation used to support the information presented in this questionnaire.

Lindley, S.T., R.S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for Assessing Viability of Threatened and Endangered Chinook Salmon and Steelhead in the Sacramento-San Joaquin Basin. San Fran. Estu. & Water. Sci.:5(1)(4). California Bay-Delta Authority Science Program and the John Muir Institute of the Environment.

National Marine Fisheries Service. 2009. Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead. Sacramento Protected Resources Division. October 2009.

CALFED Bay-Delta Ecosystem Restoration Plan July 2000

Upper Yuba River Watershed Chinook Salmon and Steelhead Habitat Assessment. 2006 See http://www.watershedrestoration.water.ca.gov/fishpassage/projects/upperyuba.cfm

NOAA-TM-NMFS-SWFSC-369 2005 Historical and Current Distribution of Pacific Salmon in the Central Valley

Note that distributions in the above NOAA tech memo have been revised after more in-depth work of UYRSP and additional GIS analysis by Technical Recovery Team (Wantuck personal communication).

Definitions of Limiting Factors for Spring-Run Chinook Salmon and Steelhead

Channel Form

This attribute describes changes to the channel, including incision, aggradation, diking, armoring, and other modifications of the channel adversely affecting spring-run Chinook salmon and steelhead.

Channel Unit Types

Examples of geomorphic features of the channel that form habitat types for spring-run Chinook salmon and steelhead are pools, riffles, glides, and runs. This attribute describes changes in the frequency and size of such features. For example, removal of large wood may reduce the frequency of pools, presence of steps, or retention of gravel for riffles.

Substrate

This attribute describes changes in the composition of the substrate of the stream, including increase in fine sediment and lack of gravel recruitment.

Structure

This attribute describes the loss of structural elements in the stream such as large wood, boulders, undercut banks, and so on. Loss of structure results in a simplification of the channel and influences Channel Form and Channel Unit Types.

Flow

This attribute addresses modification of the flow regime, including decrease in summer low flow, increased "flashiness," and dewatering of the channel as a result of withdrawals.

Temperature

Change in water temperature can be attributable to human actions such as removal of riparian shading. This attribute describes the increase in summer water temperature and the loss of temperature refugia (springs or groundwater) as a result of human actions.

Water Quality

This attribute pertains to the input to the stream of toxins or pollutants that produce adverse impacts on spring-run Chinook salmon or steelhead. This can include chemical pollutants such as fertilizer and pesticides and nutrient sources such as cattle and feedlots.

Passage

This relates to the effect of impediments to adult or juvenile migration of spring-run Chinook salmon or steelhead, including dams, culverts, channel dewatering, and other structural and channel modifications. Please describe the location of the passage impediment and describe the extent of impediment (i.e., a complete or partial blockage to migration).

Riparian/Floodplain

This attribute describes the loss of functionality of the riparian forest/vegetation and the connection of the stream to the floodplain during high water and flooding.

Population Condition Definitions for Section V. Project Objectives—Biological

Increasing

Adult returns of the target species to the watershed have generally been increasing over the last several years; expectations are that the species is displaying characteristics of a rebuilding or healthy population.

Stable

Adult returns of the target species to the watershed show no clear trend over the last several years.

Decreasing

Adult returns of the target species to the watershed are declining over the last several years; the decline in abundance is a cause of concern and characteristic of a potentially unhealthy population.

Intermittent

Adult returns of the target species are occasionally seen in the watershed, but there is no viable or sustained population in the basin.

Extirpated

The population has been eliminated from the watershed although the species was present in the past.

Never Present

The species has never been known to occur in the watershed.

Appendix J

Concept for an Adaptive Management Plan Related to the Optional Segregation Weir

Appendix J

Concept for an Adaptive Management Plan Related to the Optional Segregation Weir

The following concept for an Adaptive Management Plan (AMP) is designed to assist the resource agencies (National Marine Fisheries Service [NMFS], U.S. Fish and Wildlife Service [USFWS], and California Department of Fish and Game [DFG]) in determining the need for installation and management of a seasonal segregation weir to support development of an independent, self-sustaining population of spring-run Chinook salmon in the Lower Yuba River.

The Lower Yuba River Actions recommended in the Final HEP consist of three individual actions. Collectively, these actions expand habitat and support development of a new population of spring-run Chinook salmon. As discussed in Section 4.3.11 of the Final Habitat Expansion Plan (HEP), these actions also contribute to a larger integrated plan for management of spring-run Chinook salmon in the Lower Yuba River.

The Lower Yuba River Actions recommended in the Final HEP are as follows:

- Sinoro Bar spawning habitat expansion – expand spawning habitat in the Sinoro Bar geomorphic unit of the Englebright Dam Reach of the Lower Yuba River (described in Section 3.3.1 of the Final HEP);
- Narrows Gateway spawning habitat expansion – expand spawning habitat in the Narrows Gateway geomorphic unit of the Narrows Reach of the Lower Yuba River (described in Section 3.3.2 of the Final HEP); and
- segregation weir (optional) – plan for, and if deemed necessary by the resource agencies (NMFS, USFWS, and DFG), install a seasonally operated segregation weir at a location downstream of the Narrows Pool (described in Section 3.4 of the Final HEP).

The recommended habitat expansion actions at Sinoro Bar and Narrows Gateway (referred to as the *HEP action sites*) would provide habitat that supports development of a self-sustaining population. However, the Lower Yuba River also supports fall-run Chinook salmon that may use the expanded habitat. In other watersheds without barriers to migration, spring-run and fall-run Chinook salmon often are separated geographically, with spring-run fish ascending to upper watershed areas and fall-run fish spawning in the lower stream reaches. Upper stream reaches that are used by spring-run fish often are steeper, with cooler water temperatures relative to lower stream reaches used by fall-run fish. In some cases, seasonal hydraulic barriers that block fall-run fish from entering during low-flow periods reinforce genetic separation of the two runs. In the Yuba River, however, Englebright Dam and other upstream dams block access to areas that historically supported spring-run Chinook salmon (Yoshiyama et al. 1998). At the same time, deep reservoir projects like New Bullards Bar provide water to the Lower Yuba River that is colder than occurred historically, providing conditions that are amenable to spring-run Chinook production.

The lack of geographic or physical separation between fall-run and spring-run Chinook salmon in the Lower Yuba River introduces the risk that the incursion of fall-run Chinook into the HEA action area could inhibit development of a new population of spring-run Chinook. To enhance the separation of fall-run and spring-run Chinook salmon and preserve genetic integrity, the Licensees recommend the use of a seasonally operated weir to be located below the Narrows Pool. The weir would ensure that sufficient separation of the two runs occurs, so that a viable population of spring-run Chinook salmon can develop using the expanded habitat. Segregation, in this case, refers to the presence of habitat to meet the numeric abundance criteria for an independent population (Lindley et al. 2007) and conditions that enhance genetic separation between the two runs to create a viable spring-run Chinook population. It is quite possible that the needed segregation of the two runs will occur naturally due to differences in habitat preferences between the two runs, or that the two runs will be able to maintain genetic separation due to behavioral differences between the runs. For example, Banks et al. (2000) found that spring-run and fall-run Chinook in the Central Valley have maintained genetic integrity despite considerable physical overlap in habitat and spawning. However, in the event that natural segregation is not sufficient, a weir could be implemented as a fisheries management tool at the discretion of the resource agencies. The resource agencies could elect to use the weir on an annual basis, or decide whether the weir is needed at all. To make these decisions, the Licensees suggest that the resource agencies develop and implement a structured decision making process. This appendix provides an example of an Adaptive Management Plan (AMP) for the proposed seasonally operated weir on the Lower Yuba River.

The following concept for an AMP illustrates the notion of an adaptive plan for operation of a seasonal segregation weir and serves as an example for discussion purposes. The Licensees stand ready to assist the resource agencies in developing a final AMP for operation of the weir as part of a larger integrated plan for management of spring-run Chinook salmon in the Lower Yuba River. An important aspect of this integrated plan is DFG’s expressed support for management of the Lower Yuba River between Englebright Dam and the outlet of the Narrows Pool for spring-run Chinook salmon (Hill pers. comm.).

The concept of adaptive management calls for management actions to be implemented based on an experimental design that tests key assumptions (Walters and Hilborn 1976). An adaptive experimental design requires explicit statement of testable hypotheses, criteria for testing these hypotheses, and management responses to outcomes of the tests. The following sections provide an outline for an experimental AMP design.

J.1 Management Hypotheses

J.1.1 Hypothesis 1

Channel form and substrate in the Sinoro Bar and Narrows Gateway areas can be modified to produce stream channel characteristics that are consistent with the habitat needs of Central Valley spring-run Chinook salmon.

The HEA calls for creation of habitat capable of supporting 2,000–3,000 spring-run Chinook salmon. Pasternack (2010a, 2010c) describes features that could be constructed at Sinoro Bar and Narrows Gateway that are consistent with the spawning habitat needs of spring-run Chinook salmon and could be maintained by the existing geomorphic processes, gravel augmentation by the U.S. Army Corps of Engineers (Corps), and additional maintenance by the Licensees provided under the HEA. Construction of these features requires completion of a number of logistical and regulatory steps.

Hypothesis test: Test of this hypothesis is that the logistical and regulatory steps are completed and that the spawning habitat expansion features are constructed. Project steps include:

1. Secure access to the required sites for construction and maintenance.
2. Acquire all in-water work permits.
3. Complete the California Environmental Quality Act process and public stakeholder review.
4. Construct and maintain required features.

J.1.2 Hypothesis 2

Spring-run and fall-run Chinook salmon have habitat preferences and spawning fidelity that results in sufficient genetic separation of the two races to create a viable population of spring-run Chinook salmon in the HEA action area.

The potential of the expanded spawning habitat in the Sinoro Bar and Narrows Gateway areas to support a population of spring-run Chinook salmon depends on the preferential selection of the habitat above the Narrows Pool by spring-run fish and, conversely, the avoidance of the area by fall-run fish.

The second hypothesis is that the created habitat in the Sinoro Bar and Narrows Gateway areas will be preferentially used by spring-run fish such that the expanded habitat will support development of a viable spring-run Chinook salmon population. Facts supporting this hypothesis are: (1) the location of the action in the upper reaches of the Lower Yuba River below Englebright Dam; (2) the steeper gradient of the area relative to lower river areas; (3) the temperature of water released from upstream reservoirs that is consistent with the needs of spring-run fish; and (4) observations that early spawning Chinook in the Lower Yuba River presently migrate to this area and attempt to spawn (Pasternack 2010b).

This hypothesis could be tested through field observations of spawn-timing on the new habitat relative to explicit criteria. Should Hypothesis 2 be rejected (i.e., if movement of fall-run Chinook salmon into the expanded habitat likely precludes development of a viable spring-run Chinook salmon population), then the AMP would move to Hypothesis 3 that calls for construction and operation of a seasonal weir to mechanically ensure adequate genetic segregation of the two runs.

Hypothesis test: Following completion of the habitat expansion actions in the Sinoro Bar and Narrows Gateway areas, Hypothesis 2 would be tested through field observations over a set time period. Criteria defining success should be developed by the resource agencies. For example, the actions could be considered successful if: (1) Chinook salmon expressing a spring-run phenotype preferentially select habitat above the Narrows Pool; and (2) sufficient numbers of spring-run Chinook spawn above the Narrows Pool such that a viable population of spring-run Chinook salmon is created. This leads to two test criteria: (1) the acceptable degree of habitat selection by spring-run Chinook; and (2) the number of spring-run Chinook salmon required to create a viable population of spring-run Chinook salmon. A test of this hypothesis also requires a definition of what constitutes a spring-run Chinook salmon—a surprisingly non-straightforward question. The following are examples of test criteria for this hypothesis:

Run segregation criterion. At least 65 percent of spring-run Chinook salmon spawning in the Lower Yuba River needs to occur above the Narrows Pool in more than half the years during the test period.

Population abundance criterion. Based on the conclusions of Lindley et al. (2007) a viable salmon population needs at least 500 successful spawners (effective population size) or at least 250 spring-run Chinook redds. Using the figure of Lindley et al. (2007) that effective population size is 20 percent of total fish abundance, this translates into a total abundance of spring-run Chinook salmon in the Lower Yuba River of at least 2,500 adult fish. The HEA recommended actions should provide more than enough habitat to meet this abundance criterion.

Definition of spring-run Chinook salmon. Spring-run Chinook salmon are those that return to the Yuba River between March 1 and June 15 and spawn between August 1 and October 15.

The question of what constitutes a spring-run Chinook salmon in the Central Valley is not simple due to overlap in timing between spring-run and fall-run, and mixing of hybridized fish, particularly those of hatchery origin. The two runs can be distinguished genetically (Banks et al. 2000, Garza et al. 2009); however, genetic tests remain difficult to implement in real-time during migration. The spring-run Chinook salmon definition provided here is intended to be a practical, operational definition that could be used for test purposes as part of the AMP. The dates proposed are similar to those used in the Feather River Hatchery Draft Genetic Management Plan to provide separation of fall-run and spring-run Chinook salmon.

Test period for Hypothesis 2. Testing of this hypothesis using the above criteria would occur for up to a 10-year period[1] following completion of the habitat features in the Sinoro Bar and Narrows Gateway areas.

The test period needs to be long enough to account for natural variation in abundance of the two runs from year to year, and to allow the population to build and take advantage of the expanded habitat.

J.1.3 Hypothesis 3

A seasonally operated weir can be constructed and operated below the Narrows Pool to provide sufficient genetic segregation of fall-run and spring-run Chinook salmon to allow development of a viable spring-run Chinook salmon population.

Hypothesis 3 is tested if Hypothesis 2 is rejected (i.e., if insufficient genetic segregation is naturally occurring between the two runs). The location of the weir is envisioned to be above Timbuctoo Bend, but below the Narrows Pool. This location would support use of the Narrows Pool for adult holding of spring-run Chinook and create minimal impact on fall-run Chinook salmon production in the Timbuctoo Bend reach. Timing of the weir installation and removal would depend on seasonal fish and river monitoring data.

Currently, there is a partial passage impediment for upstream migrating fish at Daguerre Point Dam that may be contributing to the observed distribution of spring-run Chinook salmon that currently hold in the pool immediately downstream of the dam. According to the 2007 biological opinion for operations at Englebright and Daguerre Point Dams, the Corps will be enhancing passage for both adult and juvenile fish at Daguerre Point Dam[2]. Once the migration impediment has been removed, adult spring-run Chinook salmon would be

1 Actual period to be determined in consultation with the resource agencies.

2 National Marine Fisheries Service. 2007. Biological Opinion for the Operation of Englebright and Daguerre Point Dams on the Yuba River, California. File Number 151422-SWR-2006-SA00071: MET (PCTS #2007/01232). Sacramento, CA.

expected to move upstream earlier in their migration and make greater use of the Narrows Pool for summer holding.

Hypothesis test: If Hypothesis 2 is rejected, then evaluation of Hypothesis 3 involves testing the following assumptions:

1. Resource agencies agree on the need for a segregation weir.
2. A suitable engineering design can be developed to accommodate site-specific factors and seasonal operational needs.
3. All necessary permits can be secured.
4. Spring-run Chinook salmon move upstream early enough for a segregation weir to be effective.
5. Success criteria for Hypothesis 2 would apply to Hypothesis 3 as well.

J.2 References

Banks, M. A., V. K. Rashbrook, M. J. Calavetta, C. A. Dean, and H. D. Hedgecock. 2000. Analysis of microsatellite DNA resolves genetic structure and diversity of chinook salmon (*Oncorhynchus tshawytscha*) in California's Central Valley. Canadian Journal of Fisheries and Aquatic Sciences 57:915-927.

Garza, J. C., S. M. Blankenship, C. Lemaire, and G. Charrier. 2009. Draft Final Report for CalFed Project "Comprehensive Evaluation of Population Structure and Diversity for Central Valley Chinook Salmon." National Marine Fisheries Service, Santa Cruz, CA.

Lindley, S. T. and coauthors. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. Page 4 *in* San Francisco Estuary and Watershed Science [online serial]. San Francisco Estuary and Watershed Science [online].

Pasternack, G. B. 2010a. Estimate of the Number of Spring-Run Chinook Salmon That Could Be Supported by Spawning Habitat Rehabilitation at Sinoro Bar on the Lower Yuba River. Prepared for California Department of Water Resources and Pacific Gas and Electric Company. Davis, CA. July 2.

Pasternack, G. B. 2010b. Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River, CA. Prepared for U.S. Army Corps of Engineers. Davis, CA. September 30.

Pasternack, G. B. 2010c. Estimate of The Number of Spring-Run Chinook Salmon Supportable by River Rehabilitation in the Narrows Reach of the Lower Yuba River. Prepared for California Department of Water Resources and Pacific Gas and Electric Company. Davis, CA. November 9.

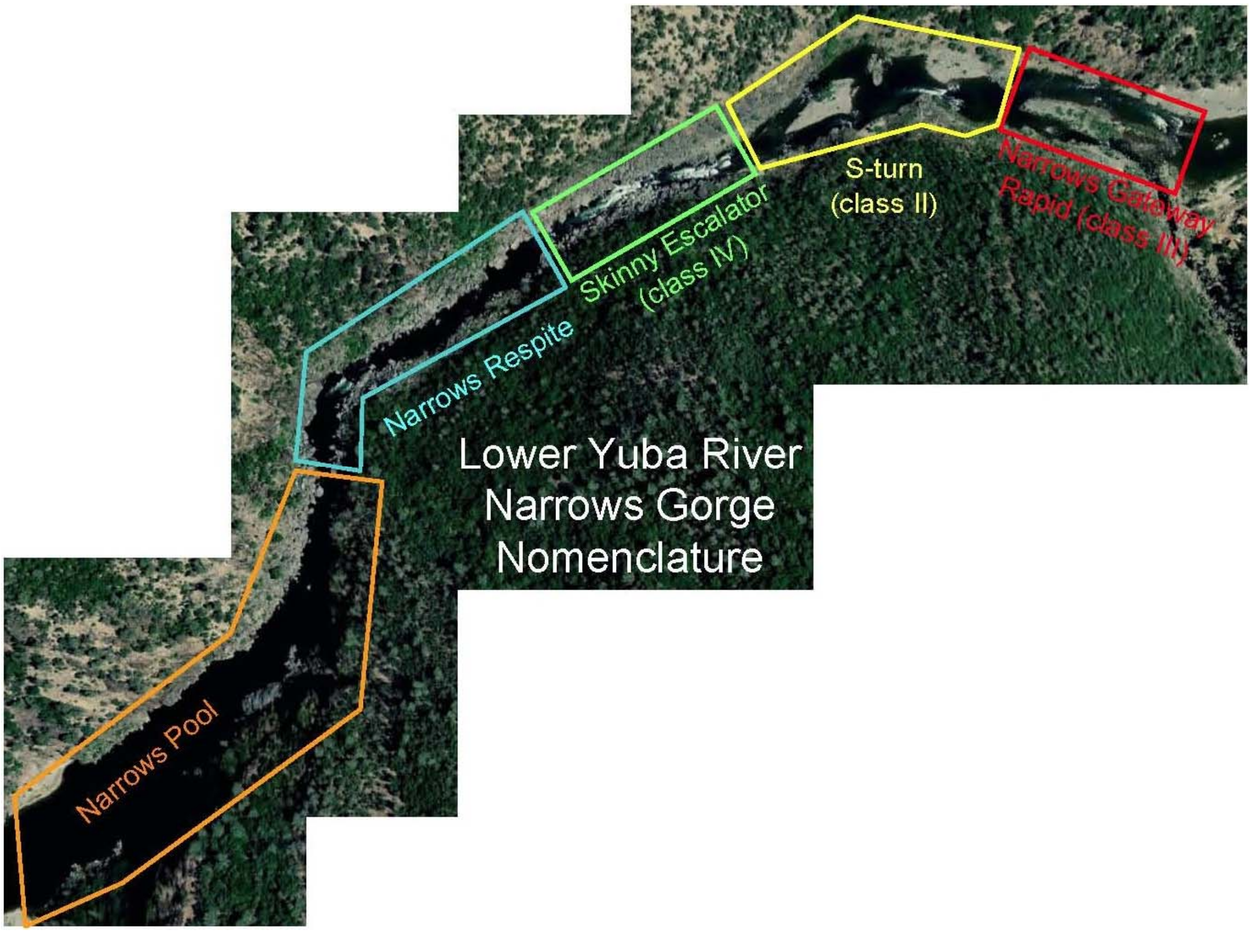
Walters, C. J. and R. Hilborn. 1976. Adaptive control of fishing systems. Journal of the Fisheries Research Board of Canada 33:145-159.

Yoshiyama, R. M., F. W. Fisher, and P. B. Moyle. 1998. Historical abundance and decline of chinook salmon in the Central Valley region of California. North American Journal of Fisheries Management 18:487-521.

Appendix K

Estimate of the Number of Spring-Run Chinook Salmon Supportable by River Rehabilitation in the Narrows Reach of the Lower Yuba River

Estimate of the Number of Spring-Run Chinook Salmon Supportable by River Rehabilitation in the Narrows Reach of the Lower Yuba River



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November 9, 2010

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1. INTRODUCTION

The Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead (HEA) seeks to expand spawning, rearing, and adult holding habitat for these salmonids in the Sacramento River basin. A key goal is to accommodate an estimated net increase of 2,000 to 3,000 adult spawning spring-run Chinook salmon as compared to the habitat available under any relevant requirement or commitment. This goal is referred to as the Habitat Expansion Threshold (HET).

A draft Habitat Expansion Plan (HEP) has been developed in which two different sets of actions are proposed to achieve the HET. One set of actions involves rehabilitating selected areas of the lower Yuba River (LYR) between Englebright Dam and the confluence with the Feather River. Different parts of the LYR serve different salmonid species and their freshwater lifestages. Of all the Pacific salmonids, spring-run Chinook salmon (SRCS) are the most likely to migrate to the upstream limit of the accessible river at Englebright Dam and attempt to spawn there. The narrow river valley below the dam may be divided into two reaches: 1) the Englebright Dam Reach (EDR) that starts at the dam and ends at the confluence with Deer Creek and 2) the Narrows Reach (NR) that starts at the end of the EDR and ends at the onset of permanent alluvial fill in the river valley at the end of the bedrock canyon constriction (Fig. 1.1). Both of these reaches have received relatively little monitoring or scientific investigation relative to the rest of the river, and the NR has received even less than the EDR.

The purpose of this report is to investigate the status of the NR and envision options for river rehabilitation there in support of a rejuvenated SRCS population. Specific objectives with respect to the NR include 1) characterization of the current hydrogeomorphic condition, 2) historical aerial photo analysis to ascertain causes of the current condition, 3) scoping of river rehabilitation opportunities and constraints, and 4) estimation of the number of SRCS that could be supported by the rehabilitation possibilities.

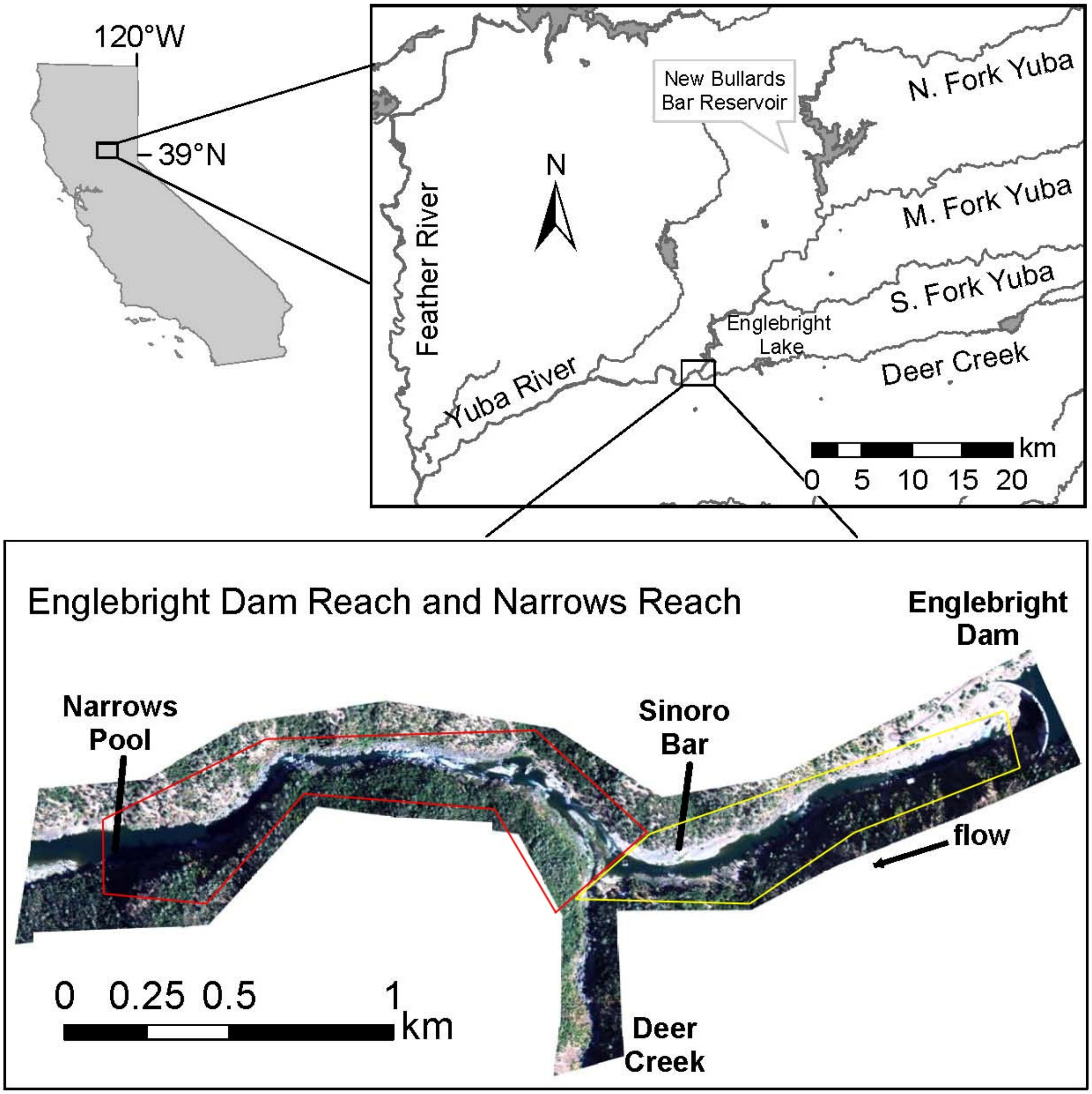


Figure 1.1. Location map and aerial imagery of the Englebright Dam Reach (yellow polygon) and Narrows Reach (red polygon) in the Yuba River watershed.

2. REACHES OF THE UPPER LYR

In geomorphology it is understood that the landscape exhibits different spatial patterns and processes when viewed at different spatial scales (Grant et al., 1990; Rosgen, 1996; Pasternack, 2008a). As a result, geomorphologists use a hierarchical framework for evaluating landscapes in which different methods and concepts are applied for each scale of analysis. The commonly used scales of analysis include hydraulic-unit (10^{-1} to 10^{0} W), geomorphic-unit (10^{1} W), reach (10^{2}-10^{3} W), and larger catchment spatial scales, where W is channel width. Spatial scales are referenced to channel width, because many observers have recognized a similarity of forms among systems of different absolute size that are governed by the same underlying processes. Note that there exists a gap for channel lengths of 10^{1} to 10^{2} W, which some geomorphologists consider to be an assemblage of geomorphic units and others simply call a reach, because they are not investigating the larger spatial scales beyond that.

In light of these concepts, the LYR may be partitioned into different units at each spatial scale. For this study it is not necessary to evaluate the entire LYR, but for context it does help to consider the top ~12 km from a reach-scale perspective. Downstream of the confluence of the South Yuba River with the mainstem Yuba River (above Englebright Reservoir), the mainstem flows through a narrow valley that includes Englebright Dam. The narrow valley ends at an abrupt, sudden expansion that denotes the onset of a perennial alluvial valley and riverbed in a reach known as Timbuctoo Bend (Fig. 2.1). In turn, Timbuctoo Bend ends just after the highway 20 bridge, because there is another abrupt, significant expansion in channel width at that location. Therefore, on the basis of abrupt changes in valley width, it is possible to distinguish three reaches at the 10^{2} W spatial scale in the topmost part of the LYR- a narrow valley, Timbuctoo Bend, and then a wide valley.

Moving down to the spatial scale of reaches at the 10^{1} to 10^{2} W spatial scale, there are geologically controlled variations in valley width and channel slope within the narrow valley between the confluence with the South Yuba River and the onset of Timbuctoo Bend. There are also tributaries that produce sediment and locally influence valley morphology, as well as Englebright Dam that artificially divides the valley into a reservoir upstream and a narrow river valley downstream. Taken together, these four factors- valley width, bed slope, tributary confluence, and man-made structures- may be used to delineate geomorphically distinct areas of the river at this reach scale.

Applying the controlling factors to the narrow valley downstream of Englebright Dam, there are four significant geomorphic controls revealed. The longitudinal profile of the river bed in the EDR shows a constant slope through the reach, but there is an unusually high rapid crest (Fig. 2.2). This feature creates a hydraulic backwater effect during flows <50,000 cfs and thus it serves as a major sediment transport barrier. There are no slope data available for the channel between the confluence of Deer Creek and the top of Timbuctoo Bend. The longitudinal profile of the wetted channel width during an extremely high flood event of 96,100 cfs (December 31, 2005) is representative of the role of valley width at the smaller reach scale (Fig. 2.3). It shows an abrupt increase in width at the onset of Sinoro Bar that is a significant geomorphic control. Next, the impingement of Deer Creek into the Yuba River is a significant geomorphic control. Although the reservoir on Deer Creek blocks sediment delivery to the Yuba now, there remains a strong asynchronous timing of floods out of Deer Creek and the Yuba River due to their different hydrological regimes. Deer Creek usually floods first, with its quicker rain-fed response. This means that Deer Creek flood flows impinging on the Yuba at an almost 90° angle cause a significant hydrodynamic barrier to bedload transport down the Yuba on the rising limb of a Yuba flood (note that bedload transport tends to be higher on the rising limb than the falling limb, because the water surface slope can be greater, driven by unsteady flows). Finally, there is a dramatic abrupt width decrease ~1,600’ downstream of the confluence with Deer Creek.

Although all four of these notable geomorphic controls are important at the geomorphic-unit scale, a decision to break up the upper LYR into reaches was made on the basis of the largest impact that transcends the reach scale, which was judged to be the role of Deer Creek. Width expansions and contractions affect the location of sediment storage in a river (White et al., 2010), but a tributary junction influences the source inputs of water, sediment, and biological materials as well as temperature and sediment storage. Consequently, the LYR is conceptually divided at the reach scale at the confluence with Deer Creek into the Englebright Dam Reach and the Narrows Reach (Figs. 1.1 and 2.1). The roles of the other geomorphic controls are thus considered within the context of the geomorphic-unit scale. It is conceivable to divide the river into finer reaches at all geomorphic controls, but then the scale of consideration becomes so small that it is no longer a reach scale assessment. This is the reasoning behind the currently used differentiation between the EDR and NR, which is important to understand in the context of the goals of this study.

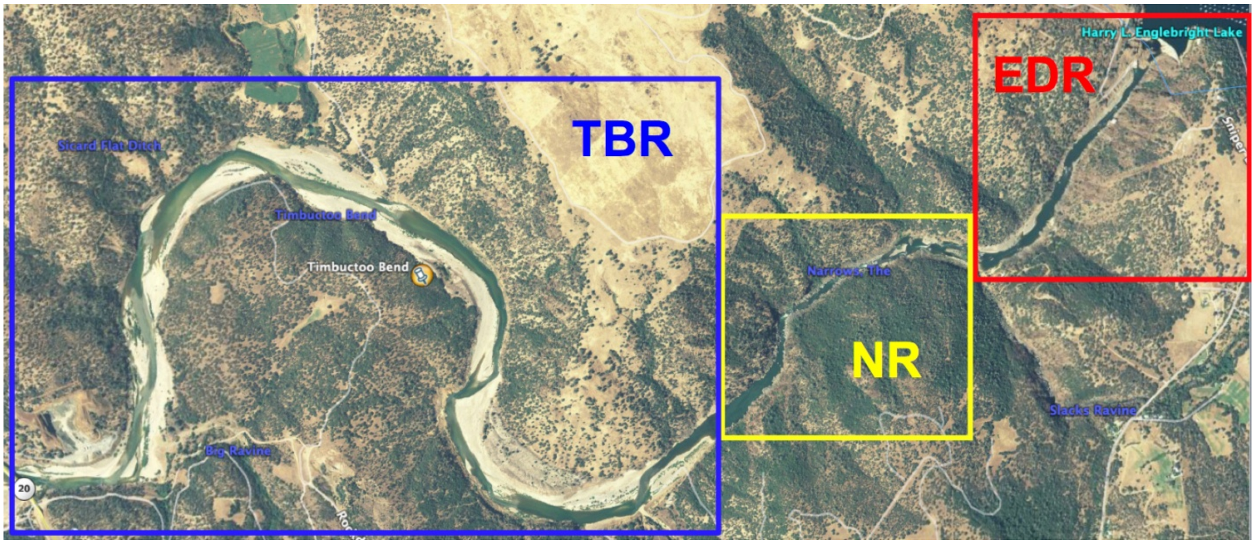


Figure 2.1. 2006 aerial image of the upper LYR delineating the Englebright, Narrows, and Timbuctoo Bend Reaches.

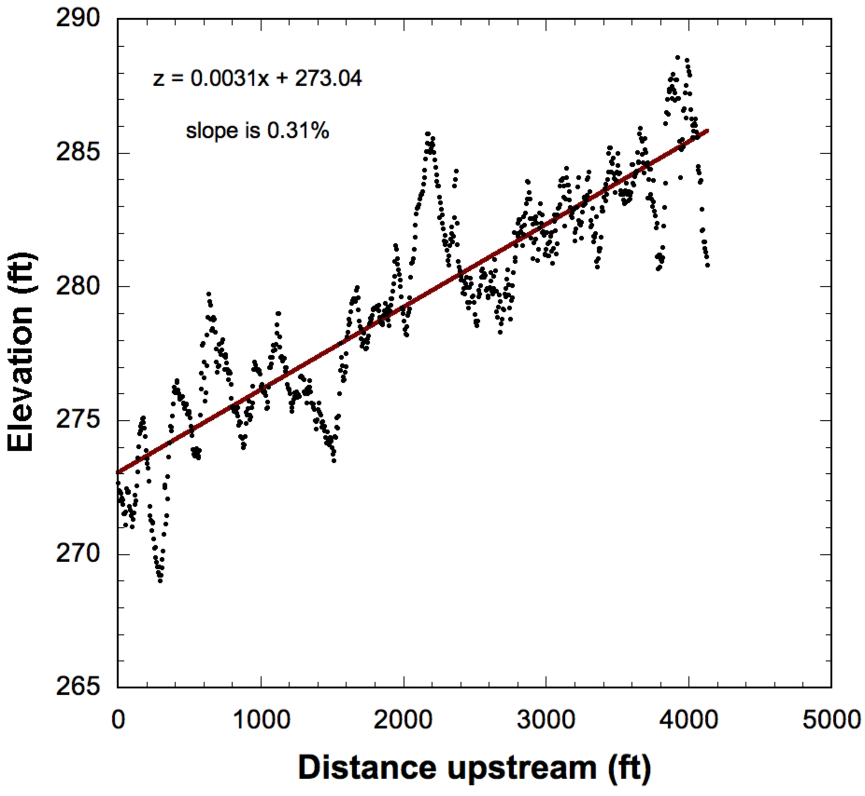


Figure 2.2. Longitudinal bed-elevation profile along 855 cfs thalweg in the EDR. The thalweg was determined using depth and velocity predictions from the SRH-2D model of the EDR. No slope break is evident in this profile.

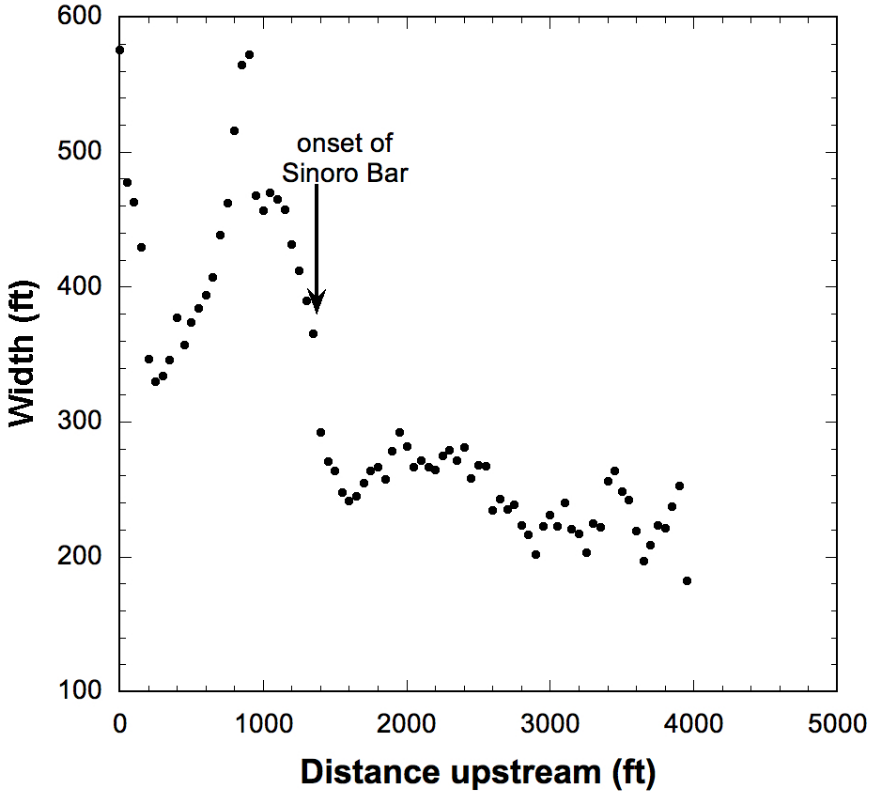


Figure 2.3. Longitudinal wetted channel width profile along the EDR centerline at 96,100 cfs. The wetted channel area for this discharge was determined using depth predictions from the SRH-2D model of the EDR. Note that the distance upstream along the centerline does not match the distance upstream along the 855 cfs thalweg in Fig. 2.2.

3. EDR ASSESSMENT RECAP

For ~10 years, stakeholders participating in the LYR Technical Working Group have discussed opportunities and constraints for river rehabilitation and enhancement in the EDR. Through interpretation of historical areal photos funded by a federal grant from the U.S. Fish and Wildlife Service, Pasternack et al. (2010) determined that the majority of degradation in the EDR in the vicinity of Sinoro Bar was caused by mechanized gold mining. Secondarily, the presence of Englebright Dam was responsible for a lack of natural, river-rounded gravel/cobble influx, as well as delivery of shot rock to that area in the 1997 flood. Equally as important, deposition of hydraulic gold mining debris in the EDR also caused large cobbles and boulders to become fixtures in the EDR at Sinoro Bar. These historical findings provided the basis for LYR stakeholders to subsequently recognize the opportunity for a direct intervention in the Sinoro Bar area to rehabilitate the river to undo the harm caused by mechanized mining and then to enhance the river to optimize physical habitat conditions for the freshwater life cycle of SRCS and to enable geomorphic sustainability. Consequently, a proposal was submitted to the HEA steering committee to consider a project in the Sinoro Bar area. Finally, that led to the Pasternack (2010) report that evaluated the geomorphic condition in the EDR and estimated the number of SRCS that could be supported by performing river rehabilitation in that reach as part of a potential HEA project.

Pasternack (2010) proposed river rehabilitation in the Sinoro Bar area of the EDR (Fig. 3.1). The goals would be to 1) undo the harm imposed by mechanized gold mining and overly coarse, angular rocks and 2) implement SRCS habitat enhancements to provide an array of sustainable, fish-preferred channel features at the hydraulic-unit and geomorphic-unit spatial scales. Such a project would entail excavating out the existing infill- estimated at a maximum of 128,940 m^3 (168,650 yds^3)- and then installing roughly the same volume of a mixture of river-rounded gravel/cobble, but distributed according to a carefully vetted design able to yield the necessary array of physical habitat needed to support the different SRCS lifestage requirements. In terms of ecological benefits of such a project relative to HEA goals and specifically the HET, 20 different estimates of supported SRCS were calculated based on different assumptions about the project area, fish behavior, and available adult SRCS. The potential for the project to support SRCS that otherwise presently have no support in that area was most reasonably estimated to be in the range of **10,116-12,644** adult SRCS (full range of uncertainty was 6,136-33,504). When population constraints due to full lifecycle constraints were considered (e.g., ocean and estuarine conditions) as an additional constraint, the most reasonable range of likely supported fish (rather than potential for support) under current conditions was **1,977-5,246**. In other words, the project would create fantastic conditions capable of supporting a large number of SRCS, but in fact there are far fewer SRCS in the LYR currently; thus, in actuality the likely supported run under current conditions would be smaller than the full potential. One benefit of having such a large excess of high-quality physical habitat available is that it would enable both fall-run and spring-run Chinook salmon to utilize the same area without having the fall-run decimate SRCS redds. The potential habitat from a Sinoro Bar project is large enough to meet both runs’ needs.

Figure 3.1. Oblique photo of the Sinoro Bar area proposed for river rehabilitation as part of the HEA. The proposed project would start at the house-sized boulder in the lower right of the photo and end at the top of the rapid barely visible at the farthest downstream location in the photo (top center).

4. NARROWS CURRENT CONDITION

A primary objective of this study involved investigating the current condition of the Narrows Reach using available information and a new reconnaissance. The Narrows Reach is a remote part of the LYR that has received relatively little scientific investigation. Beak Consultants, Inc. (1989) conducted fish surveys in the EDR and NR, which they lumped together as a single reach they called the "Narrows Reach". They also did habitat simulation, from which they concluded that the area had little fry habitat and virtually no juvenile habitat at that time. For the terrestrial land, there exists a topographic map with 2' contours (NGVD29 datum) from the 1999 Army Corps aerial photogrammetry survey. A 2005-2007 topographic and bathymetric survey of the EDR conducted by UC Davis stopped at the top of the Narrows Gateway rapid for logistic reasons and lack of scientific need. As part of that effort, some NR hillside photography is available. In 2009, the Yuba Accord River Management Team (RMT) installed a water level and temperature sensor in S-turn. For the 2009-2010 spawning season, the RMT performed weekly redd mapping in EDR and NR. That is being repeated for the 2010-2011 spawning season as well. On October 1, 2010 a site recon was conducted to observe NR conditions. Based on the available information, a geomorphic analysis and a Chinook spawning analysis under current conditions was performed to characterize the two upper geomorphic units that are amenable to river rehabilitation.

4.1. Narrows Reach Geomorphic Units

The first step in the analysis of the Narrows Reach is to describe its physical geography in terms of the sequence of geomorphic units it contains and establish a nomenclature in support of discussions. At the geomorphic-unit scale (1-10 W), the factors that are commonly used to delineate individual units in a valley-constrained reach include abrupt changes in bed slope, bankfull width (W_{bf}), bankfull depth (D_{bf}), and representative bed material size, which for a river with a gravel/cobble substrate is taken as the size at which 90% of material is smaller (d_{90}). Using these factors, five geomorphic units were identified and named (Fig. 4.1). Starting at the upstream end, the first unit is named Narrows Gateway. It is a cobble bar/fan complex that forms a Class III whitewater rapid at the confluence of Deer Creek and the Yuba. The bar/fan complex ends at a constriction associated with a large bedrock peninsula. The second unit is named S-turn, because the flow is forced to bend around a sequence of four alternating bedrock outcrops. There are two large gravel/cobble bars in S-turn. This unit ends at the major valley constriction previously described in section 2. At this point the narrow valley becomes an even narrower canyon with high walls. The narrow canyon is divided into two geomorphic units on the basis of slope, depth (D), and d_{90}/D. First is the Class IV whitewater rapid herein named Skinny Escalator. This unit is narrow, shallow, steep, and strewn with large emergent and partially submerged boulders. After that there is a calm stretch of deeper water called Narrows Respite that still moves at a moderate velocity due to low width. Few emergent or partially submerged boulders are present. Where there is one such cluster, a small rapid is present.

Finally, the Narrows Reach ends with the large Narrows Pool. Valley width expands in the pool, but the defining aspect of the pool's terminus is taken to be the presence of an emergent gravel/cobble lateral bar on river left at low flow. That denotes the onset of Timbuctoo Bend.

Only the first two NR geomorphic units presently contain alluvial bars with gravel and cobble, so those were the areas focused on for detailed analysis for potential river rehabilitation. Each of those geomorphic units was investigated independently, since they are divided by a width constriction. For this purpose, the 2009 National Agricultural Imagery program (NAIP) aerial photo of the NR was used (Fig. 1.1), since that is the most recent imagery available. First, polygons were carefully drawn around the alluvial area of each unit and the total area determined. Second, the valley centerline length was measured. Third, the mean width was calculated by dividing total area by centerline length. Fourth, the height change was estimated using the Army Corps 1999 2' contour map of the terrestrial land in the Narrows. In that mapping effort, no bathymetric surveying was done in the EDR or NR. However, it is possible to identify the contour line closest to the water's edge and get its elevation (NGVD29 datum converted to NAVD88 by Dr. Pasternack's lab group in 2007). Such near-edge water surface elevations were obtained at the top and bottom of each unit and the difference calculated. For the Narrows Gateway unit, 1.3' of height was subtracted from the total calculated, because in Pasternack (2010) that much height is reserved for use in rehabilitating the Sinoro Bar area. Finally, the water surface slope available for use in river rehabilitation was calculated as height change divided by centerline length. Final results of the analysis are presented by Table 4.1.

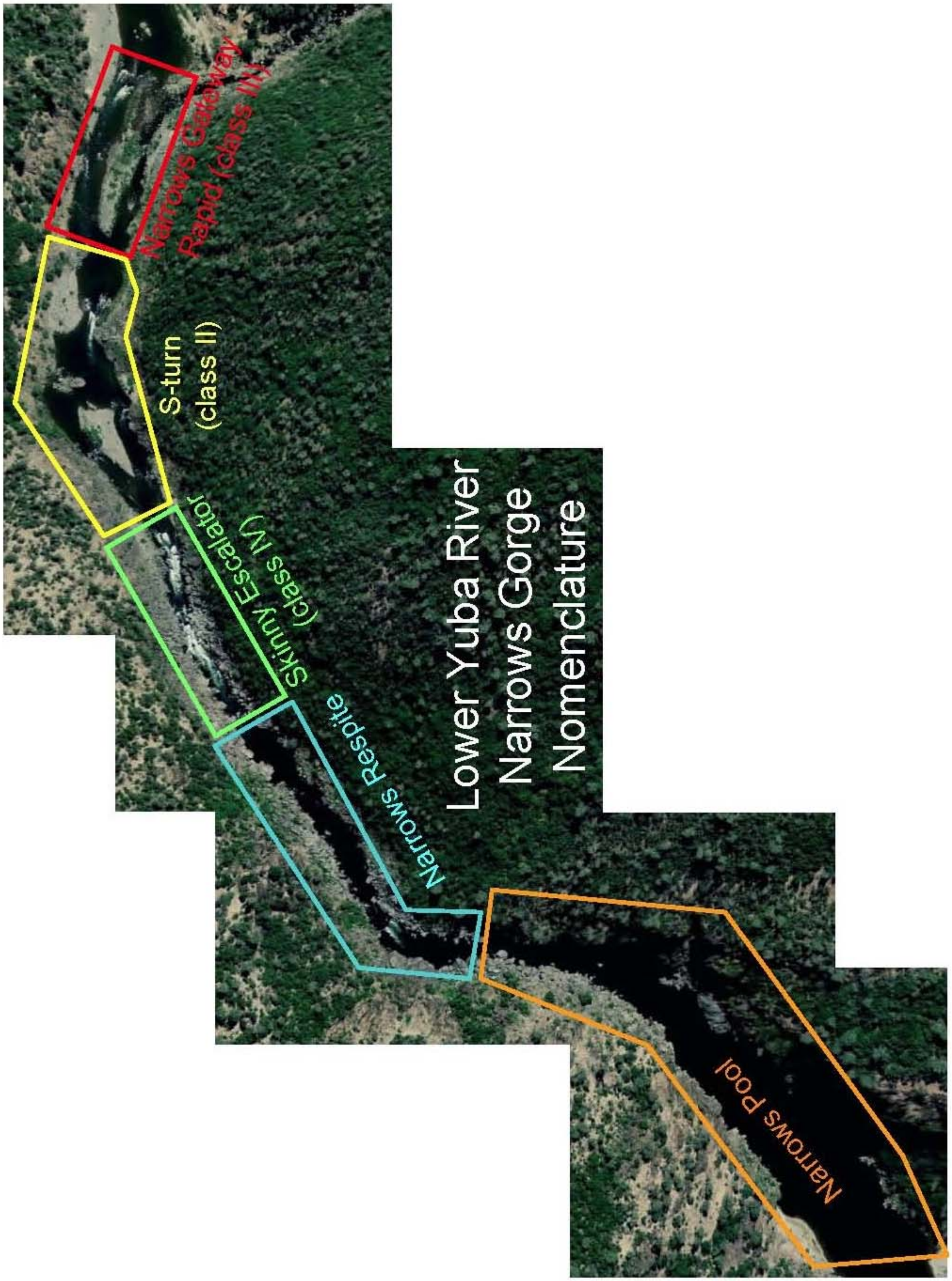


Figure 4.1. 2009 NAIP aerial photo of the Narrows Reach showing geomorphic-unit delineations and establishing a nomenclature for the individual features at this spatial scale.

Table 4.1. Results of spatial geomorphic analysis of the Narrows Reach.

	Geomorphic Unit	
Geomorphic variable	Gateway	S-turn
Total area (m^2)	15833	17210
Centerline length (m)	217.9	324.6
Mean width (m)	72.7	53.0
Height change (m)	2.44 (2.04)*	3.05
Slope	1.12% (0.94%)*	0.94%
*Parenthetical for Gateway is value after 1.3' is used for Sinoro Bar project		

4.1.1. Narrows Gateway

The Narrows Gateway geomorphic unit is influenced by several independent hydrogemorphic controls. Both the Yuba River and Deer Creek directly contribute flow and sediment into it. Two different physical valley constrictions may play a role in controlling the stage associated with the discharge input. There are two bedrock outcrops at the end of the geomorphic unit that constrict the channel. Since these outcrops are high, they produce a stage-independent areal constriction until they are overtopped. Down in S-turn there is a second constriction that is much narrower at low flow (Fig. 4.2), but since the north side of the channel is a lateral bar at that location, the constriction effect decreases as stage increases. Without doing 2D modeling it is not possible to ascertain the relative roles of each.

In terms of hydraulic-unit scale features in the Narrows Gateway, a site recon and aerial photo interpretation were used to visually estimate what was present (Fig. 4.2-4.3). The morphological unit classification of Pasternack (2008b) was used to define these units at the 0.1 to 1 W spatial scale. Given the steep slope of the channel here and the constricting role of the cobble bar, the features are primarily high-velocity units – rapids, chutes, and runs. The two pools are forced by bedrock outcrops and are deep. In the side channel there is riffle habitat, but the flow is regulated by Lake Wildwood on Deer Creek. Vegetation has grown onto much of the bar, indicating that it is not actively changing in recent years.

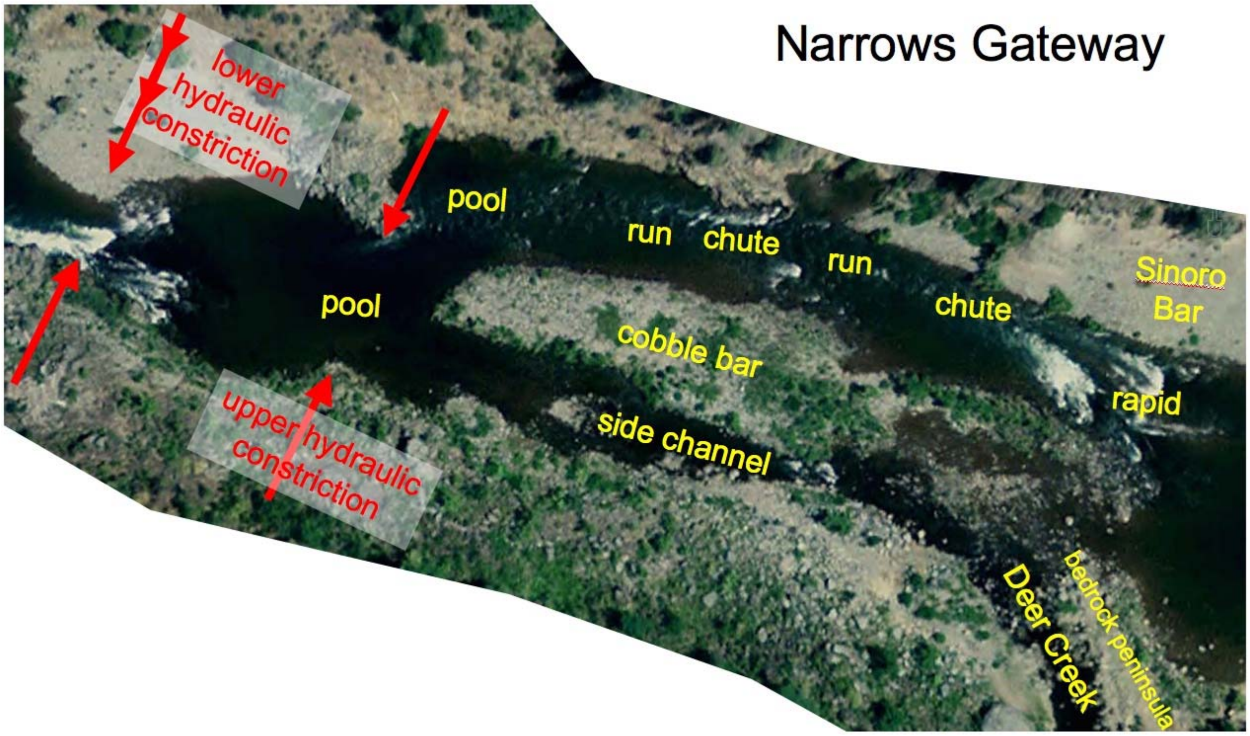


Figure 4.2. 2007 aerial photo of Narrows Gateway showing the interpretation of features at the hydraulic-unit scale.

Figure 4.3. High oblique view of Narrows Gateway taken on 11/29/2006.

4.1.2. Narrows S-turn

The aerial photo of Narrows S-turn shows several large bedrock outcrops and alluvial bars, but it does not give much of an impression of the flow pattern (Fig. 4.4). At ground level, the flow is seen to contort around the alternating bedrock outcrops, hence the name. The locations of two large cobble bars are indicative of the spatial variation of flow on the receding limb of mobilizing floods. The upper bar is along the bank located in the lee of the first bedrock outcrop on the north side of the river. That outcrop is a high peninsula that pushes flow to the south side where a deep scour hole has formed. The lower bar is in the center of the channel in the transitional area where width is decreasing steadily to the narrowest constriction at the end of the unit (Fig. 4.5). The main channel drops over a rapid and then is entrenched into alluvium on river left along the medial bar, while the side channel is at a higher elevation and more gradually drops along its length. The S-turn medial bar is widest in the widest part of the channel and narrows as the channel narrows (Fig. 4.4). The north side of the bar that is in the lee of another large bedrock outcrop on the north side of the channel is the highest area and is stable enough to have a dense cluster of willows (Fig. 4.6). The side channel to the north of the medial bar has an excellent diversity of SRCS physical habitat conditions for all lifestages, except that the substrate is overly coarse. Backwater and bank areas have microhabitat suitable for rearing. There is a deep pool in which several SRCS adult spawners were observed to hold, and down the side channel there is shallow, swift flow diverging over a riffle crest suitable for spawning and embryo incubation. No redds were observed there in the 2009-2010 survey and none on the recon visit on 10/1/2010. However, several adult SRCS were observed going in and out of the pool at the upper end and one adult fish was observed swimming around the lower end of the side channel.

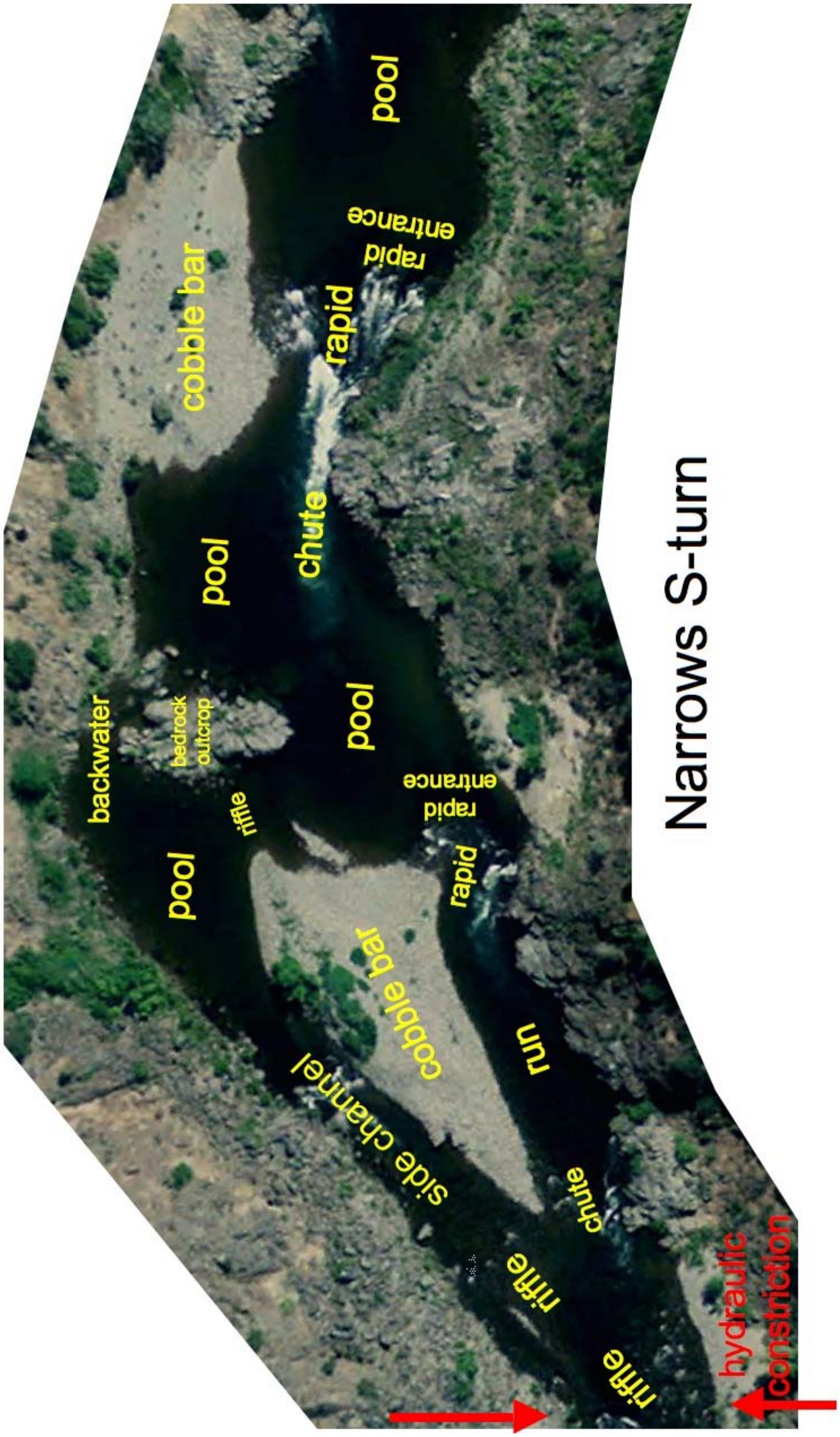


Figure 4.4. 2007 aerial photo of Narrows S-turn showing the interpretation of features at the hydraulic-unit scale.

Figure 4.5. High oblique view of Narrows S-turn and the top of Skinny Escalator taken on 11/29/2006. This view highlights the width constriction causing the deposit of the medial bar and shows the relative incision of the main channel compared to the side channel.

Figure 4.6. Medial cobble bar near the end of Narrows S-turn.

4.2. Narrows Reach 2009 Redds

The RMT has established a standard protocol for mapping all observed redds on the entire LYR in translucent water depths on a weekly basis. The protocol is available at http://www.yubaaccordrmt.com. Using this procedure, 84 redds were observed in the Narrows Reach between September 2009 and March 2010 (Fig. 4.7). The redds are concentrated in two primary and two secondary areas. One primary area was the side channel in Narrows Gateway. This is the area that receives a high outflow from Deer Creek during flushing operations in Lake Wildwood every October, which happens to be the peak of fall-run Chinook salmon spawning. Spawners were distributed all down the length of the side channel. The other primary area was the second rapid entrance in Narrows S-turn. At this site 2009 spawning was densely packed into a small area. This site was visited in 2010 during the period of phenotypic SRCS spawning and 25 adult spawners were directly observed (Fig. 4.8), with indications of many more present holding in the pool upstream of the site and in the other nearby pool to the north behind the large bedrock peninsula. In Figure 4.8 several fish are clearly discernable as well as a clean gravel substrate. Besides these primary spawning areas, there is a small amount of spawning on the large lateral bar on the north side of S-turn and at the top of the medial bar, where a submerged finger of the bar composed of gravel creates riffle-like habitat as water flows into the side channel. In the 2010 recon for this study, a large SRCS redd was observed at this location and several SRCS spawners were observed in this area and moving around nearby (Fig. 4.9). A movie was made of their activity. It appeared that the fish were all moving to the exact same spot with excellent microhabitat hydraulics, but that spot was devoid of suitably sized gravel, because it had all already been used in a large redd just downstream.

Figure 4.7. 2007 aerial photo of Narrows Gateway and S-turn showing the locations of redds in the September 2009 to March 2010 spawning period. No redds were observed in the other NR geomorphic units. (data courtesy the LYR Accord RMT)

Figure 4.8. Photo of dense (phenotypic) SRCS spawning activity on 10/1/2010 at the second rapid entrance in the Narrows S-turn geomorphic unit.

Figure 4.9. Photo of an adult SRCS (center of photo) hovering at the point of optimal microhabitat hydraulics where the substrate is on the coarse side for preferred spawning. A large redd composed of suitably sized gravel/cobble is present in the center right of the photo.

5. NARROWS REACH HISTORICAL ANALYSIS

Although knowledge of the current condition of the Narrows Reach is important baseline information for river rehabilitation, natural processes and human impacts are often revealed through a historical analysis of available information. In this case, the primary source of historical information is aerial photos taken at irregular intervals since 1937. Pasternack et al., (2010) used this set of images to investigate the history of Sinoro Bar, but the same set as well as a few others not used in that study also captured the Narrows Reach. This is the first time the historical aerial imagery of the NR has been analyzed. Photo interpretation was used to determine what landforms and physical habitat conditions were present historically. Substrate size classes (e.g., boulder, cobble/gravel, sand/mud), grain turnover, water turbidity, and presence/absence of vegetation are visually evident in the photos. For all discharges reported below, values were taken from the USGS Smartville gage only, neglecting the Deer Creek gage. The objective of this part of the study was to characterize historical changes in the NR to determine the history of sediment storage there and the extent to which fluvial landforms have changed with changes to sediment storage and in response to large floods.

5.1. Reach-scale Channel Change

At present the NR has relatively little gravel on the surface of the riverbed, especially downstream of S-turn, but that was not the case historically. We know from historical documents that an alluvial bar called Landers Bar was present in the NR (not the EDR) and that it was mined for gold. According to local landowner Ralph Mullican, gold miners built a wing dam at the mouth of Deer Creek in the ~1860s to help their effort to turn over gravel and larger rocks to get to the bottom. A derrick was used there to drag rocks onto the wing dam. Many such large rocks have hand-drilled holes in them for black powder. The first available aerial photo of the reach dates to October 21, 1937, which had a low flow of 140 cfs (Fig. 5.1). In that photo the water is turbid despite being in the dry season and there are many emergent alluvial bars throughout the NR. The emergent bars include point bars associated with constrained meandering in a narrow valley. These bars are mostly devoid of vegetation, indicating that they are active. Bedrock outcrops are very limited and in a few places only the very tops of modern outcrops poke out above the deep alluvial fill. Where the Narrows Pool is presently located, the riverbed is almost completely filled in, with half the width of the channel exhibiting a large emergent lateral bar. According to Physical Geography Prof. Allen James of University of South Carolina, during the era of intensive hydraulic mining in the Blue Point Mine area just downstream of the NR, alluvium fully blocked the flow of the river causing a lake to form and back up into the NR. He has observed backwater lake deposits up on the hillside in recent years. The 1937 photo does not exhibit any evidence of whitewater rapids in the NR. Taken together, these indicators lead to the conclusion that in 1937 the NR had a fully alluvial riverbed with some emergent floodplains constrained by bedrock walls.

In December 1937 and January 1943, large floods of 74,200 and 81,100 cfs, respectively (Smartville gage only; not considering Deer Creek) went through the NR. Englebright Dam began operation in 1942. Thereafter, the next available aerial photo is from February 22, 1947

(Fig. 5.1). That photo was taken at a higher turbid flow (1,500 cfs) in winter and it is a lower quality image, but important indicators are present. First, there are still emergent alluvial bars throughout the NR. Second, there is a large amount of alluvial at the mouth of Deer Creek and the flow is over the north side of the channel suggesting that the channel incised, leaving the deposit at the confluence at a higher emergent elevation. Third, the bedrock outcrops are more prominent. Fourth, gold dredgers had worked over the emergent lateral bar flanking the lower part of Narrows Pool and up into the Blue Point Mine canyon. Unfortunately, the water turbidity and high flow make it difficult to determine if any whitewater rapids are present in the NR, but highly visible tree shadows over the water in Skinny Escalator and Narrows Respite suggest that no rapids were there, because whitewater would not reflect such strong shadows. Taken together, these indicators lead to the conclusion that by 1947 the NR had incised substantially, but that the riverbed was still predominantly alluvial with no rapids.

On November 21, 1950 there was a flood of 109,000 cfs on the Yuba. The next aerial photo is from July 16, 1952 (2,860 cfs), and it shows dramatic change (Fig. 5.1). For the first time, the water looks black, indicating that it is translucent, not turbid. Also, no emergent alluvial bars are evident in Skinny Escalator or Narrows Respite. Bedrock outcrops in Narrows Gateway and S-turn are very prominent. An abrupt increase in water depth is evident at the constriction between S-turn and Skinny Escalator. The dredger tailings flanking Narrows Pool have mostly been swept away. Taken together, these indicators lead to the conclusion that by 1952 Skinny Escalator and Narrows Respite had lost the majority of their alluvial fill and the other geomorphic units had incised substantially, though not as much.

Unfortunately, there is a gap in the imagery from 1952-1984. In that period there were five large floods between 86,000 and 171,000 cfs. According to local landowner Ralph Mullican, a bulldozer was brought into the EDR in 1960, followed by an excavator in the 1970s. The machinery was used to access underlying gold-bearing gravel. The excavator was also used to divert the Yuba down a newly deepened channel on the south bank of the river. Photos and movies of such activities are available by contacting Mr. Mullican. The aerial photo from June 28, 1984 shows that Skinny Escalator and Narrows Respite had essentially arrived at the condition we see them in now, 26 years later (Fig. 5.2). The bedrock outcrops in Gateway and S-turn are also as prominent as they appear now. The alluvium in the upper half of Narrows Pool is no longer visible and the emergent lateral bar in that area eroded away, but swift currents visible in the photo suggest that the water is shallow there.

After the 100,000 cfs flood of February 19, 1986 there was not much change (Fig. 5.2). No other large events occurred, so the 1991 and 1996 aerial photos look similar. An important indicator shared by the 1986, 1991, and 1996 photos is that there is strong visual evidence of an alluvial riffle midway down the Narrows Pool.

The next big flood was a rain-on-snow event on January 2, 1997. The next photo thereafter is from the Army Corps topographic survey in 1999 (Fig. 5.2). In that photo the pre-existing riffle midway down the Narrows Pool is gone and there is now a very deep scour pool instead. This has been the condition of the Narrows Pool ever since.

Overall, the reach-scale historical aerial photo analysis revealed that erosion and incision took place steadily over time in the NR. By 1952 Skinny Escalator and Narrows Respite had lost the majority of their alluvial fill (Fig. 5.1). By 1984, bedrock outcrops had reached their final prominent stature and emergent bars in gateway and S-turn were mostly as they appear now. By 1999, Narrows Pool had achieved the current deeply scoured condition, and that took place by an entirely natural process (Fig. 5.2). There is no photo evidence of in-channel dredger mining occurring in Narrows Pool. A more detailed consideration of conditions and changes in Narrows Gateway and S-turn is presented next.

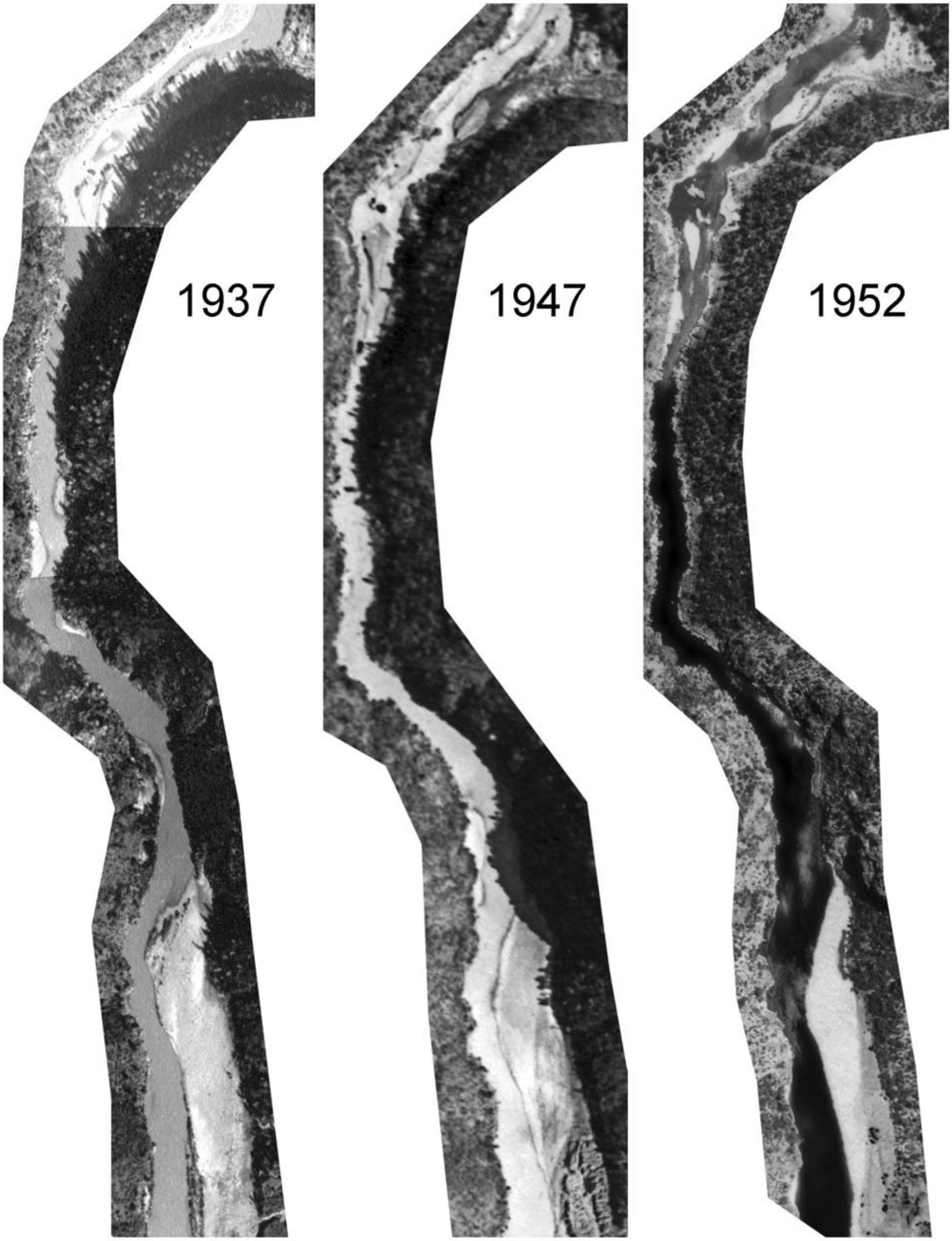


Figure 5.1. Comparison of NR aerial imagery 1937-1952.

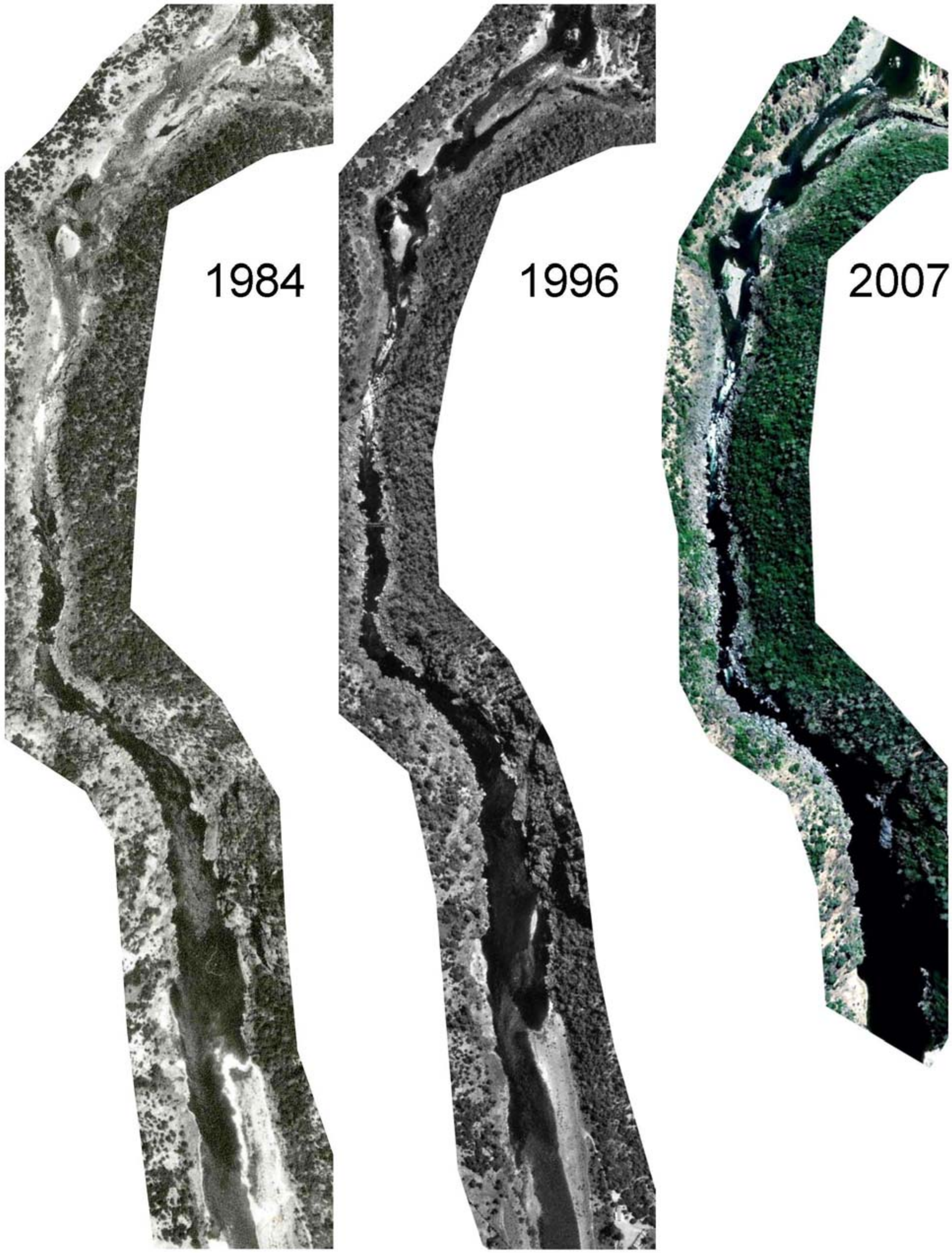


Figure 5.2. Comparison of selected NR aerial images 1984-2007.

5.2. Geomorphic-Unit Scale Channel Change

Based on the reach-scale historical analysis, the Narrows Gateway and S-turn geomorphic units have always had alluvium in them, even prior to hydraulic gold mining. When designing a river rehabilitation project for these units, knowledge about what morphological units are sustainable is helpful. Therefore, the historical aerial imagery was cropped down to these units and given closer inspection. The objective is to ascertain how dynamic morphological units have been in those areas.

Figures 5.3, 5.4, and 5.5 show a subset of the images cropped to the two upper geomorphic units. Despite the significant incision that took place over 70 years of imagery, several of the alluvial features have shown resilience and remained present. In the 2007 photo, there are three major emergent bars. All of them are present in every photo over 70 years. The bar at the confluence with Deer Creek was a lateral bar in the 1937 and 1947 photos, but thereafter there is a single isolated low-flow side channel that captures the outflow from Deer Creek along the south side of the channel. The lateral bar on the north side of the river in S-turn that is in the lee of a large bedrock outcrop was a medial bar in 1937, but once the river incised enough for the outcrop to control hydraulics there, the bar shifted behind the outcrop where it has stayed ever since. The medial bar at the end of S-turn has also persisted and its shape has shown relatively little change. In 1937, 1984, and 1986 it was shorter, while in all other years it had a tail. Present-day vegetation on that bar was not there in the 1952 photo, but was present by 1984. Since then it has expanded, indicating that the bar top is stable, with the stability aided by the vegetation. The present-day rapid at the head of Narrows Gateway was a less steep riffle that was stable in 1937-1996 despite floods and incision. The riffle was replaced by a rapid in the 1999 photo, so it must have been changed by the 1997 flood or possibly by artificial activity. Finally, there appears to have been a riffle in the transition between S-turn and Skinny Escalator over the last 70 years. Overall, the morphological units in Narrows Gateway and S-turn have been remarkably stable since 1937 despite dramatic channel incision. The explanation is that the bedrock outcrops in S-turn and the valley width oscillations throughout the reach impose a persistent suite of hydraulic controls that stabilize the morphology of geomorphic units in the NR. Unfortunately, it is not possible to discern much about riverbed grain size in the NR, but it is likely that the bars have coarsened and armored somewhat, based on what was observed during the recent site recon.

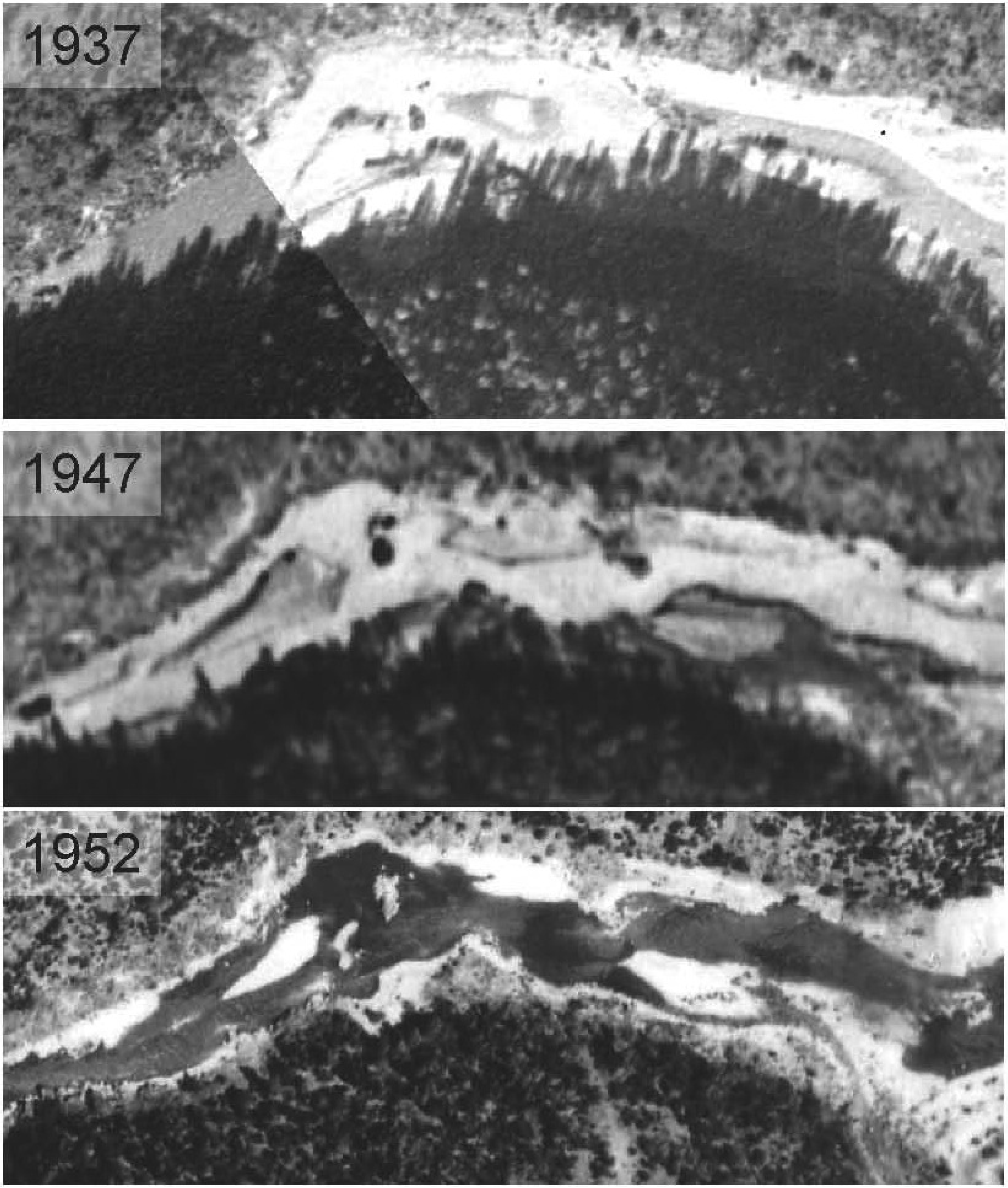


Figure 5.3. Comparison of aerial imagery of the top area of the NR 1937-1952.

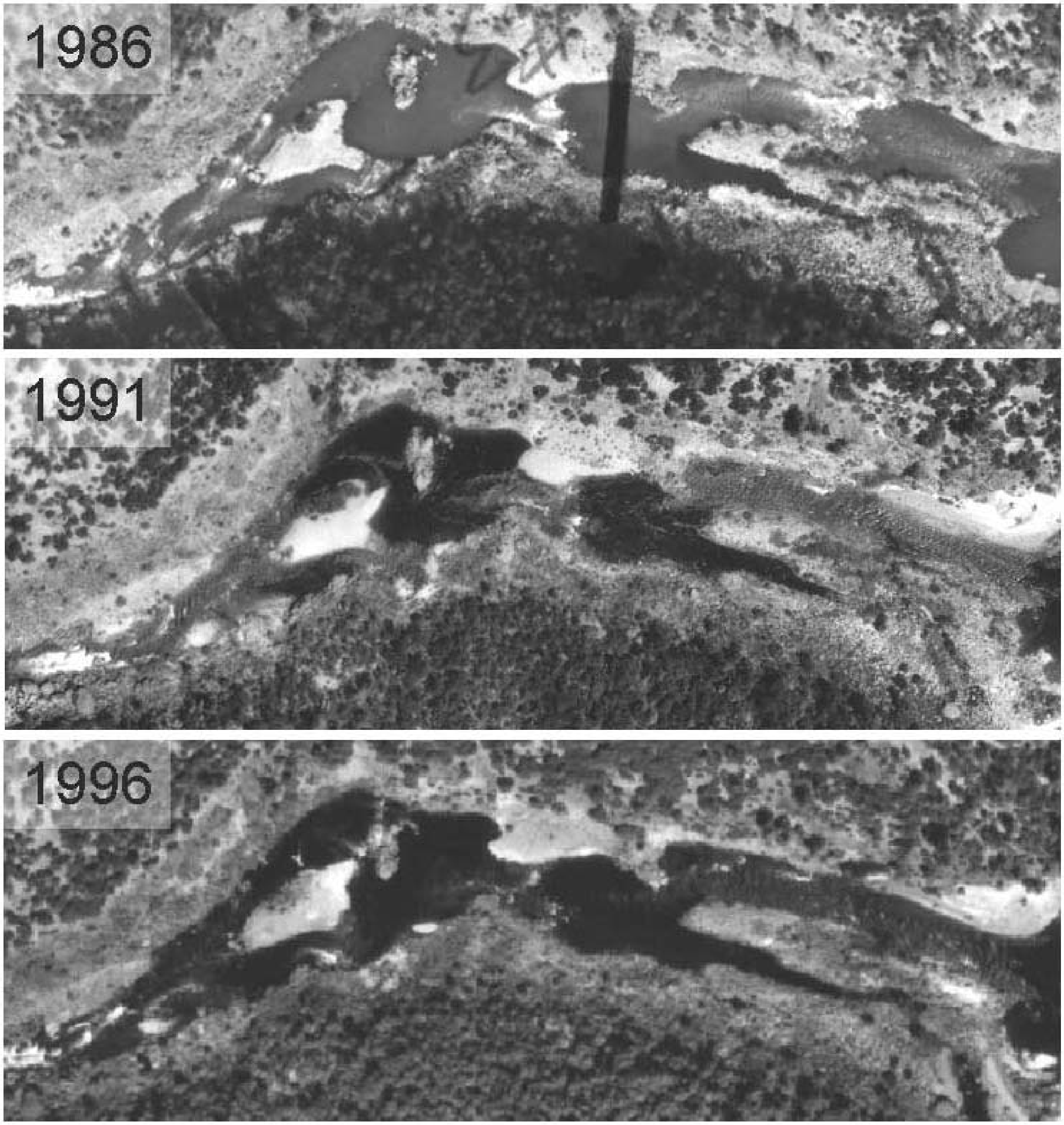


Figure 5.4. Comparison of aerial imagery of the top area of the NR 1986-1996.

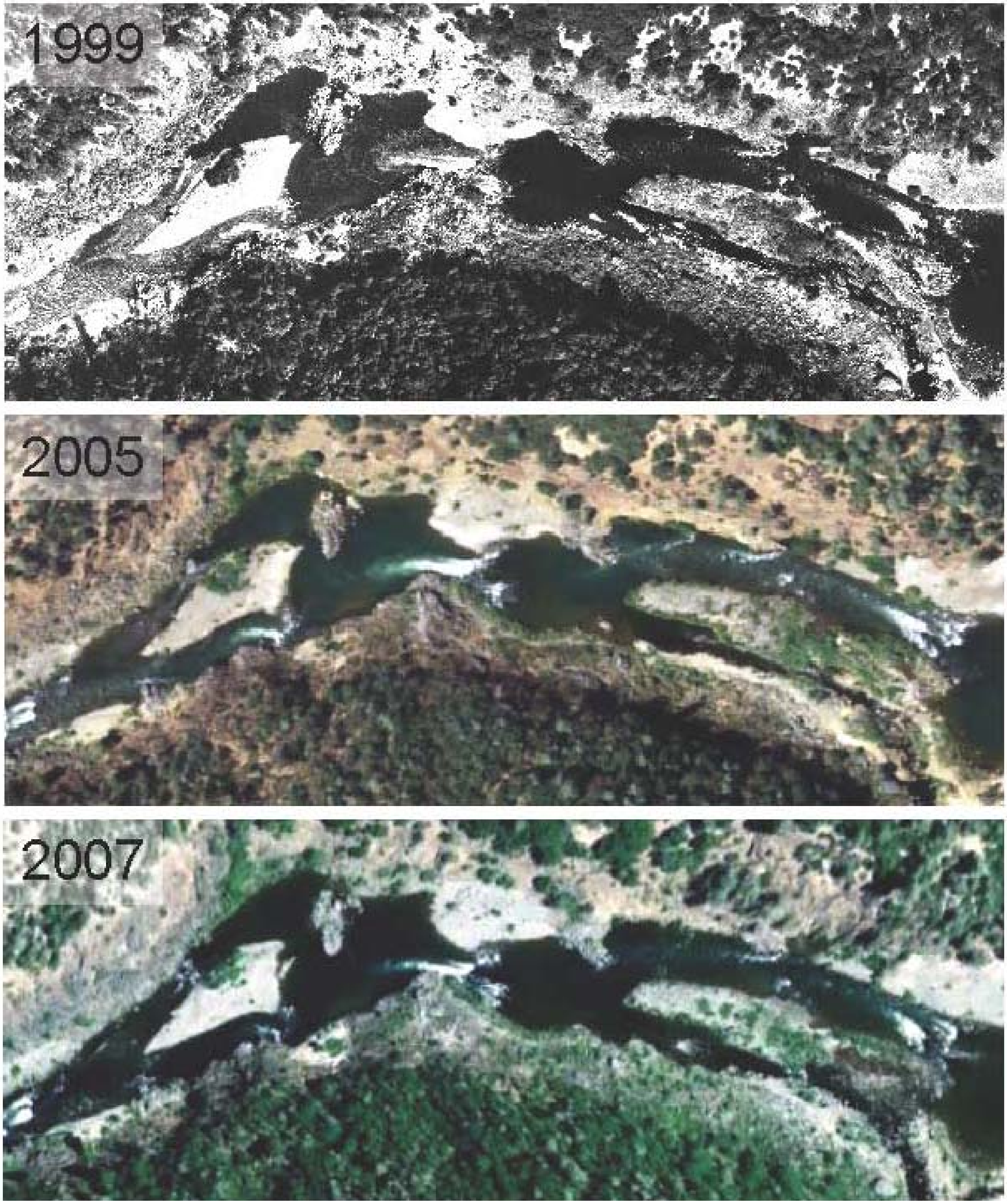


Figure 5.5. Comparison of selected aerial imagery of the top area of the NR 1999-2007.

6. NARROWS REACH ENHANCEMENT VISION

At present the Narrows Reach includes two geomorphic units with alluvial landforms capable of supporting SRCS adult holding, spawning, and embryo incubation freshwater lifestages. A small number of Chinook salmon have been observed spawning in the NR in the 2009-2010 and 2010-2011 spawning seasons. Historical analysis has revealed that the landforms in these geomorphic units have been resilient in the face of erosion and channel incision caused by the return of the river to a condition similar to its pre-mining status due to Englebright Dam blocking hydraulic mining debris from continuing to snuff the river valley, as it had prior to the dam's construction (Gilbert, 1917). The resiliency is due to the role of valley width oscillations and large bedrock outcrops that yield a persistent spatial pattern of hydraulic convergence and divergence (MacWillliams et al., 2006; Sawyer et al., 2010; White et al., 2010).

Despite the resilience in the NR, there are two discernable problems that are limiting natural SRCS production there, and both problems are solvable using river rehabilitation methods. The first problem has to do with the history of the NR filling with mining waste and then having the river incise back through it. When a river cuts down in this manner, previously active areas of the riverbed become high bars, islands, and terraces in the channel. They also can become excessively stabilized by vegetation, delaying the natural recovery process. The problem is that these features in the Narrows Gateway and S-turn units are taking up a disproportionate area of the channel, thereby constricting the remaining wetted areas. This causes these units to have narrow, moderately deep, and fast rapids, instead of riffles. Over geologic time, such features naturally come and go with glacial cycles. In this case, the problem was caused by anthropogenic impact (hydraulic gold mining) and it is appropriate and beneficial to undo that damage by hastening the natural recovery process with an active river rehabilitation project. Such a project would not only undo the historic damage, but it could also be designed in a way that is both geomorphically sustainable and biologically enhanced to support SRCS.

The second problem has to do with the fact that as the riverbed has incised, the surface has also coarsened, in a process known as armoring. Not only are the individual particles on the bed surface coarser than the natural bed material load, but the surface of the emergent bars exhibits a feature called "imbrication", in which large particles become stacked up against each other oriented with the flow. This stacking makes the bed more resistant to erosion. In the absence of any test pit data of the underlying sediment, it is unclear how armored the river has become; however, the site recon did find some areas that were not armored, and those were being heavily used by SRCS spawners at that time. Other areas that were hydraulically preferable for spawning did not have adults active there, because the substrate was obviously too coarse.

Besides the natural process of coarsening as a river incises, there are anthropogenic factors contributing to this problem. Ever since the discovery of gold in the Yuba, gold miners have manipulated the sediment in the river by hand and machine. They built dams and diversions, used explosives, and redirected flows. Pasternack et al. (2010) reported that mechanized mining was responsible for altering and degrading Sinoro Bar just upstream of the NR. In that process, a bulldozer was used to move cobbles and boulder out of the way to get to underlying gold-rich gravels. Dislodging material and putting very coarse particles up above the ambient bed would make them much more susceptible to transport downstream into the NR, where they would be captured onto the bars during large floods. Even though Englebright Dam is providing the major benefit of *annually* holding back an additional 477,184 yds^3 of hydraulic mining waste and other sediment settling into the reservoir (Childs et al., 2003), the total absence of any EDR sediment inputs is a cause of armoring. With the available information there is no way to precisely partition blame.

Regardless of who is at fault, the opportunity exists to do a rehabilitation project that substantially enhances the geomorphic units in the Narrows Reach beyond its observed historical and present natural capability. The Watershed Hydrology and Geomorphology Lab in the Department of Land, Air, and Water Resources at UC Davis has been designing spawning habitat rehabilitation projects since 1999 using the Spawning Habitat Integrated Rehabilitation Approach (SHIRA) described by Wheaton et al. (2004a) (Fig. 6.1). Over the years, testing of numerous gravel-contouring schemes in 2D models and in actual construction (Wheaton et al., 2004b; Elkins et al., 2007; Pasternack, 2008a) has yielded a conceptual understanding of expected hydraulic attributes, geomorphic processes, and ecologic benefits. Specific design examples are illustrated on the SHIRA website at http://shira.lawr.ucdavis.edu/casestudies.htm. The website also provides peer reviewed scientific reports and journal articles that have thoroughly vetted the SHIRA framework.

This section of the report presents concepts for what actions could be taken. It is beyond the scope of this study to perform detailed design development. This is a brainstorm of opportunities and constraints.

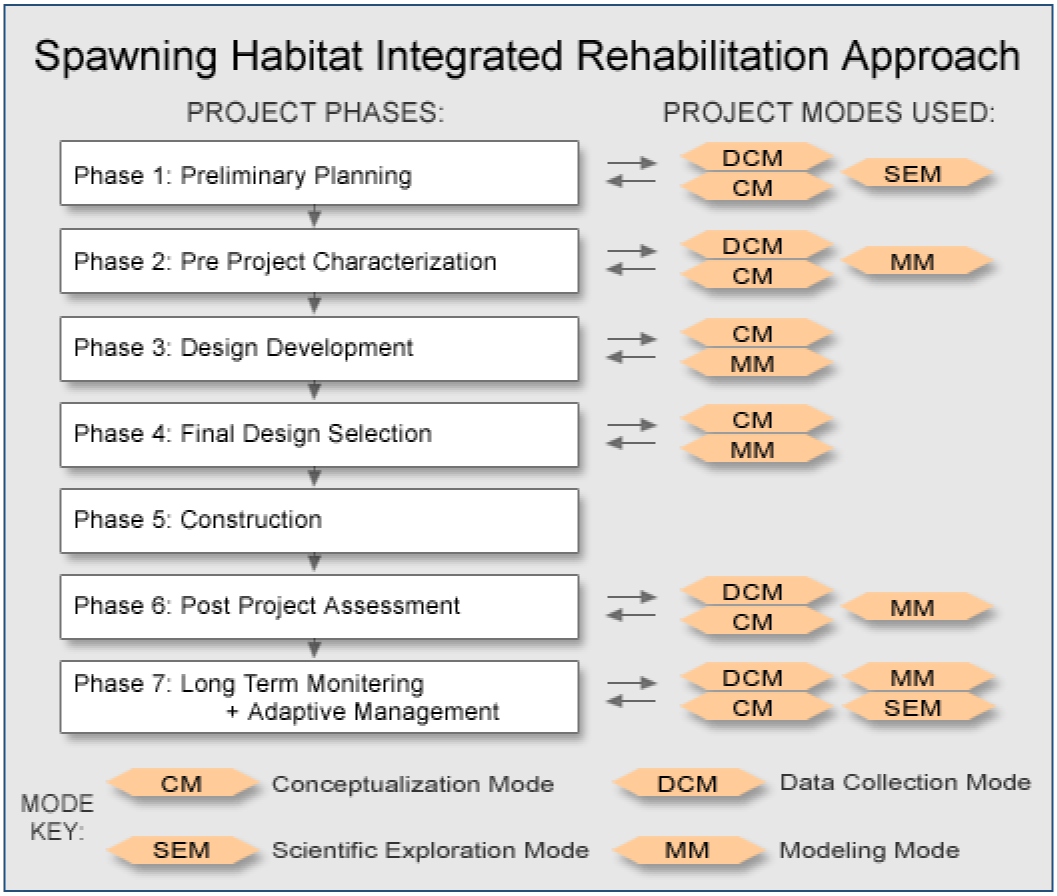


Figure 6.1. General schematic illustrating what is involved in the SHIRA framework.

6.1. Project Goals

The geomorphic goal of the potential river rehabilitation project is to re-shape the landforms in the Narrows Gateway and Narrows S-turn geomorphic units to redistribute the slope, expand the wetted width, and reduce riverbed surficial grain sizes in support of having larger riffle areas, while also retaining the existing self-sustainability of the landforms by designing in harmony with the controlling valley width oscillations and bedrock outcrops.

The ecologic goal of the potential river rehabilitation project is to enhance meso- and micro-scale physical habitats for the freshwater lifestages of anadromous salmonids, particularly SRCS.

6.2. Design Objectives And Hypotheses

A design objective is a specific goal that is aimed for when a project plan is implemented. To achieve the objective, it has to be translated into a design hypothesis. According to Wheaton et al. (2004b), a design hypothesis is a mechanistic inference, formulated on the basis of scientific literature review and available site-specific data, and thus is assumed true as a general scientific principle. Once a design hypothesis is stated, then specific morphological features are designed to work with the flow regime to yield the mechanism in the design hypothesis. Finally, a test is formulated to determine after implementation whether the design hypothesis was appropriate for the project and the degree to which the design objective was achieved. Through this sequence, a process-oriented rehabilitation is achieved. From the mathematics of differential equations, it is evident that processes derive from the physics of motion, input conditions, and boundary conditions. Changes to either input or boundary conditions impact processes, so it is possible and appropriate to design the shape of the riverbed to yield specific fluvial mechanism associated with desired ecological functions.

The design objectives and associated information for potential NR river rehabilitation are enumerated in Tables 6.1 and 6.2. These tables provide a transparent accounting of the objectives, hypotheses, approaches, and tests for the effort. From this point the next step would be to work up detailed design alternatives to determine how best to implement the proposed approaches.

Table 6.1. Design objectives and hypothesis 1-4 for a potential NR river rehabilitation project.

Design objective	Design hypothesis	Approach	Test
1. Remove excess cobbles and boulders from the riverbed where appropriate.	1A. Bed armoring hinders natural landform rejuvenation and is unsuitable for salmon spawning	Some amount of excavation is required, but then it is possible to either haul the material away or dump it down into the Skinny Escalator and let it wash into Narrows Respite and Narrows Pool where it would do no harm at those depths.	Perform pre-project and as-built Wolman pebble counts to confirm that overly coarse material has been removed. Perform annual re-surveys to determine if the river re-armors itself. Also, monitor for gravel/cobble influx from any EDR gravel augmentaiton program or Sinoro Bar rehabilitation project.
2. Reduce the elevation of emergent bars to reintegrate them into the active channel area and allow for wider riffles that are not constrained by excessively high bars	2A. Natural active emergent bars and riffles on the LYR often exist in the widest part of oscilalting valley walls and exhibit a dynamic interplay over time.	Use machinery to re-contour emergent bars.	Perform pre-project and as-built topographic surveys to document and quantify changes in landform morphology. Also, collect aerial imagery of the as-built condition.
3. Redistribute the bed slope to change rapid-pool and chute-pool sequences into riffle-pool sequences	3A. Riffle-pool sequences on the major gravel-bed rivers in the Central Valley of California typically have an optimal slope of ~0.04.	Use machinery to re-contour the riverbed using existing material and additional gravel/cobble per the slope creation method of Elkins et al. (2007)	Perform pre-project and as-built longitudinal profile surveys (or extract them from topgoraphic maps) to confirm the change in the sequence of geomorphic units. Also, collect aerial imagery of the as-built condition.
4. Allow gravel/cobble to wash downstream	4A.The NR should become an active participant in the conveyance of bed material load throughout the entire LYR.	no specific action required	Conduct annual recon of NR to track where injected gravel/cobble goes. Measure and/or simulate the spatial pattern of Shields stress and identify likely erosion areas by their values >0.06.

Table 6.2. Design objectives and hypothesis 5-8 for a potential NR river rehabilitation project.

Design objective	Design hypothesis	Approach	Test
5. Provide higher quantity of preferred-quality Chinook spawning habitat	5A. SRCS require deep, loose, river-rounded gravel/cobble for spawning (Kondolf, 2000).	Add river-rounded gravel/cobble.	Perform Wolman pebble counts of the delivered sediment stockpile and in the river after each gravel injection to insure that the mixture's distribution is in the required range.
	5B. Spawning habitat should be provided that is as close to GHSI-defined high-quality habitat as possible (Wheaton et al., 2004b)	Place and contour gravel to yield depths and velocities consistent with salmon spawning microhabitat suitability curves.	Measure and/or simulate the spatial pattern of GHSI after project construction to determine quantity of preferred-quality (GHSI>0.4) habitat present.
6. Provide adult and juvenile refugia in close proximity to spawning habitat.	6A. Structural refugia in close proximity to spawning habitat should provide resting zones for adult spawners and protection from predation and holding areas for juveniles.	Create spawning habitat in close (<10 m) proximity to pools, overhanging cover, bedrock outcrops, boulder complexes, and/or streamwood.	Measure distance from medium and high GHSI quality habitats to structural refugia and check to see that most spawning habitat is within reasonable proximity.
7. Provide morphological diversity to support ecological diversity, including behavoral choice by individuals.	7A. Designs should promote habitat heterogeneity to provide a mix of habitat patches that serve multiple species and lifestages.	Avoid GHSI optimization of excessively large contiguous areas of habitat; design for functional mosaic of geomorphic forms and habitat.	Large (>2 channel widths) patches of homogenized flow conditions in hydrodynamic model and homogenized habitat quality in GHSI model results should not be present at spawning flows.
8. Add streamwood to backwater areas and interweave it to produce cover and refugia for rearing fish	8A. Streamwood jams enhance salmonid rearing	Push the abundant streamwood along the highwater line in the EDR into the river and float it down to the backwater locations in the NR. Use machinery to position large pieces.	Conduct pre-project, as-built, and periodic snorkel surveys to assess utilization by rearing fish.

7. ESTIMATED POTENTIAL SRCS SUPPORTED

There is no single correct method for predicting what the SRCS population supportable by a rehabilitation project in the Narrows Reach would be at this stage of design development. Choices in the design process can enhance or detract from estimates. The approach used here is identical to that used in Pasternack (2010), which involved evaluating the relation between site conditions and redd occurrence, and then relating redd occurrence to the supportable SRCS adult population (Fig. 7.1). Making an estimate of the number of redds to occur in a channel area comes down to picking two things: redd density (sum of occupied and unoccupied channel surface area (m^2) per redd) and area of riffle habitat. For redd density, the same set of six values was used as in Pasternack (2010). For riffle area, two different values were used. Since both geomorphic units have an excess of available slope, the full length and area is available for riffle habitat creation, if desired. However, it is common and appropriate to create a mosaic of hydraulic units, so an area estimate holding back 20% of the total area for non-riffle units was calculated and used. Overall, this approach yielded an array of 12 different redd abundance estimates for each geomorphic unit. Finally, the spawner:redd ratios of 4:1 and 2:1 used in Pasternack (2010) were applied to convert redd abundance estimates to estimates of SRCS supported. The 4:1 ratio is the more realistic value for the LYR, but it helps to have a conservative value as well.

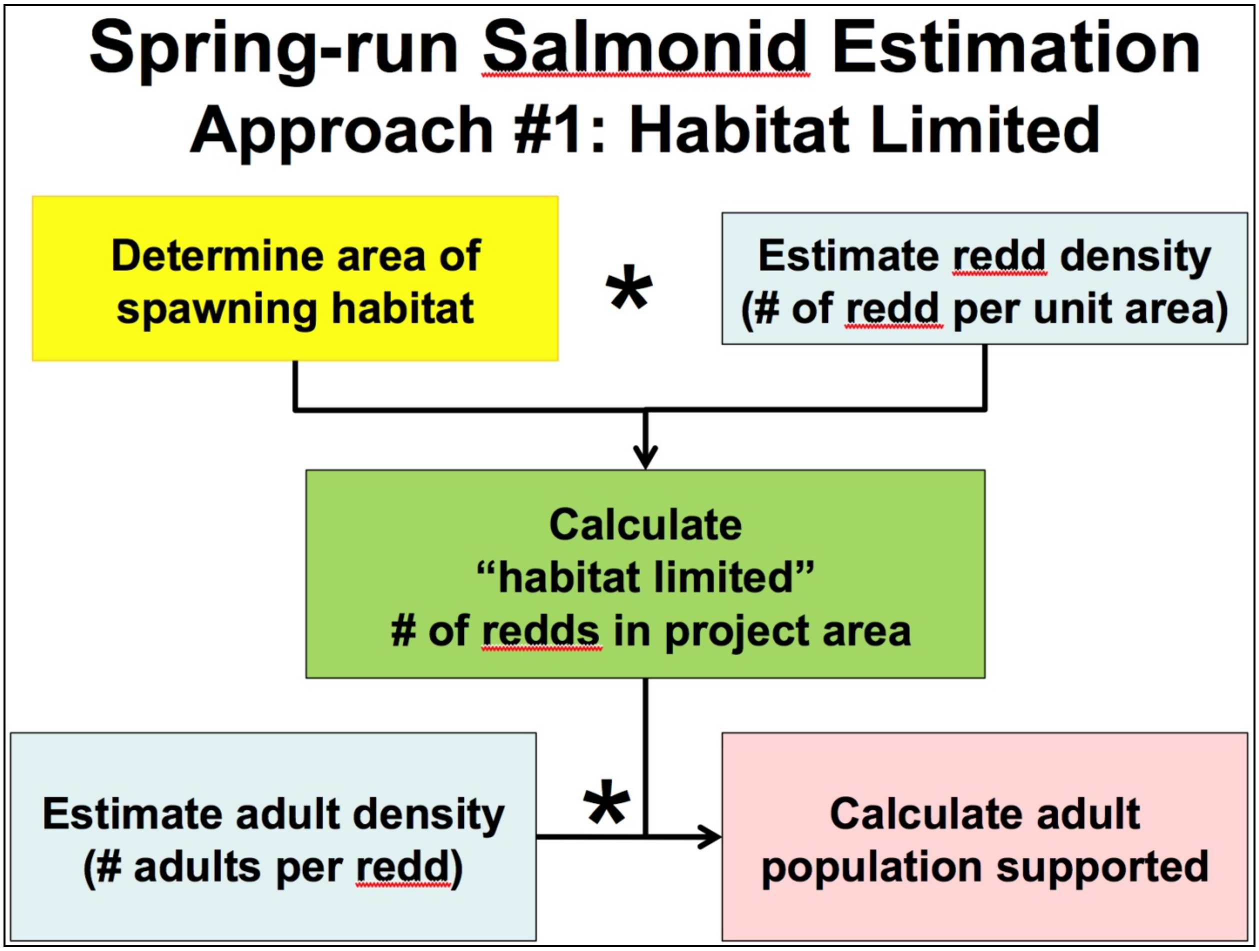


Figure 7.1 Flowchart illustrating the calculation procedure for estimating the potential number of SRCS supported through physical habitat rehabilitation in a channel area.

7.1. Narrows Gateway SRCS Estimate

The range of redd abundance estimates for the Narrows Gateway unit are presented in Table 7.1. The full range is 692-2,853 redds, but following the same reasoning as used in Pasternack (2010a), the best estimate is 1,141 redds. Applying the 4:1 and 2:1 spawner:redd ratios to that value yields **4,564** and **2,282** adults, respectively. If the most conservative set of assumptions is used, then the number of adults supportable in Narrows Gateway is estimated to be 692*2= 1,384 adults. That is still a large number of SRCS.

Table 7.1. Estimated number of redds produced for Narrows Gateway using different sets of assumptions.

	redd density (m^2 per redd)	Total rehab area (m^2)	Rehab with 20% extra area reserve (m^2)
Riffle SRCS habitat area (m^2)	n/a	15833	12666
LYR index site mean redd size	5.55	2853	2282
LYR index site mean redd size + 1 SD	8.60	1841	1472
LYR index site max redd size	14.18	1117	893
LYR index site mean redd size with equal unoccupied area	11.1	1426	1141
LMR rehabilitated riffle area redd occurrence density assuming 10% superimposition missed	16.60	954	763
LMR rehabilitated riffle area redd occurrence density	18.3	865	692
Green values indicate the most reasonable estimates			

7.2. Narrows S-turn SRCS Estimate

The range of redd abundance estimates for the Narrows S-turn unit are presented in Table 7.2. The full range is 752-3,101 redds, but following the same reasoning as used in Pasternack (2010a), the best estimate is 1,240 redds. Applying the 4:1 and 2:1 spawner:redd ratios to that value yields **4,960** and **2,480** adults, respectively. If the most conservative set of assumptions is used, then the number of adults supportable in Narrows S-turn is estimated to be 752*2= 1,504 adults.

In summary, the most reasonable and most conservative estimates for the total number of SRCS potentially supported by rehabilitating the top two geomorphic units in the Narrows Reach are **9,524** and **2,888**, respectively. Both of these estimates meet the HET criteria.

Table 7.2. Estimated number of redds produced for Narrows S-turn using different sets of assumptions.

	redd density (m^2 per redd)	Total rehab area (m^2)	Rehab with 20% extra area reserve (m^2)
Riffle SRCS habitat area (m^2)	n/a	17210	13768
LYR index site mean redd size	5.55	3101	2481
LYR index site mean redd size + 1 SD	8.60	2001	1601
LYR index site max redd size	14.18	1214	971
LYR index site mean redd size with equal unoccupied area	11.1	1550	1240
LMR rehabilitated riffle area redd occurrence density assuming 10% superimposition missed	16.60	1037	829
LMR rehabilitated riffle area redd occurrence density	18.3	940	752

Green values indicate the most reasonable estimates

8. ACCOUNTING FOR REGIONAL LIMITING FACTORS

Pasternack (2010) described an alternate method for evaluating the benefits of river rehabilitation on the LYR taking into account regional limiting factors. The calculation involved starting with the actual observed maximum population of spawning Chinook salmon on the LYR in the era of modern observation since 1953 (40,000 adults), multiplying it by the fraction of spawners utilizing riffles (0.69), then multiplying that product by the estimate of the fraction of the total LYR (38 km) that is riffles (either 0.09 or 0.18) to arrive at the density of spawners per km of the LYR. Then the length of the rehabilitation site is multiplied by this fish density to arrive at the final estimate of SRCS supported in a run-limited condition (Fig. 8.1). The important point about this computation is that it has nothing to do with the local physico-chemical potential of the project area to support SRCS, and instead considers the larger problem of regional limiting factors on population size to get at the likely amount of individual Chinook salmon served by the site.

For the Narrows Reach, the estimation procedure yields a significant number of SRCS supported in a run-limited condition. The total length of the NR geomorphic units suitable for rehabilitation is 0.5425 km. The reason there are two estimates for the fraction of the LYR that is riffles is that this number has not been accurately estimated just yet (available by January 2011 most likely); it has only been estimated for Timbuctoo Bend. If the same fraction of the whole LYR is present as riffles as found in Timbuctoo Bend, then the estimated number of SRCS supported is **2,189** spawners. The more likely case is that the whole LYR has about half the length of riffles as Timbuctoo Bend, so in that case the estimated number of SRCS supported is **4,378** spawners. Either way, both values meet the HET criteria

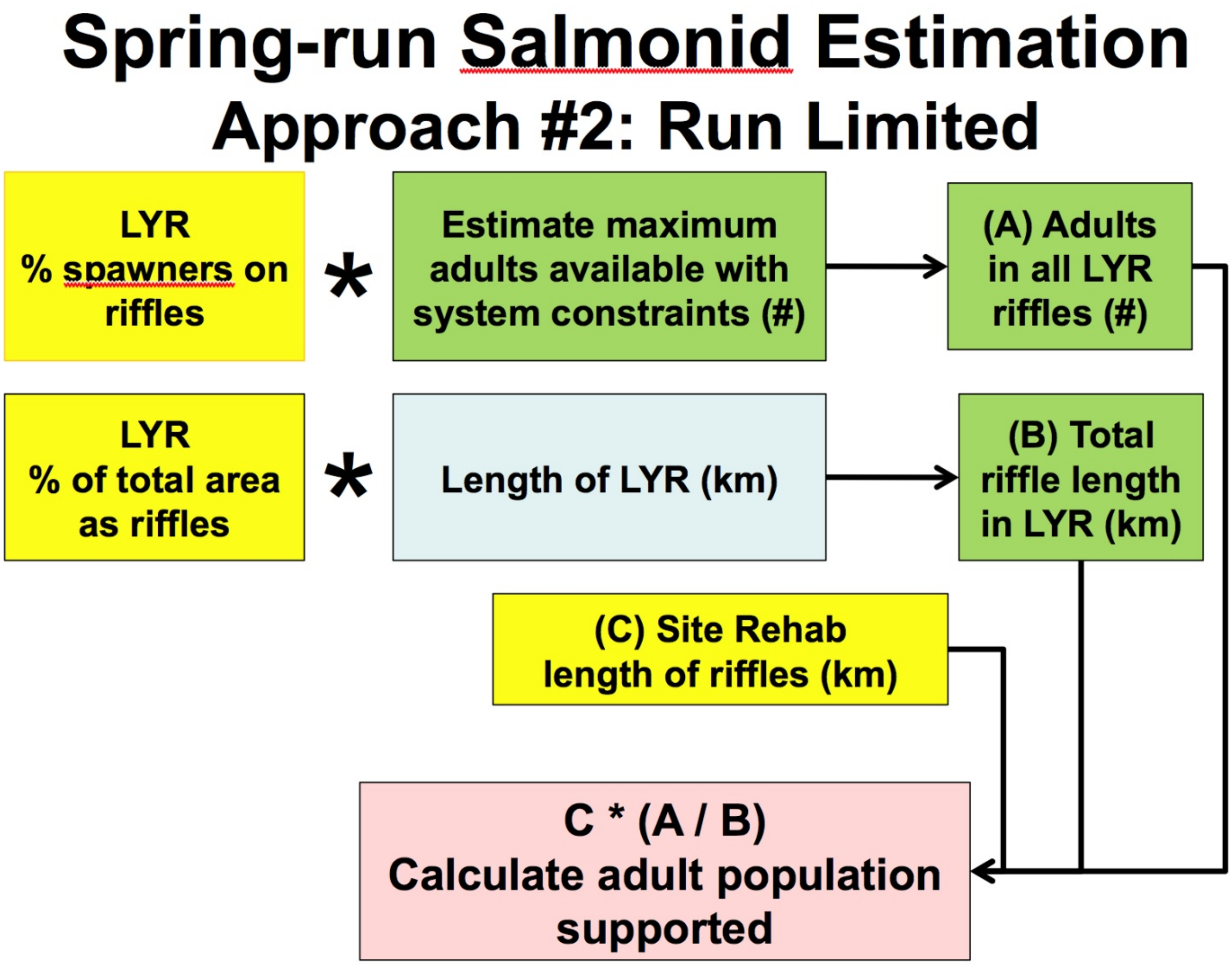


Figure 8.1. Flowchart illustrating the calculation procedure for estimating the run-limited number of SRCS supported through physical habitat rehabilitation in a channel area.

9. REFERENCES

Beak Consultants, Inc. 1989. Yuba River Fisheries Investigations, 1986-88, Summary Report Of Technical Studies On The Lower Yuba River, California.

Childs, J.R., Snyder, N.P., and Hampton, M.A., 2003, Bathymetric and geophysical surveys of Englebright Lake, Yuba-Nevada Counties, California, U.S. Geological Survey Open-File Report 03-383 http://geopubs.wr.usgs.gov/open-file/of03-383.

Elkins, E. E., Pasternack, G. B., and Merz, J. E. 2007. The Use of Slope Creation for Rehabilitating Incised, Regulated, Gravel-Bed Rivers. Water Resources Research 43, W05432, doi:10.1029/2006WR005159.

Gilbert, G.K., 1917, Hydraulic-Mining Debris in the Sierra Nevada: U.S. Geological Survey Professional Paper 105, 154 p.

Grant, G. E., F. J. Swanson, and M. G. Wolman. 1990. Pattern and origin of stepped-bed morphology in high-gradient streams, western Cascades, Oregon. Bulletin of the Geological Society of America 102:340-352.

Kondolf, G.M. 2000. Assessing salmonid spawning gravels. Transactions of the American Fisheries Society 129: 262-281.

MacWilliams, M. L., Wheaton, J. M., Pasternack, G. B., Kitanidis, P. K., Street, R. L. 2006. The Flow Convergence-Routing Hypothesis for Pool-Riffle Maintenance in Alluvial Rivers. Water Resources Research 42, W10427, doi:10.1029/2005WR004391.

Pasternack, G. B. 2008a. Spawning habitat rehabilitation: advances in analysis tools. In (D.A. Sear, P. DeVries, S. Greig, Eds) Salmonid spawning habitat in rivers: physical controls, biological responses, and approaches to remediation. Symposium 65, American Fisheries Society, Bethesda, MD, p. 321-348.

Pasternack, G. B. 2008b. SHIRA-Based River analysis and field-based manipulative sediment transport experiments to balance habitat and geomorphic goals on the lower Yuba River. Cooperative Ecosystems Studies Unit (CESU) 81332 6 J002 Final Report, University of California at Davis, Davis, CA, 569pp.

Pasternack G. B. 2010. Estimate of the number of spring-run Chinook salmon that could be supported by spawning habitat rehabilitation at Sinoro Bar on the lower Yuba River. Prepared for PG&E, Gregory B. Pasternack, Davis, CA.

Pasternack, G. B., Fulton, A. A., and Morford, S. L. 2010. Yuba River analysis aims to aid spring-run Chinook salmon habitat rehabilitation. California Agriculture 64:2:69-77.

Rosgen, D. L. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, Colorado.

Sawyer, A. M., Pasternack, G. B., Moir, H. J., Fulton, A. A. 2010. Riffle-Pool Maintenance and Flow Convergence Routing Confirmed on a Large Gravel Bed River. Geomorphology 114:143-160.

Wheaton, J. M., G. B. Pasternack, and J. E. Merz. 2004a. Spawning habitat rehabilitation-I. conceptual approach and models. International Journal of River Basin Management 2: 3-20.

Wheaton, J. M., G. B. Pasternack, and J. E. Merz. 2004b. Spawning habitat rehabilitation-II. Using hypothesis development and testing in design, Mokelumne River, California, U.S.A. International Journal of River Basin Management 2: 21-37.

White, J. Q., Pasternack, G. B., and Moir, H. J. 2010. Valley width variation influences riffle-pool location and persistence on a rapidly incising gravel-bed river. Geomorphology 121:206-221.

Appendix L

Potential Juvenile Rearing Habitat Expansion Actions in the Lower Yuba River

Appendix L
Potential Juvenile Rearing Habitat Expansion Actions in the Lower Yuba River

Aquarium Pool
Photo courtesy of William T. Mitchell, ICF International, 2008

L.1 Description

The juvenile rearing habitat expansion actions (potential actions) address historical reductions in off-channel rearing habitat that currently limit production and life history variability of juvenile spring-run Chinook salmon and steelhead in the Lower Yuba River (Figure L-1). The South Yuba River Citizens League (SYRCL) recently prepared a proposal that focuses initially on planning and design for restoration of off-channel rearing habitat in the 3-mile reach below the Highway 20 Bridge (cbec 2010). This is considered a key reach for restoration because of its proximity to the primary spring-run Chinook salmon and steelhead spawning reaches, favorable rearing temperatures, and the limited extent of off-channel habitat. The juvenile rearing habitat expansion actions discussed here would complement a current Anadromous Fish Restoration Program (AFRP)-funded pilot restoration project and utilize a 180-acre conservation easement on land in the Yuba Goldfields owned by Western Aggregates. The general targets identified by SYRCL for the initial phase of the action are restoration of 5 acres of backwater or side-channel habitat and restoration of 50 acres of functional floodplain with enhanced riparian habitat.

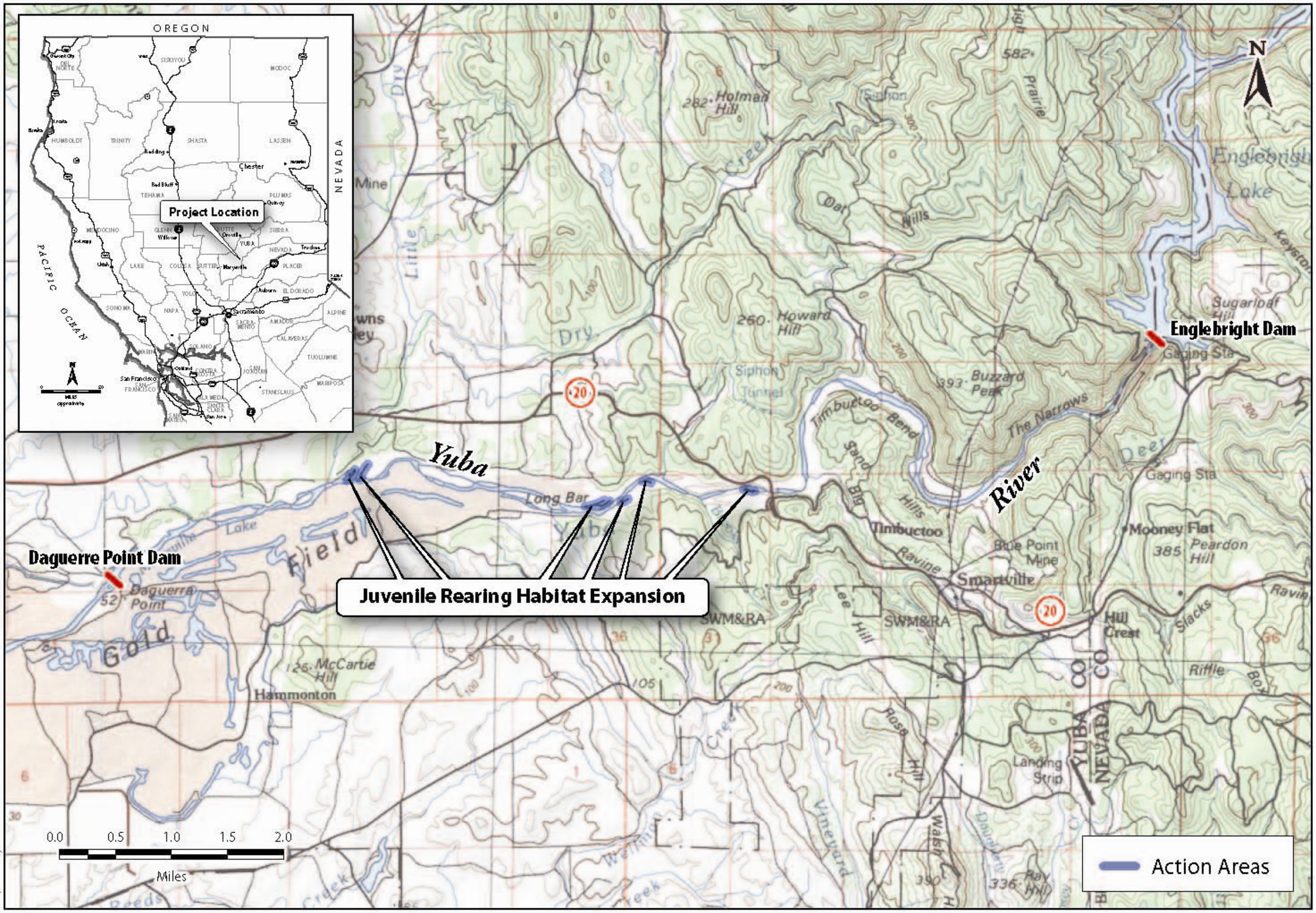


Figure L-1. Location of Potential Juvenile Rearing Habitat Expansion Actions in the Lower Yuba River

The goal of off-channel habitat enhancement is to increase the rearing capacity of the Lower Yuba River to support an increase in production of juvenile spring-run Chinook salmon. The potential actions for achieving this goal would connect, expand, and enhance existing off-channel habitats that, under existing conditions, have limited rearing potential because of their size, water depths, cover characteristics, and degree of connectivity with the main river. Potential expansion and restoration sites include abandoned river channels, overflow channels, flood swales, and associated backwaters that have been the subject of a fish stranding study since 2007 (Mitchell pers. comm.). In addition to investigating the factors influencing stranding risk, this study provided evidence of the significant rearing potential of off-channel habitats for Chinook salmon in the Lower Yuba River.

The primary objectives of the potential actions would be to improve the connectivity of existing off-channel habitats with the main river, and increase the quantity and quality of these habitats for spring and summer rearing of spring-run Chinook salmon. The key sites for this effort are abandoned river channels, overflow channels, and flood swales that are disconnected from the main river at their upper ends but support groundwater-fed channels in their lower reaches at summer and fall flows. Aerial photography and extensive field surveys of off-channel habitats since 2007 have revealed that these are common natural features of the Lower Yuba River floodplain. These off-channel areas are frequently connected to the main river during high winter flows, providing access for Chinook salmon fry that seek out shallow, lower-velocity shoreline and floodplain areas following emergence.

Following high winter flows, fish stranding surveys indicate that the quality of off-channel habitat varies as a function of water depth, cover availability, water quality, and the presence or absence of predators (Mitchell pers. comm.). Many of the surveyed floodplain habitats support fry for variable periods of time following winter flows but do not provide suitable rearing habitat after flows recede because they become too shallow, too warm, or lack sufficient cover to protect fry from piscivorous birds and other predators. However, long-term monitoring of several isolated groundwater-fed channels in 2008 confirmed that some sites can support high densities and growth of juvenile salmon and other native fish species through the spring and summer (Mitchell pers. comm.). Habitat conditions that appear to be important for extended off-channel rearing are the presence of groundwater flow, sufficient water depths, riparian and aquatic vegetation, and the absence of large predatory fish (e.g., pikeminnow).

While floodplain and off-channel habitats are sources of stranding mortality, recent studies have documented significant growth and potential survival benefits associated with floodplain and off-channel habitat use by Chinook salmon in the Central Valley (Limm and Marchetti 2009; Jeffres et al. 2008; Sommer et al. 2001, 2002). Compared to main channel habitats, important attributes of floodplain habitat generally include warmer water temperatures, abundant vegetation, higher prey densities (aquatic insects), lower water velocities, and lower predator abundance. Consequently, floodplain and other off-channel habitats serve important refuge and rearing functions for native fishes; these habitats likely contributed substantially to the productive capacity and life history diversity of Chinook salmon and other fish species in the Sacramento River system before large-scale channel modifications, levee construction, and agricultural conversion of floodplains (Lindley et al. 2009, Yoshiyama et al. 1998). In gravel-bed rivers like the Yuba River, off-channel habitats serve similar ecological functions and may be especially important for juvenile salmon production, given historical reductions in floodplain habitat throughout the lower reaches of the Sacramento River system.

L.1.1 Proposed Design Concept for Juvenile Rearing Habitat Enhancement

The general design concept for rearing habitat enhancement involves excavating and lowering the outlets and interiors of selected overflow channels, flood swales, and isolated groundwater channels and ponds to connect these features to the main river and increase the area of suitable water depths and cover for the target species and life stages. The upper portions of the bars or inlets leading to these off-channel habitats would remain undisturbed to preserve the natural surface and groundwater flow characteristics of the site. A key design feature is the alignment of off-channel habitats along existing overflow channels and riparian vegetation to capitalize on the natural habitat-forming processes inherent at these locations, as well as minimize the volume of material that would need to be excavated to achieve the desired elevations. Large boulder and/or wood complexes would be installed, as needed, to control flows, promote scour, and maintain habitat diversity in areas devoid of existing riparian vegetation or other geomorphic controls (e.g., bedrock).

Figure L-2 shows the locations of six potential rearing habitat expansion sites identified by the Licensees and described below. Figures L-3 through L-6 illustrate the general concepts for these six sites. Selection criteria for these sites included detectable surface water and groundwater flow, presence of riparian and/or aquatic vegetation, proximity to the main channel, and construction access. These sites also were identified because juvenile salmonids and suitable summer water temperatures have been documented at these sites during recent off-channel stranding surveys (Mitchell pers. comm.).

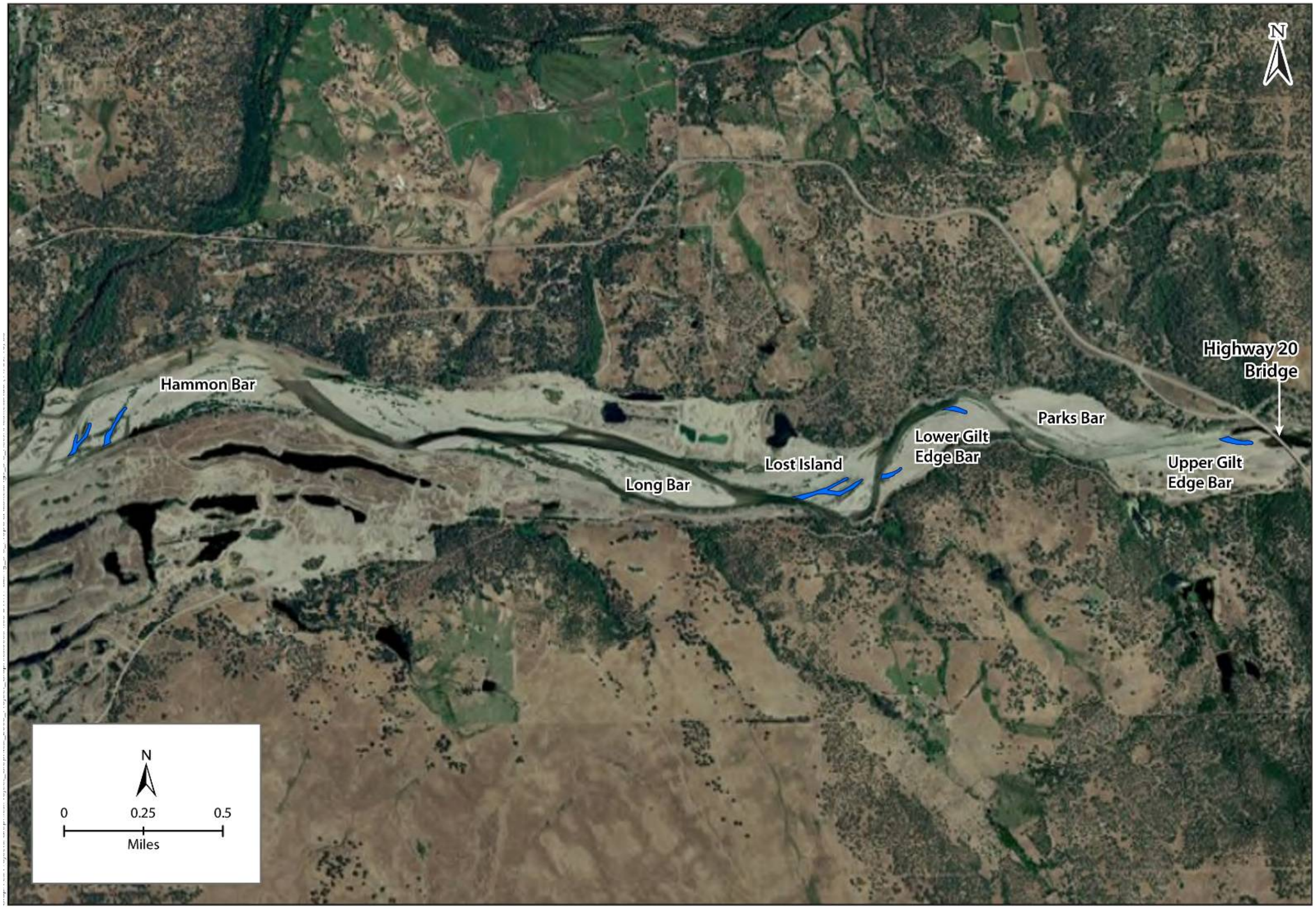


Figure L-2. Potential Juvenile Rearing Habitat Expansion Sites (in blue)

Hammon Bar Side Channel
Photo courtesy of William T. Mitchell, ICF International, 2007

- **Sites 1a and 1b – Hammon Bar (Figure L-3).** The western end of Hammon Bar is characterized by a series of remnant channels that intersect the bar and lead to a large side channel sustained by groundwater flows from the river and the Yuba Goldfields. This side channel supports high densities of juvenile Chinook salmon, steelhead, and other native fishes during spring and summer. Off-channel rearing habitat could be created by excavating two to three channels along the alignments of the remnant channels and preserving the existing riparian vegetation bordering these channels. Approximately 4,000 m^2 would be available as juvenile rearing habitat at Site 1a, and approximately 4,200 m^2 would be available at Site 1b.

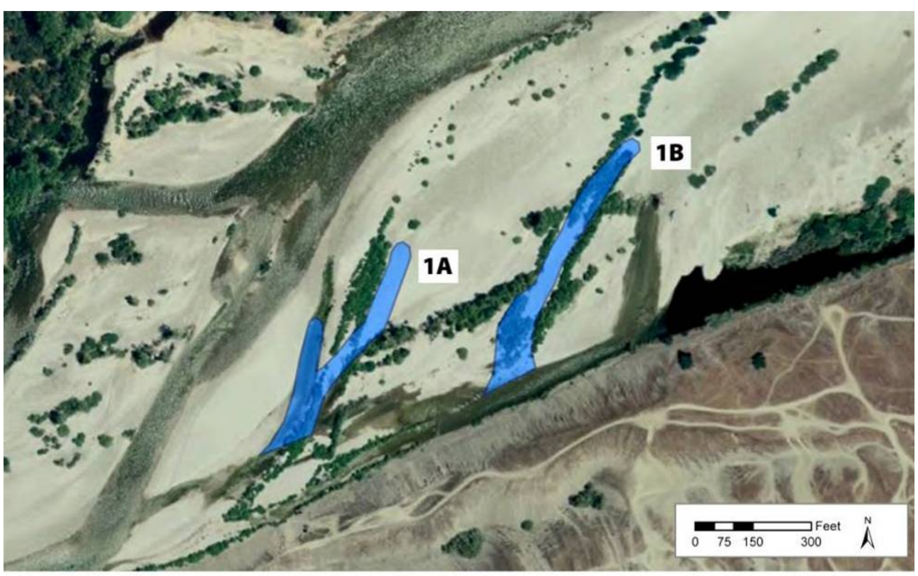


Figure L-3. Off-Channel Habitat Enhancement Concept at Hammon Bar

- **Site 2 – Lost Island (Figure L-4).** This bar is characterized by two large interconnected flood channels that, during low flows, become a series of isolated ponds and depressions formed by flood scour at the base of the existing riparian vegetation. Stranding of juvenile salmonids is frequently observed here because of the frequency of inundation and presence of low-velocity cover (Mitchell pers. comm.). Lowering the bed along the existing flood swales would eliminate the stranding risk and create off-channel rearing habitat. Approximately 8,300 m^2 would be available as juvenile rearing habitat at Site 2. Large boulder and/or woody complexes may be needed along portions of the channels to promote scour, enhance habitat quality, and ensure connectivity with the main river at low flows.

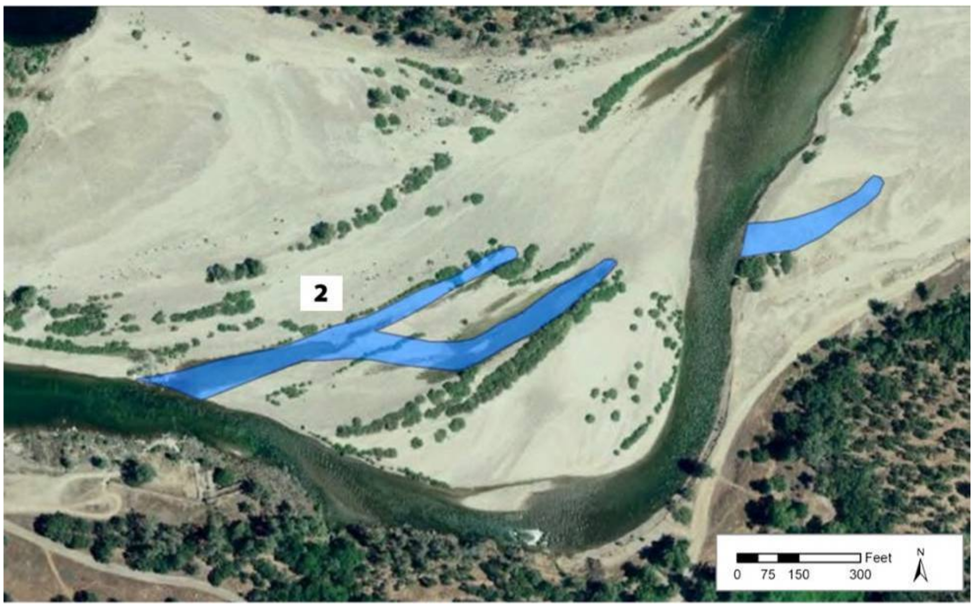


Figure L-4. Off-Channel Habitat Enhancement Concept at Lost Island

- **Sites 3a and 3b – Lower Gilt Edge Bar (Figure L-5).** Site 3b consists of a relatively deep scour feature associated with a band of riparian vegetation adjacent to the main river. The site is noteworthy because of significant groundwater flow and documentation of relatively high densities and growth of juvenile Chinook salmon through summer and fall 2008. The existing habitat would be expanded by removing the sediment plug at the outlet and extending the channel upstream along the existing flood swale. The channel area that would be available as juvenile rearing habitat at Site 3b is approximately 2,000 m^2.

  Additionally, the potential exists for creating one or two similar off-channel habitats farther downstream along the western shoreline of Lower Gilt Edge Bar. The low topography (i.e., swale-like nature) coupled with existing vegetation at several locations along the shoreline provides the potential for creating habitat conditions similar to that described for Site 3b. One potential site, Site 3a, similar in size to Site 3b, is shown in Figure L-5.

Figure L-5. Off-Channel Habitat Enhancement Concept at Lower Gilt Edge Bar

- **Site 4 – Upper Gilt Edge Bar (Figure L-6).** Site 4 is a small flood swale that would be improved by lowering the entire site adjacent to the existing band of riparian vegetation. The channel area that would be available as juvenile rearing habitat is approximately 3,400 m^2 .

Figure L-6. Off-Channel Habitat Enhancement Concept at Upper Gilt Edge Bar

Key assumptions for the potential juvenile rearing habitat expansion actions are that: (1) groundwater channels can be expanded relatively easily and cost effectively using moderate terra-forming techniques; and (2) constructed features would be sustained naturally for many years. As described above, potential habitat enhancement sites follow the alignments of previous river channels and existing flood channels. These areas appear to be ideal locations for creating and expanding juvenile rearing habitat because of the observed stability and persistence of groundwater channels in these areas. However, additional geomorphic and hydrographic analysis would be necessary to fully understand the processes that maintain these channels and their groundwater connections within the selected sites. Additional analyses may include determining the location and gradient of the groundwater table in vicinity of the habitat expansion sites, hydraulic modeling of river and off-channel enhancement areas to determine water surface elevations and associated duration and stage of overbank flow, and assessment of the stability and performance of boulder or large woody placements that may be proposed as part of the design. Sediment transport modeling may not be necessary given the apparent stability of the bars and existing groundwater channels under frequently recurring flood flows.

The number of off-channel habitat expansion sites and their precise locations, areas, and cross-sectional and longitudinal profiles would be determined following completion of the site-specific field evaluations and analyses described above. Several general design guidelines are described below based on the physical characteristics of existing off-channel habitats and habitat relationships of the target species and life stages. To ensure year-round flow and suitable water depths for extended juvenile rearing, off-channel areas should be excavated to a depth of approximately 1 m below the lowest level of the summer water table. An important objective would be to mimic the channel geometry, dimensions, and gradient of existing groundwater channels within the site or other sites where suitable habitat has been documented. Based on field observations, channel gradient does not appear to be a major determinant of habitat quality in groundwater channels; rather, habitat quality appears to be mainly a function of channel depth, riparian cover, and river-floodplain connectivity.

The presence of existing riparian vegetation is a key component of the off-channel habitat design because of its role in promoting scour, enhancing habitat quality, and creating river-floodplain connectivity. While a primary design objective is to minimize dependence on artificial structures, site-specific hydraulic and channel stability assessments may identify the need for additional structural controls or hard points to serve these functions where vegetation is not present. A broad range of boulder and woody structure designs and installation methods are described in the literature. Determining the feasibility and performance of various designs would require a review of the success and failures of these designs under similar settings, as well as site-specific analyses of the hydraulic and geomorphic forces acting on these structures under typical flood flows.

L.2 Objectives and Benefits

The primary objectives of the juvenile rearing habitat expansion actions would be to improve the connectivity of existing off-channel habitats with the main river channel, and increase the quantity and quality of these habitats for extended in-river rearing of spring-run Chinook salmon. Low habitat diversity or complexity is believed to be one of the primary factors limiting production and life history diversity of juvenile salmonids in the Lower Yuba River (Lower Yuba River Fisheries Technical Group 2005). It is hypothesized that the quantity and quality of available rearing habitat limit the rearing capacity of the Lower Yuba River and the number of juveniles that can successfully rear to large sizes (>70 mm FL) before emigrating to the ocean. Limited rearing habitat in the Lower Yuba River may increase the number of Chinook salmon fry that migrate to downstream reaches (Lower Yuba River below Daguerre Point Dam, Feather River, Sacramento River, Delta) where rearing conditions may be less conducive for growth and survival. Thus, increasing the amount of habitat capable of supporting extended in-river rearing of juvenile spring-run Chinook salmon would be expected to increase opportunities for fry to complete the majority of their freshwater rearing in the Yuba River and to increase the overall survival of fry to the smolt stage.

Enhancement of existing off-channel habitats is considered a relatively simple and cost-effective action for achieving juvenile rearing habitat expansion objectives. From a geomorphic perspective, enhancement of natural floodplain habitats can be readily accomplished and has a high probability of success based on current understanding of the natural processes that create and maintain these habitats in the Lower Yuba River. From a biological perspective, these actions are expected to result in immediate and potentially long-term gains in habitat known to support extended in-river rearing of Chinook salmon, and therefore addresses an important limiting factor that has been identified for spring-run Chinook salmon in the Lower Yuba River.

L.3 Estimated Cost

L.3.1 Capital Cost

For the purposes of cost estimation, it was assumed that the newly excavated channels would be trapezoidal in cross section, with top widths of 10 m, bottom widths of 4 m, bank slopes of 1.5 horizontal to 1 vertical, and channel gradients up to 0.5 percent.

The pre-feasibility study capital cost estimate for implementing the juvenile rearing habitat expansion actions, including permitting, design, and construction, is approximately $1.3 million. Construction costs for the action would depend in large part on the amount of gravel excavation necessary to construct side channels and restore functional floodplain habitat.

L.3.2 Operations and Maintenance

The cost of maintaining the juvenile rearing habitat component of the Lower Yuba River Actions is estimated to be $30,000 per year and $1.5 million for 50 years.

L.3.3 Funding Partners

The USFWS AFRP has funded SYRCL for a total of $160,000 for a pilot restoration project intended to inform planning, design, and permitting for a more extensive juvenile rearing habitat project (Campbell pers. comm.). In addition, AFRP has identified funding for ongoing Yuba River salmon habitat evaluation and restoration, some of which might be available for portions of project construction or maintenance. Western Aggregates has pledged to commit $50,000 toward implementation of floodplain restoration on property they own in the area and where they have agreed to establish a 180-acre conservation easement.

L.4 Implementation Schedule

Members of the RMT have suggested (Appendix M in the Final HEP) that, because several tools are already in development and the pilot restoration project design is currently underway, (1) preliminary design and permitting analysis for the juvenile rearing habitat expansion actions could be completed within 1 year; (2) permitting, landowner access, and other issues could be resolved within 1 or 2 years; and (3) construction could be accomplished in one to two seasons.

L.5 Other Issues

Channel design would be coordinated with the SYRCL plans, AFRP-related planning or funded actions, and Western Aggregates floodplain restoration. Because designs for the juvenile rearing habitat expansion actions are still conceptual in nature, constraints and challenges to completing the action may not have been fully identified. Permits and landowner permission would need to be obtained for construction at each of the restoration sites.

L.6 References

L.6.1 Printed References

Jeffres , C. A., J. J. Opperman, and P. B.Moyle. 2008. Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in a California river. Environmental Biology of Fishes 83(4): 449-458.

Limm, M. P., and M. P. Marchetti. 2009. Juvenile Chinook salmon *(Oncorhynchus tshawytscha) growth in off-channel and main-channel* habitats on the Sacramento River, CA using otolith increment widths. Environmental Biology of Fishes 85(2): 141-151.

Lindley, S. T., C. B. Grimes, M. S. Mohr, W. Peterson, J. Stein, J. T. Anderson, L.W. Botsford, , D. L. Bottom, C. A. Busack, T. K. Collier, J. Ferguson, J. C. Garza, A. M. Grover, D. G. Hankin, R. G. Kope, P. W. Lawson, A. Low, R. B. MacFarlane, K. Moore, M. Palmer-Zwahlen, F. B. Schwing, J. Smith, C. Tracy, R. Webb, B. K. Wells, and T. H. Williams. 2009. What caused the Sacramento River fall Chinook stock collapse? Pre-publication report to the Pacific Fishery Management Council. Portland, OR. March 18.

Lower Yuba River Fisheries Technical Group. 2005. Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration. Funded by CALFED and Yuba County Water Agency. Sacramento, CA.

Sommer, T. R., L. Condrad, G. O'Leary, F. Feyrer, and W. C. Harrell. 2002. Spawning and Rearing of Splittail in a Model Floodplain Environment. Transactions of the American Fisheries Society 131: 966-974.

Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001. Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58(2): 325-333.

Yoshiyama, R. M., F. W. Fisher, and P. B. Moyle. 1998. Historical Abundance and Decline of Chinook Salmon in the Central Valley Region of California. North American Journal of Fisheries Management 18: 487-521.

L.6.2 Personal Communication

Campbell, E. Habitat Restoration Coordinator. U.S. Fish and Wildlife Service, Anadromous Fish Restoration Program. Stockton, CA. Telephone conversation with Chris Wilkinson, California Department of Water Resources, regarding juvenile salmonid rearing habitat restoration in the lower Yuba River. October 27, 2009.

Mitchell, Bill. Fisheries Biologist. ICF International. Sacramento, CA. Meeting with the HEA Steering Committee regarding juvenile rearing habitat expansion sites in the lower Yuba River. October 14, 2010.

Appendix M

Habitat Expansion for Spring-Run Chinook Salmon and Steelhead in the Lower Yuba River

Prepared for the HEA Steering Committee by Members of the Yuba Accord River Management Team

HABITAT EXPANSION FOR SPRING-RUN CHINOOK SALMON AND STEELHEAD IN THE LOWER YUBA RIVER

Prepared for the HEA Steering Committee

INTRODUCTION

Representatives of the Habitat Expansion Agreement (HEA) Steering Committee provided the Yuba Accord River Management Team (RMT) with an overview of the HEA project evaluation, selection and approval process. In response to the HEA Steering Committee's request for additional information regarding biological, physical and operational considerations pertinent to the lower Yuba River, the HEA Steering Committee and the Yuba Accord RMT held an informal technical workshop on October 6, 2009. Background information relevant to the lower Yuba River was provided to the HEA Steering Committee, and project-specific implementation considerations were discussed. HEA Steering Committee provided the RMT with a list of questions regarding habitat expansion issues on the lower Yuba River. Subsequent to the HEA Steering Committee and the Yuba Accord RMT informal technical workshop, the RMT conducted a field tour of the lower Yuba River on October 7, 2009 and reviewed and further discussed potential habitat expansion projects.

The RMT does not feel that it would be appropriate to provide comments as a group. Members of the RMT have different views and perspectives about some habitat restoration measures, and may choose to provide comments on behalf of their respective agencies. However, some of the members of the RMT did work together to draft comments for the HEA Steering Committee, and to provide some feedback on the questions posed. Those comments are incorporated into this document.

The Yuba Accord RMT membership includes Yuba County Water Agency (YCWA), California Department of Fish and Game (CDFG), National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), the South Yuba River Citizens League (SYRCL), the Bay Institute, Friends of the River, Trout Unlimited, PG&E, and Department of Water Resources (DWR), with the collaboration of the Pacific States Marine Fisheries Commission (PSMFC) and University of California at Davis (UC Davis). RMT responsibilities include providing input to real-time operational decisions, developing and implementing a Monitoring and Evaluation Program (M&E Program), and guiding the implementation of specific habitat restoration pilot projects. Using revenues generated by the water transfer program component of the Yuba Accord, YCWA is providing $6 million (about $550,000 annually) to implement the M&E

Program, and an additional $300,000 of funding dedicated to development and implementation of pilot restoration projects.

BACKGROUND

Goals of the Habitat Expansion Agreement

The overall goal of the HEA is to expand the amount of habitat with the physical characteristics necessary to support spawning, rearing and adult holding of spring-run Chinook salmon (and steelhead) in the Sacramento River Basin. The specific Habitat Expansion Threshold (HET) is to expand spawning, rearing and adult habitat sufficiently to accommodate an estimated net increase of 2,000 to 3,000 spring-run Chinook salmon for spawning in the Sacramento River Basin. The HET is focused on spring-run Chinook salmon as the priority species, because expansion of habitat for spring-run Chinook salmon typically accommodates steelhead as well.

Lower Yuba River Potential to Meet Identified Habitat Expansion Agreement Goals and Thresholds

The lower Yuba River supports persistent populations of spring-run Chinook salmon and steelhead, and historically supported the largest, naturally-reproducing population of steelhead in the Central Valley (CDFG 1996). The lower Yuba River is among the last Central Valley floor tributaries supporting populations of naturally-spawning spring-run Chinook salmon and steelhead.

The lower Yuba River, extending approximately 24 miles from Englebright Dam downstream to the confluence with the Feather River near Marysville, is the largest river in the Central Valley not supported by a hatchery (**Figure 1**). The lower Yuba River has a high potential to meet the HEA goals and thresholds, and to meet the NMFS recovery objectives of supporting a viable independent population of spring-run Chinook salmon (and steelhead) primarily because: (1) the river continues to support persistent populations of spring-run Chinook salmon and steelhead; (2) flow and water temperature conditions under the Lower Yuba River Accord are suitable to support all life stage requirements; (3) the river does not have a hatchery on it; and (4) high habitat enhancement potential. These attributes are particularly important when considering long-term climate change (discussed below).

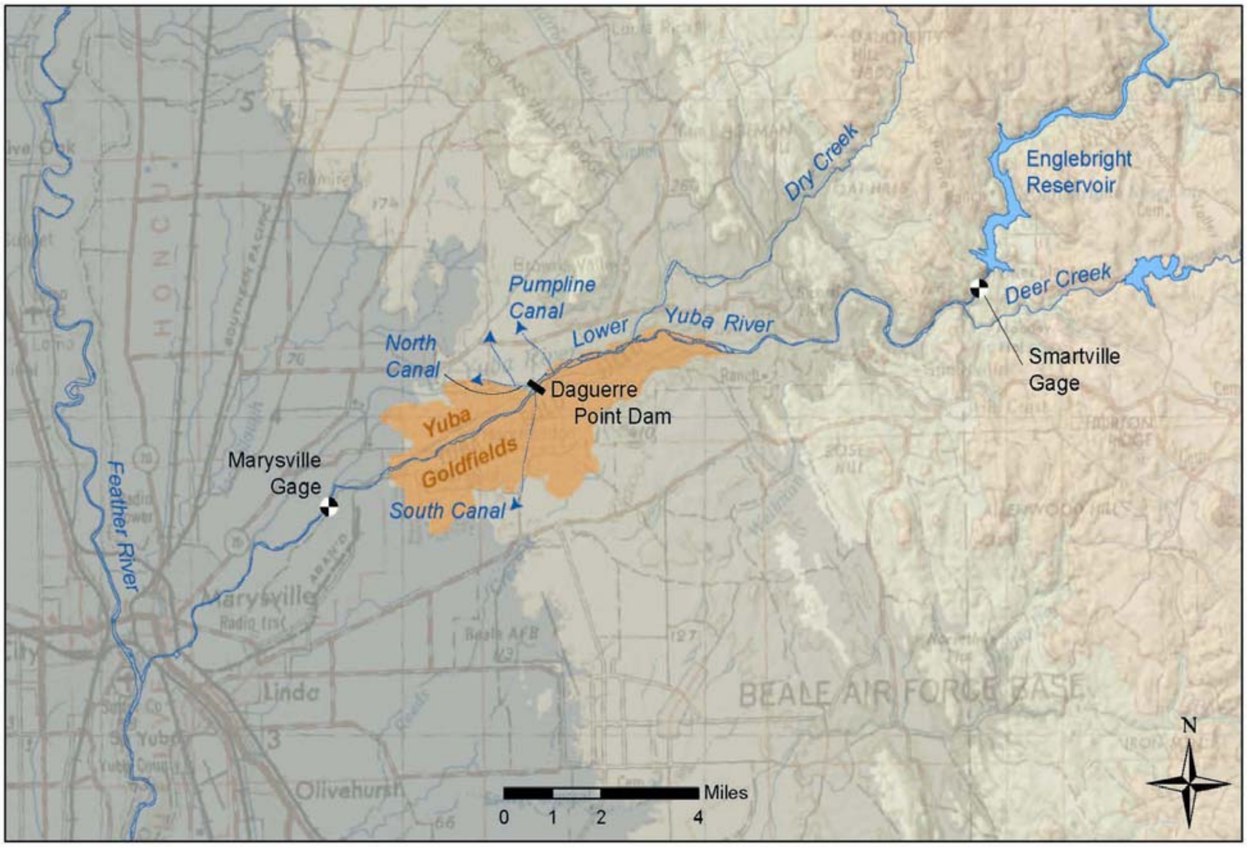


Figure 1. Lower Yuba River

The NMFS (2009) Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon, and the Distinct Population Segment of Central Valley Steelhead ("Draft Recovery Plan") recognizes the importance and potential to increase spring-run Chinook salmon and steelhead populations in the lower Yuba River. The Draft Recovery Plan established three priority levels to help guide recovery efforts for watersheds that are currently occupied, and are referred to as Core 1, 2, and 3 populations. Core 1 Populations are highest priority, have a known ability or potential to support viable populations, and have the capacity to respond to recovery actions (NMFS 2009). Spring-run Chinook salmon and steelhead in the lower Yuba River are Core 1 populations (NMFS 2009). Core 1 populations form the foundation of the recovery strategy, and should be the first focus of an overall recovery effort (NMFS 2009).

The Draft Recovery Plan states that "…*many of the processes and conditions that are necessary to support a viable independent population of spring-run Chinook salmon can be improved with provision of appropriate instream flow regimes, water temperatures, and habitat availability. Continued implementation of the Yuba Accord is expected to address these factors and considerably improve conditions in the lower Yuba River*".

After two one-year pilot programs in 2006 and 2007, on March 18, 2008 the State Water Resources Control Board (SWRCB) approved the consensus-based, comprehensive Yuba Accord to protect and enhance aquatic habitat in the lower Yuba River. The Yuba Accord will be in effect at least until 2016. Beyond 2016, it is anticipated that the Lower Yuba River Accord flow schedules will be the basis of new FERC license requirements for the lower Yuba River.

Presently, the lower Yuba River is one of the few Central Valley floor tributaries that consistently provides suitable water temperatures for salmonids throughout the year. In fact, water temperature evaluations conducted for the Yuba Accord EIR/EIS indicate that Yuba River water temperatures generally remain suitable for all life stages of spring-run Chinook salmon and steelhead. Water temperatures generally remain below 58°F year-round (including summer months) at Smartsville, and below 60°F year-round at Daguerre Point Dam (YCWA *et al.* 2007). At Marysville, water temperatures generally remain below 60°F from October through May, and below 65°F from June through September (YCWA *et al*. 2007).

Habitat Conditions

Major factors (not directly flow-related) continuing to influence the status of naturally-spawning spring-run Chinook salmon and steelhead in the Yuba River include: (1) blockage of historic spawning habitat resulting from the construction of the U.S. Corp of Engineers (Corps) Englebright Dam in 1941, which has implications for the spatial structure of the populations; (2) impaired adult upstream passage at the Corps Daguerre Point Dam; (3) unsuitable spawning conditions in the uppermost area (i.e., Englebright Dam to the Narrows) of the lower Yuba River; and (4) impaired juvenile downstream passage at Daguerre Point Dam. Additionally, other factors continue to influence juvenile spring-run Chinook salmon and steelhead habitat suitability including sparse and restricted amounts of riparian vegetation and associated instream object and overhanging object cover, limited aquatic habitat complexity and diversity, and altered natural river function and morphology in the lower Yuba River (CALFED and YCWA 2005).

The section of the lower Yuba River extending from Englebright Dam downstream through the Narrows (Englebright Dam Reach) is steep and contains a series of rapids, runs, and deep pools confined by a bedrock canyon (CALFED and YCWA 2005). Habitats classified as moderate gradient riffles are found only in this reach of the lower Yuba River (CALFED and YCWA 2005). Salmonid spawning gravels are scarce in the Englebright Dam Reach due to the truncation of gravel recruitment resulting from the construction of Englebright Dam and the high-energy hydraulic nature of this reach. Furthermore, the quantity and quality of salmonid spawning habitat in this reach has been significantly reduced by the deposition of large, consolidated rock fragments (i.e., "shot-rock") downstream of Englebright Dam, resulting from dam construction and hillside landslides during major floods (Pasternack 2009). Additionally, local instream gravel mining has influenced potential spawning habitat in this reach.

Downstream of the Englebright Dam Reach, spawning gravels are abundant and generally of high quality throughout the lower Yuba River with the exception of the lowermost reach (Simpson Lane Reach) (YCWA *et al.* 2000).

Although montane hardwoods occupy much of the Englebright Dam Reach, the steep-walled canyons preclude riparian growth immediately adjacent to the river channel, thereby affecting aquatic habitat suitability (CALFED and YCWA 2005). In the vicinity of Daguerre Point Dam, the lower Yuba River is largely devoid of sufficient riparian vegetation commonly associated with highly suitable juvenile salmonid rearing habitat conditions (CALFED and YCWA 2005). The Yuba Goldfields area, comprised of approximately 11,000 acres of land adjoining the lower Yuba River near Daguerre Point Dam, is the result of intensive gold dredging in the late 1800s and early 1900s when up to 27 gold dredges simultaneously operated along the river and floodplain (Smith 1990). The Yuba Goldfields section near Daguerre Point Dam is largely devoid of streamside vegetation.

Shaded riverine aquatic (SRA) habitat generally occurs in the lower Yuba River as scattered, short strips of low-growing woody species (e.g., *Salix sp*.) adjacent to the shoreline (CALFED and YCWA 2005). The most extensive and continuous segments of SRA habitat occur along bars where recent channel migrations or avulsions have cut new channels through stands of riparian vegetation. Due to a lack of riparian vegetation throughout much of the lower Yuba River, coupled with Englebright Dam precluding the downstream transport of woody material, instream woody material also is limited in the lower Yuba River (CALFED and YCWA 2005).

In recent years, another factor influencing the status of naturally-spawning spring-run Chinook salmon and steelhead in the lower Yuba River included flow fluctuations (YCWA *et al.* 2007; CALFED and YCWA 2005). However, since the issuance of the SWRCB Yuba Accord Decision, a full-flow bypass structure has been installed on the Narrows II hydropower facility which will essentially eliminate the potential for flow fluctuations to occur in the lower Yuba River associated with maintenance and operation of the Narrows II facility.

MONITORING AND EVALUATION

Anadromous salmonid management in California's Central Valley suffers from the lack of sufficiently-funded, comprehensive, and sustained monitoring programs. The lower Yuba River is unique among Central Valley Rivers in that an ongoing monitoring and evaluation program, based on quantified expressions of the viable salmonid population (VSP) concept, provides the opportunity to develop and evaluate the implementation of habitat expansion projects.

The Yuba Accord includes a Fisheries Agreement, under which YCWA cooperatively manages the flows of the lower Yuba River according to certain specified criteria, and provides $550,000 of annual funding for monitoring and evaluation of fish populations (including spring-run Chinook salmon and steelhead), aquatic habitat conditions, and fish-habitat interactions through the year 2016. Additionally, extensive in-kind contributions from YCWA and CDFG, plus solicitation of grant funding when available, further extend the monitoring and evaluation budget.

The Yuba Accord River Management Fund is administered by the RMT, which has developed and is implementing the Yuba Accord M & E Program. Because of the complexity associated with the multiple considerations for monitoring and evaluation efforts within the lower Yuba River, the M&E Program framework is designed to evaluate whether implementation of the Yuba Accord maintains fish in good condition, and promotes viable salmonid populations in the lower Yuba River.

McElhany *et al.* (2000) developed the "Viable Salmonid Population" (VSP) concept to facilitate establishment of Evolutionarily Significant Unit (ESU)-level delisting goals and to assist in recovery planning by identifying key parameters related to population viability. As presented in Good *et al.* (2007), criteria for viable salmonid populations (VSP) are based upon measures of population parameters that reasonably predict extinction risk and reflect processes important to populations: (1) abundance; (2) productivity; (3) diversity; and (4) spatial structure (McElhany *et al.* 2000). Abundance is critical, because small populations are generally at greater risk of extinction than large populations. Stage-specific or lifetime productivity (i.e., population growth rate) provides information on important demographic processes. Abundance and productivity data are used to asses the status of populations of threatened and endangered ESUs (Good *et al.* 2005). Genotypic and phenotypic diversity are important in that they allow species to use a wide array of environments, respond to short-term changes in the environment, and survive long-term environmental change. Spatial structure reflects how 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.

In the M&E Program, performance indicators associated with each of the VSP parameters (Abundance, Productivity, Diversity and Spatial Structure) and analytical steps ("analytics") to address each of these performance indicators are provided separately for the adult and juvenile lifestages of the anadromous salmonids, including spring-run Chinook salmon and steelhead, in the lower Yuba River. Completed, ongoing, or planned M&E Program activities include the following:

- Flow and Water Temperature Monitoring
- Morphological Unit & Mesohabitat Classification
- Substrate and Cover Classification and Mapping
- Topographic Mapping
- Development of a Digital Elevation Model of the entire 24 miles of the lower Yuba River
- Development of a 2-D Hydraulic Model
- Acoustic Tracking of Phenotypic Spring-run Chinook Salmon

- Genetic Analysis of Spring-run and Fall-run Chinook Salmon
- Chinook Salmon Escapement (Carcass) Surveys
- Adult Salmonid Biological Sampling (otoliths, scales, tissue, CWT)
- VAKI Riverwatcher System Monitoring of Fish Passage at Corps' Daguerre Point Dam
- Angler Surveys
- Redd (and Superimposition) Surveys
- Juvenile Outmigration Rotary Screw Trapping
- Juvenile Habitat Utilization Snorkel Surveys

Information obtained through the Yuba Accord M&E Program provides a basis to develop and consider habitat expansion projects in the lower Yuba River, within the context of the HET and expanded habitat utilization. Additionally, the Yuba Accord M&E Program will serve as a baseline for the future evaluation of habitat expansion projects in the lower Yuba River and, if lower Yuba River habitat expansion projects are implemented in a timely fashion, the Yuba Accord M&E Program could directly evaluate population response, as well as serve as a baseline.

LOWER YUBA RIVER HABITAT EXPANSION CONSIDERATIONS

The intent of the HEA is to create "permanent" solutions to problems, or at least to provide benefits through the term of a typical Federal Energy Regulatory Commission license (i.e., up to 50 years). Where possible, projects should address the root cause of current habitat constraints rather than dealing with their symptoms or surface expression, and should consider the potential effects of climate change.

CLIMATE CHANGE AND HABITAT EXPANSION SUSTAINABILITY

The scientific, political, and public priorities associated with long-term climate change are evolving toward determining its ecosystem impacts, and developing strategies for adapting to those impacts.

Studies suggest that up to 40 percent of Pacific Northwest salmon populations may be lost by 2050 (Battin *et al.* 2007). In California and the Pacific Northwest, most wild salmon populations are extinct or imperiled in 56 percent of their historical range (Francis and Mantua 2003). Studies also suggest that about one-third of the current habitat for salmon and other coldwater fish will no longer be suitable for them by the end of this century as key temperature thresholds are exceeded (Thomas *et al.* 2009). Because climate change impacts on salmon and steelhead habitat is projected to be negative, climate change is expected to hinder efforts to recover depleted populations of Chinook salmon and steelhead (Thomas *et al.* 2009). Climate change also could be reasonably expected to affect the sustainability of habitat expansion projects in the Central Valley.

In California, there have been observed changes in air temperatures, annual precipitation, runoff, and sea levels over the past century (Anderson *et al.* 2008). Regional-scale climate models for California are in broad agreement that temperatures in the future will warm significantly, total precipitation may decline, and snowfall will decline significantly (Lindley *et al.* 2007). Literature suggests that by 2100, mean summer temperatures in the Central Valley may increase by 2 to 8°C, precipitation will likely shift to more rain and less snow, with significant declines in total precipitation possible, and hydrographs will likely change, especially in the southern Sierra Nevada mountains. Thus, climate change poses an additional risk to the survival of salmonids in the Central Valley.

Long-term climate change considerations emphasize the importance of implementing habitat expansion projects in locations where they would be expected to be sustainable. The lower Yuba River has a high potential to sustain spring-run Chinook salmon and steelhead populations, primarily because of suitable flows and the consistent flow of cold water.

The lower Yuba River is expected to provide the most suitable water temperature conditions for anadromous salmonids, of all Central Valley floor rivers, in consideration of long-term climate change because of specific physical and hydrologic factors. New Bullards Bar Reservoir is a deep, steep-sloped reservoir with ample coldwater pool reserves. Throughout the period of operations of New Bullards Bar Reservoir (1969 through present), which encompasses the most extreme critically dry year on record (1977), the coldwater pool in New Bullards Bar Reservoir has not been depleted. Since 1993, coldwater pool availability in New Bullards Bar Reservoir has been sufficient to accommodate year-round utilization of the lower river outlets at the direction provided by CDFG in order to provide cold water to the lower Yuba River.

Recovery Actions and Habitat Expansion Projects

The conceptual recovery scenarios for spring-run Chinook salmon and steelhead in the Draft Recovery Plan include: (1) securing extant populations by implementing key habitat restoration actions, particularly in the near term; and (2) establishing additional viable independent populations.

In order to secure viable independent populations of spring-run Chinook salmon and steelhead in the lower Yuba River, the Draft Recovery Plan identified several key near-term and long-term habitat restoration actions, including the following:

- Continue implementation of the Yuba Accord flow schedules to provide suitable habitat (flow and water temperature) conditions for all life stages
- Implement a spawning habitat rehabilitation program in the uppermost area (i.e., Englebright Dam to the Narrows) of the lower Yuba River
- Improve riparian habitats for juvenile salmonid rearing
- Create and restore side-channel habitats to increase the quantity and quality of off-channel rearing (and spawning) areas
- Implement projects to increase floodplain habitat availability to improve habitat conditions for juvenile rearing
- Improve adult and juvenile salmonid passage at Daguerre Point Dam

According to HEA Evaluation Criterion (b), a number of projects might need to be concentrated in a single watershed to result in sufficient environmental change to meet the HET.

The HEA Steering Committee considered several individual habitat expansion actions in combination for the lower Yuba River. The HEA Steering Committee considered integration of these actions because they believed that the actions potentially benefited each other. The following actions are being considered by the HEA Steering Committee for the lower Yuba River:

- Spawning habitat rehabilitation of the Englebright Dam Reach, including Deer Creek
- Side channel, floodplain and riparian habitat restoration
- Operation of a segregation weir in the 6-mile reach between the Highway 20 Bridge and Englebright Dam
- Fish passage improvements at Daguerre Point Dam

Total funding availability, engineering feasibility, operations and maintenance, and action sustainability may require consideration of the priority of specific actions within the suite of potential actions for the lower Yuba River, and consideration of each action's ability to achieve biological benefit and accomplishment of the goals of the HEA. For example, two of the four actions directly address the overall goal of the HEA, which is to expand the amount of habitat with the physical characteristics necessary to support spawning, rearing and adult holding of spring-run Chinook salmon and steelhead in the Sacramento River Basin: (1) spawning habitat rehabilitation of the Englebright Dam Reach; and (2) side channel, floodplain and riparian habitat restoration.

The two remaining actions do not directly address the overall goal of the HEA: (3) operation of a segregation weir in the 6-mile reach between the Highway 20 Bridge and Englebright Dam; and (4) fish passage improvements at Daguerre Point Dam.

- Design, construction, operation and maintenance of a segregation weir does not, unto itself, expand habitat. Rather, the stated intent is to accomplish geographic distinction and thereby reduce the potential for genetic introgression between fall-run Chinook salmon and spring-run Chinook salmon.

- Although improved fish passage at Daguerre Point Dam would help to facilitate access to available upstream habitat, it would not expand the amount of habitat with the physical characteristics necessary to support spawning, rearing and adult holding of spring-run Chinook salmon and steelhead.

Spawning Habitat Rehabilitation of the Englebright Dam Reach, Including Deer Creek

Englebright Dam was constructed by the Corps in 1941 on the lower Yuba River to trap hydraulic mining debris resulting from the gold rush in California. The dam has been blocking the natural recruitment of spawning gravels in the Englebright Dam Reach, extending approximately 0.8 miles downstream from Englebright Dam to the confluence with Deer Creek, for over 65 years. In many areas of this reach, the spawning gravels are completely absent and have been replaced by a bedrock substrate. Spring-run Chinook salmon have been observed to migrate and hold in this area of river, but spawning success has been largely impacted by a lack of suitable spawning habitat.

The Englebright Dam Reach spawning habitat rehabilitation component is highly feasible, based upon a 5-year (2003-2008) comprehensive investigation conducted to ascertain the linkages between hydrology, geomorphology, and ecology (Pasternack 2009), and a 2007 pilot gravel injection study. Pasternack (2009) highly recommended that spawning habitat rehabilitation in this reach be designed using the Spawning Habitat Integrated Rehabilitation Approach (SHIRA) that is in use on the Feather, American, Trinity, and Mokelumne Rivers. For details, see the website at http://shira.lawr.ucdavis.edu. Using SHIRA would ensure that a project of this magnitude would immediately yield spawning habitat, as has been thoroughly documented on the Mokelumne and Trinity rivers.

There are three shot-rock deposits in the Englebright Dam Reach. First, an extremely coarse and thin veneer occurs at the upper end of the reach on river right. Second, angular cobble forming a bar is located just upstream of the USGS Gaging Station rapid that impacts the gaging station every time there is a flood. Third, a mixture of angular gravel, cobbles, and boulders is located upstream of the junction with Deer Creek on river right. This deposit is called Sinoro Bar. Thus, there are two big deposits on river right and one small deposit on river left (Pasternack 2009).

To yield high quality Chinook spawning habitat in the Englebright Dam Reach, Pasternack (2009) stated that a spawning habitat rehabilitation project must accomplish two things. First, it must remove the massive amount of shot-rock off of Sinoro Bar, returning that entire point bar to the elevation of the water’s surface at approximately 800 cfs. Second, it must place suitable spawning gravel into the river, substantially filling in the present channel and changing site-specific hydraulic characteristics to new suitable patterns. Shot-rock removal, localized grading, and gravel injection will improve spawning habitat by restoring natural channel morphological units, restoring natural channel form and unit types synonymous with spawning habitat values (i.e. pool, riffle, bank structure, LWD retention, etc.), and restoring natural spawning substrate absent in this reach. Once spawning habitat rehabilitation is performed in this reach, it would be possible to sustain the project using gravel injection at the upper portion of this reach (e.g., downstream from the Narrows II Powerhouse).

Wheaton *et al.* (2004) further described how spawning habitat rehabilitation is segregated into three categories: (1) gravel augmentation; (2) hydraulic structure placement; and (3) spawning bed enhancement. Gravel augmentation (also known as gravel injection, infusion or replenishment) involves dumping clean spawning gravels into piles along the edges of a river (usually just downstream of a dam). For this approach to yield usable spawning habitat, practitioners must assume that high flows occur in the near future, that augmented gravels entrain during high flows, and that gravels do not fill mining holes or pools but instead deposit as bars or riffles. Hydraulic structure placement entails placement of large woody debris (LWD), boulder clusters, v-dams or similar structures to alter hydrodynamics in such a way that spawning gravels are deposited in the vicinity of the structures (Brookes *et al*. 1996 in Wheaton *et al*. 2004). The technique relies on an adequate supply of gravel from upstream and an active bedload transport regime to deliver it. Such structures may also be intended to provide refugia, cover and add habitat heterogeneity (Van-Zyll-De-Jong *et al*. 1997 in Wheaton *et al.* 2004). Spawning bed enhancement is the direct modification of the bed to provide immediate spawning habitat (e.g., riffle construction, bed ripping and riffle cleansing). Although bed enhancement may quickly provide usable spawning habitat, limited project lifespan may result without adequate consideration of geomorphic processes or regular gravel replenishment (Kondolf 2000b in Wheaton *et al.* 2004). In summary, spawning habitat rehabilitation projects are typically reach-scale restoration activities sometimes, but not necessarily, nested within a larger, long-term, basin-scale management plan (e.g., McBain and Trush 1997 in Wheaton *et al.* 2004).

Spawning habitat rehabilitation in the Englebright Dam Reach is expected to expand available spawning habitat primarily for spring-run Chinook salmon, because suitable flow and water temperature regimes already exist. A pilot gravel injection project was successfully completed in the Englebright Dam Reach during November 2007. Approximately 361 cubic yards of spawning gravels were injected below the Narrows II Powerhouse. Aerial redd surveys conducted during 2008 and snorkel surveys conducted during 2009 identified spring-run Chinook salmon utilizing small, localized pockets of gravel created by this pilot project. However, additional gravels, as well as hydraulic structure placement and spawning bed enhancement, are needed to fully rehabilitate this reach. Thus, the Englebright Dam Reach spawning habitat rehabilitation project is specifically comprised of shot-rock removal from Sinoro Bar, hydraulic structure placement and spawning bed enhancement of Sinoro Bar, gravel injection downstream of Narrows II Powerhouse for recruitment to Sinoro Bar, and possible direct placement of gravel on Sinoro Bar itself (**Figure 2**).

Figure 2. The Sinoro Bar site for spawning habitat rehabilitation.

Spawning habitat rehabilitation in the Englebright Dam Reach of the lower Yuba River could provide additional spawning habitat to achieve the specific HET to accommodate an estimated net increase of 2,000 to 3,000 spring-run Chinook salmon spawning annually. A realistic approach to estimate the number of spring-run Chinook salmon that would be expected to utilize the habitat expansion resulting from the Englebright Dam Reach spawning habitat rehabilitation project is based on observations of actual SHIRA sites. The most data from SHIRA rehabilitation sites in the Central Valley is available from the Mokelumne River. For those SHIRA sites, 2005 redd surveys resulted in a calculation of 1 Chinook salmon redd per 17m^2. For the Sinoro Bar project, an approximate area estimate of 40,500 m^2 could be expected to result in establishment of 2,382 spring-run Chinook salmon redds. Assuming 2 spring-run Chinook salmon adults per redd, the result would be 4,764 adult spring-run Chinook salmon.

Gravel augmentation in lower Deer Creek has been included as a potential component of the project. Spawning habitat rehabilitation in lower Deer Creek may have substantial benefit for steelhead. However, concerns persist regarding the efficacy of gravel augmentation in Deer Creek due to: (1) flow patterns associated with releases from Lake Wildwood; (2) the presence of a significant falls located approximately 500 feet upstream of the mouth of Deer Creek which is likely impassable during drier years, although steelhead have been found above the falls during wetter years with high runoff (CDFG 1991); and, particularly (3) extant water temperatures during the spring-run Chinook salmon spawning period.

Side Channel, Floodplain, and Riparian Habitat Restoration

As previously mentioned, several factors continue to influence juvenile spring-run Chinook salmon and steelhead rearing habitat suitability: (1) including sparse and restricted amounts of riparian vegetation and associated instream object and overhanging object cover; (2) limited aquatic habitat complexity and diversity; and (3) altered natural river function and morphology in the lower Yuba River. SRA habitat generally occurs in the lower Yuba River as scattered, short strips, with the most extensive and continuous segments of SRA habitat occurring along bars where recent channel migrations or avulsions have cut new channels through stands of riparian vegetation.

The juvenile salmonid rearing habitat expansion actions directly address the overall goal of the HEA, which is to expand the amount of habitat with the physical characteristics necessary to support spawning, rearing and adult holding of spring-run Chinook salmon and steelhead. Moreover, these actions are consistent with several key near-term and long-term habitat restoration actions identified in the Draft Recovery Plan for the lower Yuba River, including: (1) the creation and restoration of side-channel habitats to increase the quantity and quality of off-channel rearing (and spawning) areas; (2) improvement of riparian habitats for juvenile salmonid rearing; and (3) implementation of projects to increase floodplain habitat availability to improve habitat conditions for juvenile rearing.

Several ongoing activities addressing habitat enhancement opportunities in the lower Yuba River have recently been funded by the RMT, Anadromous Fish Restoration Program (AFRP), and PG&E. These activities include conducting studies and obtaining fluvial/geomorphological information necessary to guide habitat enhancement actions, and also include the conduct of pilot habitat enhancement projects in the lower Yuba River. The RMT M&E Program has completed or soon will have available invaluable information to guide specific spring-run Chinook salmon (and steelhead) juvenile rearing habitat enhancement actions. In addition to habitat utilization, specific physical habitat capabilities, which will be generally available (including to the HEA Steering Committee), to guide habitat enhancement actions include:

- Morphological Unit & Mesohabitat Classification
- Substrate and Cover Classification and Mapping
- Topographic Mapping
- Development of a Digital Elevation Model of the entire 24 miles of the lower Yuba River
- Development of a 2-D Hydraulic Model

In addition, SYRCL has been funded by the AFRP to conduct a pilot project, taking advantage of a conservation easement on Western Aggregates land, directed towards enhancing juvenile salmonid rearing habitat. The pilot project is considering creation of new functional floodplain habitat, off-channel rearing habitat (backwaters and side-channels), installation of large wood structure and enhancement of riparian vegetation. At present, a pre-project assessment is being conducted to inform opportunities for juvenile salmonid habitat enhancements in a 3.5-mile study reach from Parks Bar to Hammon Bar on the lower Yuba River. The pre-project assessment is addressing the geomorphic, hydrologic, and biotic factors influencing: (1) available floodplain habitat; (2) creation and maintenance of marginal and off-channel rearing habitat; and (3) riparian recruitment, growth, and survival in the project area. Current work includes a public outreach component to inform nearby landowners, concerned stakeholders, and watershed groups about the proposed pilot project. Information obtained through this pilot project also will inform future habitat enhancement actions in the lower Yuba River.

Members of the RMT conducted a field tour of the lower Yuba River on October 7, 2009, and among other activities reviewed and further discussed potential spring-run Chinook salmon (and steelhead) juvenile rearing habitat expansion projects. Some of the RMT representatives believe that the most beneficial and cost-effective type of juvenile rearing habitat expansion projects, and those that would yield the most immediate benefits, would be the creation of new side-channel habitats associated with existing stands of riparian vegetation not hydraulically connected to the river channel. Specifically, the benefit of new side-channel habitats would: (1) increase and maintain existing riparian vegetation; (2) provide instream object and overhanging object cover; (3) provide new SRA, and associated allochthonous food sources for rearing juveniles; (4) increase aquatic habitat complexity and diversity; (5) provide habitats more consistent with those previously available in the upper watershed; and (6) provide predator escape cover, and overall increased survival of juvenile spring-run Chinook salmon and steelhead.

On October 13, 2009 a small group of RMT members met to further identify and refine potential juvenile salmonid rearing habitat expansion actions for the lower Yuba River. Following a thorough discussion regarding project effectiveness within a fluvial geomorphological perspective, this stakeholder group identified nine habitat enhancement actions/locations to provide rearing habitat for juvenile spring-run Chinook salmon and steelhead. Essentially, the group reviewed locations along the lower Yuba River where residual riparian vegetation indicated that the river channel had previously existed. In several of these locations, the hydraulically disconnected river channel could be re-connected fairly easily, thus developing additional secondary (side-channel) habitat. Based on work conducted in the lower Yuba River by Professor Greg Pasternack (UC Davis) and the RMT, the group determined that these side-channel habitat locations are viable for re-construction.

From upstream to downstream in the lower Yuba River, they have been identified as follows:

Upstream of Daguerre Point Dam

The lower Yuba River extends approximately 12.6 miles from Englebright Dam to Daguerre Point Dam. The following juvenile salmonid rearing habitat enhancement action sites are located within this section of the lower Yuba River.

Site 1 (**Figure 3**) "Upper Gilt Edge" – Enhance the structural complexity of the left bank of the main river channel. Line the left bank of the main channel with boulder/wood structures, and enhance an ephemeral backwater with boulder/wood structures to maintain aquatic habitat.

Site 2 (**Figure 4**) "First Island" – Create a side channel in an existing swale within a stand of relatively dense riparian vegetation. Enhance the structural complexity of the left bank of the main river channel by placement of large wood material. Approximate length 1,500 ft, potential area 30,000 ft^2 (0.7 ac at 20 ft width, 60,000 ft^2 (1.4 ac) at 40 ft width.

Site 3 (**Figure 5**) "North Silica Bar" (bar opposite of Silica Bar side channel) – Create a side channel in an existing swale within a stand of relatively dense riparian vegetation which presently includes willows and cottonwoods. Approximate length 4,600 ft, potential area 92,000 ft^2 (2.1 ac at 20 ft width, 189,000 ft^2 (4.3 ac) at 40 ft width.

Site 4 (included in Figure 5) "Silica Bar" – Create a side channel in an existing swale within a stand of diverse, mature, native riparian vegetation. Approximate length 2,000 ft, potential area 40,000 ft^2 (0.9 ac at 20 ft width, 80,000 ft^2 (1.9 ac) at 40 ft width.

Site 5 (**Figure 6**) "Hammon Bar" – Create a side-channel, within a stand of riparian vegetation, extending from the bar on the southern bank of the main-channel into the current backwater area. Boulder structures for hydraulic maintenance may be placed at the inflow section. At the outflow section, wood/boulder structures may be placed, and riparian vegetation may be planted. Approximate length 1,250 ft, potential area 25,000 ft^2 (0.6 ac at 20 ft width, 50,000 ft^2 (1.1 ac) at 40 ft width.

Site 6 (**Figure 7**) "South Bar above Daguerre Point Dam" – Create a side channel, within a stand of riparian vegetation, along the toe of the training wall, extending from the upper portion of the site to the existing downstream backwater area. Boulders for hydraulic maintenance may be placed at the inflow. Approximate length 2,400 ft, potential area 48,000 ft^2 (1.1 ac at 20 ft width, 96,000 ft^2 (2.2 ac) at 40 ft width.

Downstream of Daguerre Point Dam

The lower Yuba River extends approximately 11.4 miles from Daguerre Point Dam to the confluence with the lower Feather River. The following juvenile salmonid rearing habitat enhancement action sites are located within this section of the lower Yuba River.

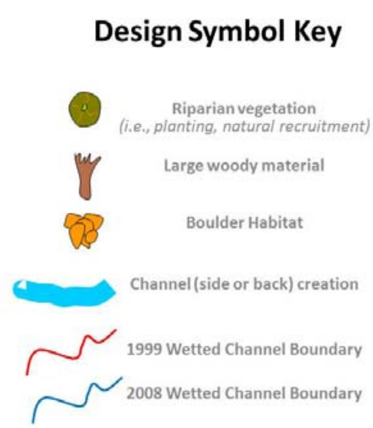
Site 7 (**Figure 8**) "Waterway 13" – Create a side-channel, within a stand of riparian vegetation, extending from the main-channel into the current backwater area. Boulder structures for hydraulic maintenance may be placed at the inflow section. This site would be expected to receive flow augmentation from the Yuba Goldfields return flow. Approximate length 2,800 ft, potential area 56,000 ft^2 (1.3 ac at 20 ft width, 112,000 ft^2 (2.6 ac) at 40 ft width.

Site 8 (**Figure 9**) "Narrow Bar" – Create a side-channel north of the main channel following a historic channel path. Existing riparian vegetation would border the created side-channel. Boulders for hydraulic maintenance may be placed at the inflow. Approximate length 2,900 ft, potential area 58,000 ft^2 (1.3 ac at 20 ft width, 116,000 ft^2 (2.7 ac) at 40 ft width.

Site 9 (**Figure 10**) "Goldfields Terminus" – Create a side-channel, within a stand of riparian vegetation, extending into a current backwater habitat located at the downstream corner of the Goldfields. Boulder structures for hydraulic maintenance may be placed at the inflow section. Approximate length 5,000 ft, potential area 100,000 ft^2 (2.3 ac at 20 ft width, 200,000 ft^2 (4.6 ac) at 40 ft width.

Figures 3 – 10 identify the locations of the potential sites for habitat enhancement. Design plans would be informed by the information and processes listed above. The precise location of side-channels as well as the placement of structural elements and riparian plantings would be informed by a variety of analyses including hydraulic modeling. As evidenced by existing riparian vegetation or topography in Figures 3 - 10, many of these potential side channels follow previous alignments of the river, or were side channels. Additional geomorphic analysis will be necessary to fully understand the processes that originally formed these channels and subsequently moved the river to a different location. However, these features were selected based on the premise that: (a) side channels can be re-established relatively easily using moderate terra-forming, boulder placement, and other techniques; and (b) that the features will have more than a short-term persistence in the river once constructed.

The Design Symbol Key (below) is utilized in the following figures.



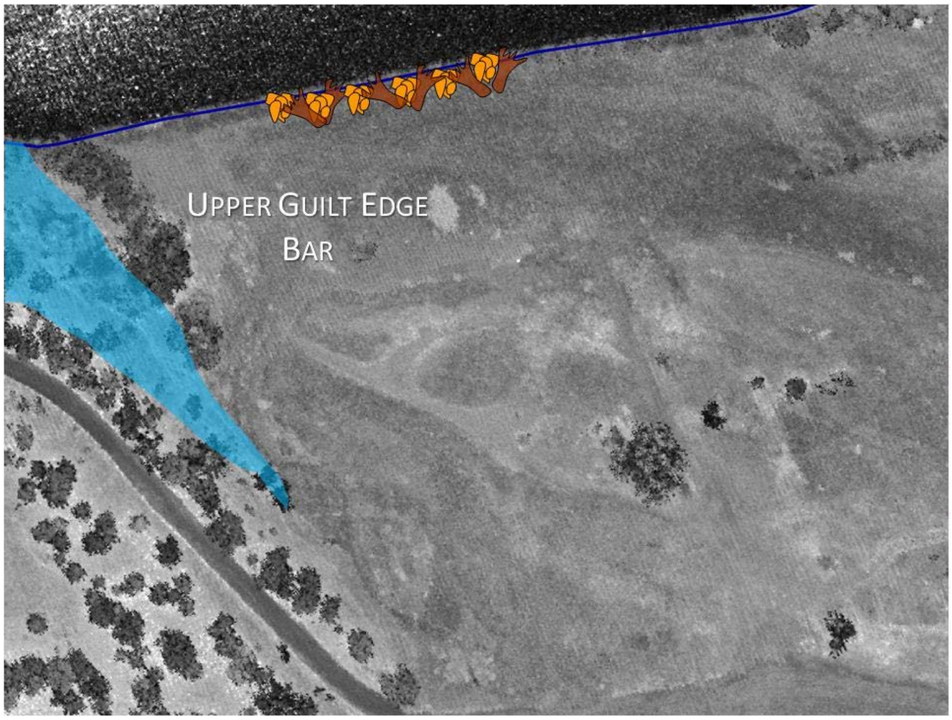


Figure 3. The Upper Guilt Edge Bar site for juvenile rearing habitat enhancement.

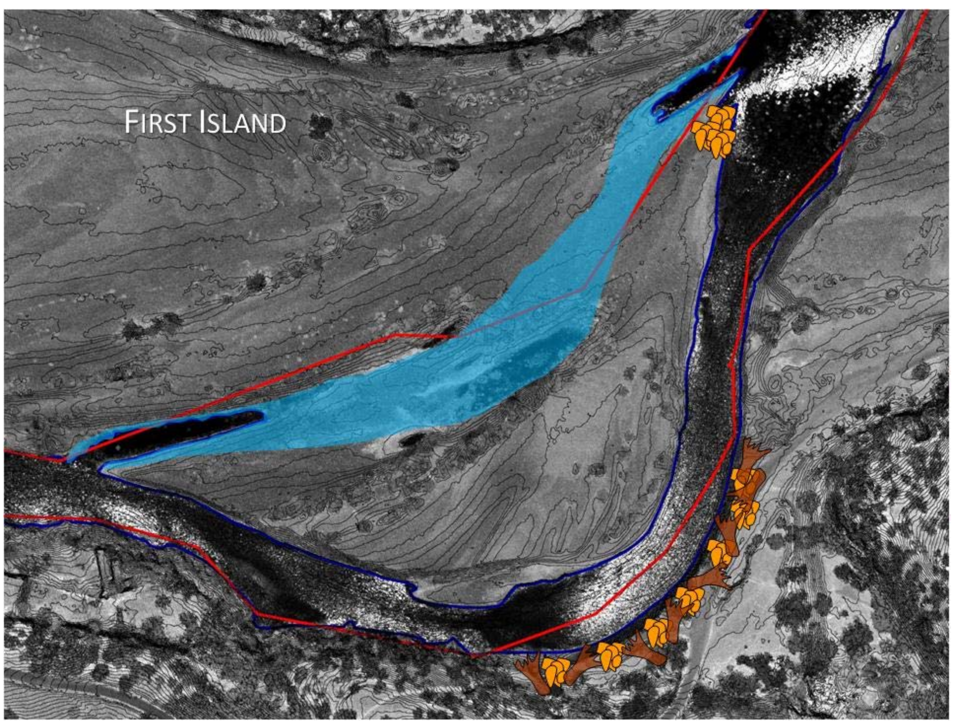


Figure 4. The First Island site for juvenile rearing habitat enhancement.

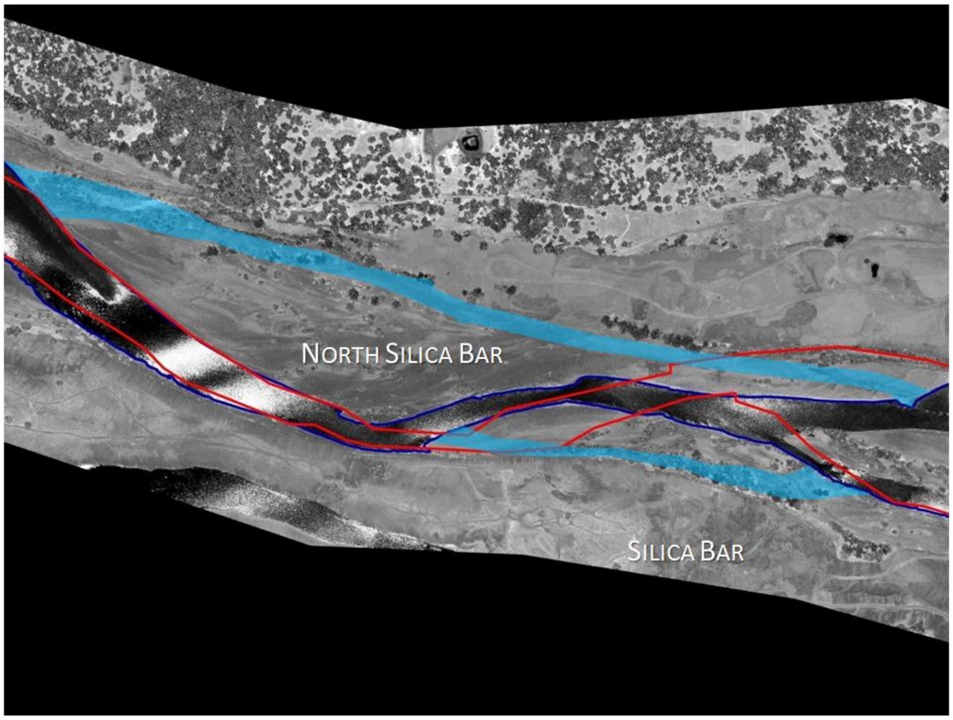


Figure 5. The North Silica Bar and Silica Bar sites for juvenile rearing habitat enhancement.

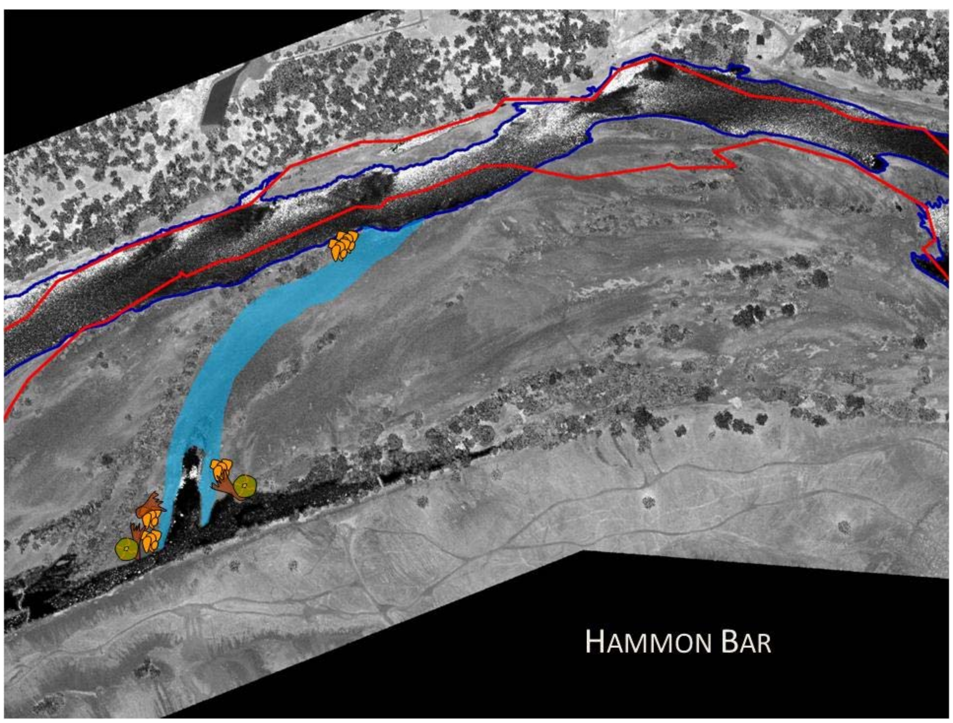


Figure 6. The Hammon Bar site for juvenile rearing habitat enhancement.

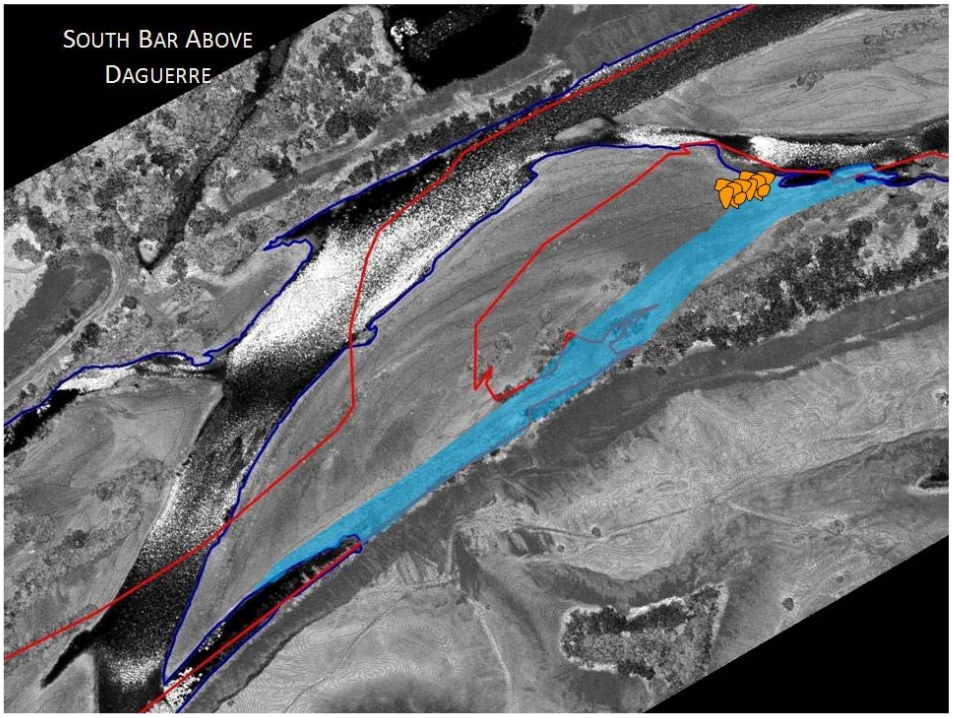


Figure 7. The South Bar above Daguerre Point Dam site for juvenile rearing enhancement.

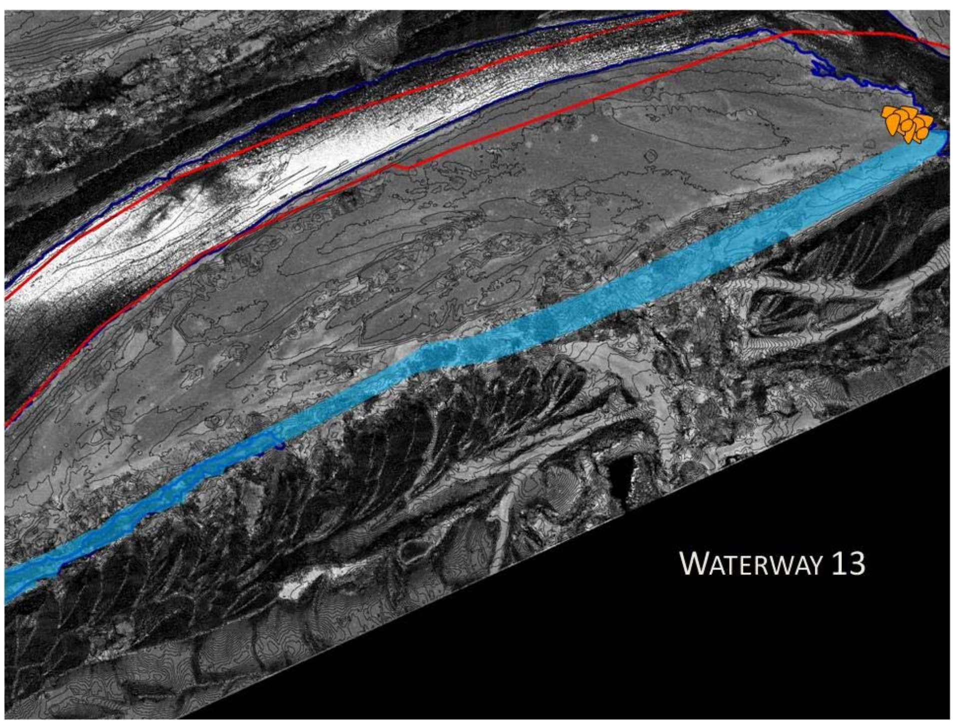


Figure 8. The Waterway 13 site for juvenile rearing habitat enhancement.

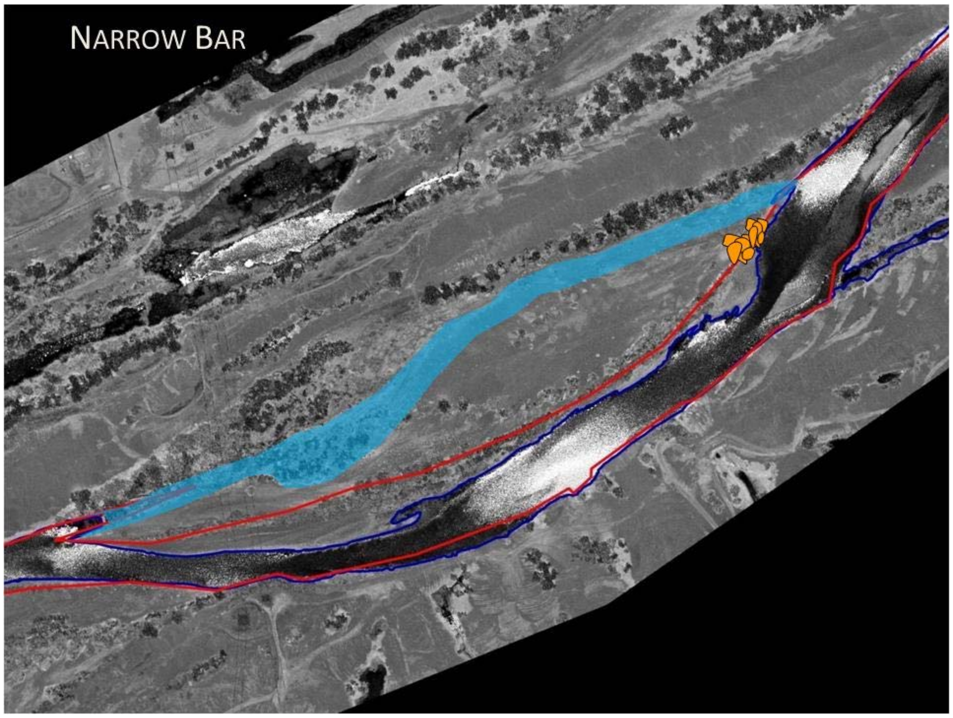


Figure 9. The Narrow Bar site for juvenile rearing habitat enhancement.

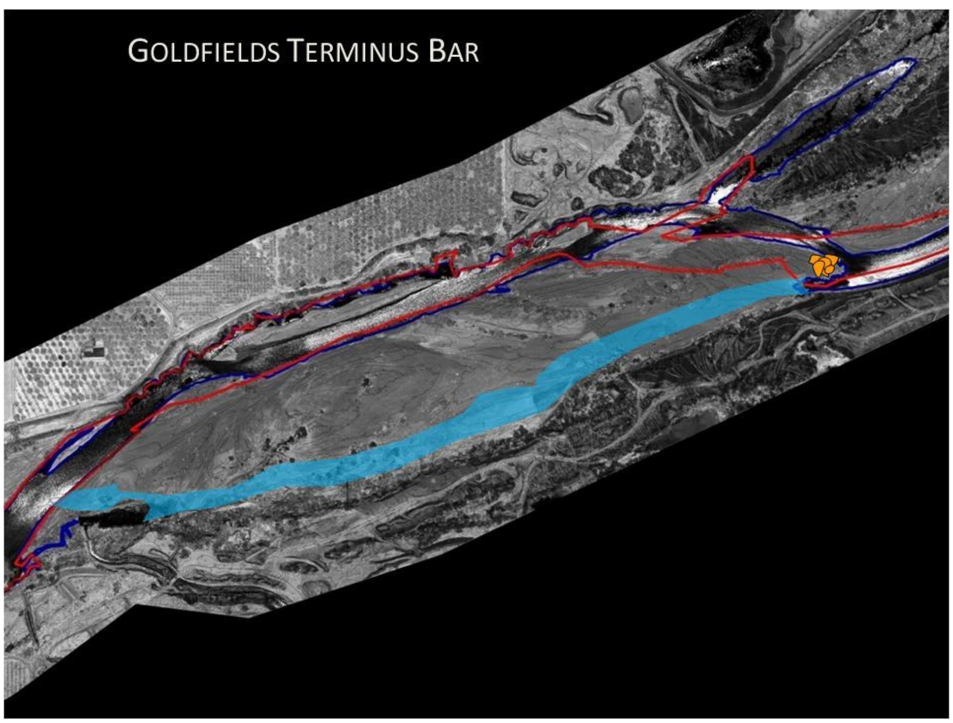


Figure 10. The Goldfields Terminus Bar site for juvenile rearing habitat enhancement.

Segregation Weir

The intent of the segregation weir component is to achieve "…*favorable spatial separation from other populations or runs to maintain genetic diversity by minimizing interbreeding…*" A priority within the HEA is the segregation of habitat for spring-run and fall-run Chinook salmon. In the Central Valley, introgression of fall- and spring-run Chinook salmon has been identified as a potential factor limiting spring-run Chinook salmon. In many cases, this is due to the concurrent spawning of hatchery-produced fall-run Chinook salmon in areas where spawning of spring-run Chinook salmon occurs.

Unlike many rivers in the Central Valley, there is no hatchery on the lower Yuba River. However, some straying does occur in the lower Yuba River, most likely from the Feather River Hatchery. However, straying of fish into the lower Yuba River can be addressed by a number of actions including replacing off-site releases with volitional releases from the hatchery, allowing all fish that attempt to return to the hatchery to do so, and reducing the amount of fish released (see CDFG and NMFS (2001), for a review of hatchery issues). Currently, best management practices and a hatchery genetics management plan continue to be developed and implemented at the Feather River Hatchery.

Further, to address the problem of introgression of fall- and spring-run Chinook salmon, the HEA criterion indicate that projects that encourage the separation of fall- and spring-run Chinook salmon will be considered favorable. Separation may be achieved either through physical barriers or through the development of habitat conditions that favor spring-run Chinook salmon over fall-run Chinook salmon. Clearly, the intent is to achieve separation of fall-run and spring-run Chinook salmon to minimize/avoid genetic introgression.

The biologic premise behind the concept of "separation" is the intent to achieve reproductive isolation. Reproductive isolation has a spatial and/or temporal component that, in a natural system, can be accomplished through behavioral manifestation achieving spatial and/or temporal segregation. In the lower Yuba River, to some extent spatial and temporal segregation of Chinook salmon spawning presently occurs. Previously conducted reconnaissance-level redd surveys, carcass surveys, and the more intensive 2008 pilot redd survey demonstrate that the majority of redds constructed during September to early October (phenotypically consistent with spring-run Chinook salmon spawning timing) were observed in the uppermost portion of the survey area (i.e., upstream of the Highway 20 Bridge). Preliminary data obtained from early season redd surveys conducted from August 31 through October 1, 2009 demonstrate that of the total 714 redds constructed during this period throughout the lower Yuba River, 520 (73%) were constructed upstream of the Highway 20 Bridge. By contrast, redds constructed later in the season (phenotypically consistent with fall-run Chinook salmon spawning timing) were primarily observed further downstream in the lower Yuba River. Preliminary 2009 data demonstrate of the

1,598 redds constructed since October 1 through October 29, 2009, 952 (60%) were constructed downstream of the Highway 20 Bridge.

Seasonal flow releases and suitable spring-run Chinook salmon water temperatures are currently being provided by implementation of the Yuba Accord, which enhances the spawning of phenotypically characterized spring-run Chinook salmon. Additional monitoring (acoustic tracking, spawning surveys, genetic analysis) is ongoing, and will provide additional information regarding the current extent of reproductive isolation between spring-run and fall-run Chinook salmon in the lower Yuba River. The need for, benefits of, and specific operational considerations for the segregation weir component of the project are presently uncertain, and can be more completely evaluated following results from ongoing studies by the Yuba Accord RMT. A genetic analysis of phenotypic spring-run Chinook salmon collected in the lower Yuba River is in progress. The results of this study will help identify the amount of introgression among spring-run and fall-run Chinook salmon, and source populations for phenotypic spring-run Chinook salmon that currently exist in the lower Yuba River. Ongoing monitoring conducted as part of the Yuba Accord M&E Program will provide additional information regarding specific timing and specific locations of adult immigration, holding, and spawning of Chinook salmon in the lower Yuba River. This additional information will be useful to evaluate the need for, and potential location of a segregation weir in the future. In addition, evaluation of the technical feasibility and full costs associated with implementation of a segregation weir in the lower Yuba River remains to be conducted. At a minimum, careful consideration of the feasibility and full costs of construction of a hard-mounted fish barrier (including in-river construction techniques and impacts), the costs of developing and securing access for construction and operations, the challenges of operations and cleaning, and the risk and potential for damage by high or flood flows will need to be undertaken prior to a final decision on this potential project.

The segregation weir is not supported at this time.

Daguerre Point Dam Passage Improvement

Upstream passage at the Corps Daguerre Point Dam can be impeded for migrating adult spring-run Chinook salmon and steelhead due to the inadequacies of the fish ladders. Adult salmonid passage is impeded when rain or snowmelt runoff produces high flow conditions at the dam, which coincides with flow conditions under which spring-run Chinook salmon and steelhead generally migrate upstream to their spawning areas. The Corps' policy is to close the ladders when water elevation reaches 130 feet, and to keep them closed until the water recedes to an elevation of 127 feet. Because spring-run Chinook salmon and steelhead upstream migration occurs during the potentially high-flow periods during winter and spring, this policy can affect their upstream migration. Throughout winter and spring when flows are high, adult spring-run Chinook salmon and steelhead can experience difficulty in finding the entrance to the ladders because of the relatively low percentage of attraction flows exiting the ladders compared to the massive sheet-flow coming over the rest of the dam. The angle of the orifices and proximity to the plunge pool also increase the difficulty for fish to find the entrances to the ladders. Other design deficiencies which have been identified include periodic obstruction of the ladders by woody material, operating criteria that require closure of the ladders at high flows, and the proximity and orientation of the ladder entrances to the spillway (CDFG 1991; USFWS 1994 in NMFS 2007).

Upstream passage at the Corps Daguerre Point Dam can also be impeded when sediment builds up near the upstream exit of the fish ladders. Geofluvial action has, in the past, caused gravel to build up on the upstream side of the dam where it can impede flows into the ladders, thereby reducing the ability of fish to climb the ladders and reducing the attraction flow exiting the base of the ladders. In addition, the gravel bars have built up to the point where they reduce access to the main channel for fish that have exited at the top of the ladders and are attempting to continue their upstream migration. The Corps has initiated a long-term sediment management program to address this problem, and it is expected that this issue will be alleviated through continued diligent implementation of this program.

Adult Chinook salmon have been observed congregating in the plunge pool below the dam and leaping at the face of the dam, indicating that migrating adults may not readily find the entrances to the fish ladders. A simple time delay is not the only consequence of spring-run Chinook salmon being unable to pass Daguerre Point Dam. When adult Chinook salmon enter fresh water they cease eating and must rely solely on the finite supply of energy which they have stored in their bodies to last them through their entire migration, holding, and spawning activities. In their efforts to pass Daguerre Point Dam, particularly if these efforts continue for several days or even weeks, they consume a greater amount of these energy stores than if there had been no obstacle in their path. This may leave the fish in a weakened state before spawning which may subject them to a greater chance of disease, especially if they have to hold over the summer prior to spawning (e.g., spring-run Chinook salmon). Other biological consequences of blockage or passage delay include changes in spawning distribution (Hallock 1987), increased adult pre-spawning mortality (Reclamation 1985 in NMFS 2007), and decreased egg viability (Vogel *et al.* 1988), all of which may result in the reduction in abundance and productivity of this species.

Juvenile salmonids can also be adversely affected by Daguerre Point Dam on their downstream migration. Juveniles can experience injury or direct mortality by being carried over the face of the dam by sheet flow and encountering the dam face or the downstream base of the dam. Also, there is an elevated risk of predation created when juveniles plunge over the dam into the pool below. The large plunge pool at the base of the dam creates an area for predatory fish which may seasonally congregate below Daguerre Point Dam. The deep pool provides ambush habitat for predators in an area where juvenile salmonids can be disoriented or injured as they plunge over the face of the dam into the turbulent waters at the base, making them vulnerable to predation. High levels of predation over long periods of time can reduce juvenile numbers and weaken their contribution to year class strength and recruitment.

The potential to improve both adult upstream and juvenile downstream passage at Daguerre Point Dam has been the subject of previous studies, including: (1) Daguerre Point Dam Fish Passage Improvement Project Alternative Concepts Evaluation (DWR and Corps 2003 in NMFS 2007); (2) Daguerre Point Dam Fish Passage Improvement Project 2002 Fisheries Studies – Analysis of Potential Benefits to Salmon and Steelhead from Improved Fish Passage at Daguerre Point Dam (DWR and Corps 2003a in NMFS 2007); and (3) Daguerre Point Dam Fish Passage Improvement 2002 Water Resources Studies (DWR and Corps 2003b in NMFS 2007). In November 2007 NMFS issued a Biological Opinion (NMFS 2007) on the operation of Corps facilities on the Yuba River, including Daguerre Point Dam and passage-related issues. Passage at Daguerre Point Dam is the subject of ongoing considerations. Although much evaluation and analysis has already been completed, a final preferred alternative has not yet been identified to alleviate passage impediment issues at Daguerre Point Dam.

SELECTION AND APPROVAL CRITERIA CONSIDERATIONS

CONTRIBUTION TO ACHIEVING THE HABITAT EXPANSION THRESHOLD

> *As previously mentioned, the specific Habitat Expansion Threshold (HET) is to expand spawning, rearing and adult habitat sufficiently to accommodate an estimated net increase of 2,000 to 3,000 spring-run Chinook salmon for spawning in the Sacramento River Basin. The Habitat Expansion Threshold is focused on spring-run Chinook salmon as the priority species, as expansion of habitat for spring-run Chinook salmon typically accommodates steelhead as well.*

Preliminary estimates indicate that spawning habitat rehabilitation in the Englebright Dam Reach of the lower Yuba River could provide additional spawning habitat for 4,764 spring-run Chinook salmon, and thereby achieve the specific HET to accommodate an estimated net increase of 2,000 to 3,000 spring-run Chinook salmon spawning annually. The benefit of new side-channel habitats would: (1) increase and maintain existing riparian vegetation; (2) provide instream object and overhanging object cover; (3) provide new SRA, and associated allochthonous food sources for rearing juveniles; (4) increase aquatic habitat complexity and diversity; (5) provide habitats more consistent with those previously available in the upper watershed; and (6) provide predator escape cover, and overall increased survival of juvenile spring-run Chinook salmon and steelhead – all of which would thereby contribute to increased annual spawning run abundance. Based on preliminary estimates of area (scaled from Figures 4 – 11 herein), additional aquatic rearing habitat could be 10 to 21 acres; additional riparian habitat could be an additional 10 to 21 acres.

As previously mentioned, a segregation weir does not, unto itself, expand habitat and directly contribute to achieving the goals of the HET. Rather, the stated intent is to accomplish geographic distinction (and reproductive isolation) and thereby reduce the potential for genetic introgression between fall-run and spring-run Chinook salmon. Similarly, although improved fish passage at the Corps Daguerre Point Dam would help to facilitate access to available upstream habitat, it would not expand the amount of habitat with the physical characteristics necessary to support spawning, rearing and adult holding of spring-run Chinook salmon and steelhead.

MOST COST-EFFECTIVE COMPARED TO OTHER POTENTIAL HABITAT EXPANSION ACTIONS

> *For each Viable Action, a rough estimate of its cost and contribution to the HET will be determined. Each Viable Action then will be ranked in terms of its cost effectiveness (i.e., the cost of the action versus its contribution to the HET). Refer to the discussion of favorable cost effectiveness in Evaluation Criterion (d).*

Based upon the economic feasibility (below) it is possible that the proposed habitat enhancement actions in the lower Yuba River can be implemented within extant funding limitations, and would achieve or exceed the specific HET goal of establishing a self-sustaining, viable population, representing a net increase of 2,000 to 3,000 spring-run Chinook salmon spawning annually in the Central Valley. Although uncertainty remains regarding the feasibility and cost, particularly associated with the segregation weir, and the consideration that Daguerre Point Dam fish passage improvements may be required to be implemented through other processes, the Englebright Dam Reach spawning habitat rehabilitation component would be extremely cost-effective, and the juvenile salmonid rearing habitat enhancement actions would have synergistic benefit and augment resulting habitat expansion through enhanced spring-run Chinook salmon and steelhead juvenile production.

FEASIBILITY (ACTION[S] CAN REASONABLY BE ACCOMPLISHED)

> *As stated in Evaluation Criterion (a), actions/projects must have a high likelihood of success (i.e., they must be highly feasible). The term "feasibility" is being interpreted broadly to include the concepts described for four Evaluation Criteria: (a) technical feasibility, (d) economic feasibility, (i) favorable political and local support, and (l) consistency with other resource uses.*

The feasibility varies among the suite of actions being considered by the HEA Steering Committee.

The Englebright Dam Reach spawning habitat rehabilitation component is highly feasible, based upon a 5-year (2003-2008) comprehensive investigation conducted to ascertain the linkages between hydrology, geomorphology, and ecology (Pasternack 2009), and a 2007 pilot gravel injection study. Pasternack (2009) highly recommended that such a project be designed using the Spawning Habitat Integrated Rehabilitation Approach (SHIRA) that is in use on the Feather, American, Trinity, and Mokelumne Rivers. For details, see the website at http://shira.lawr.ucdavis.edu. Using SHIRA would ensure that a project of this magnitude would immediately yield spawning habitat, as has been documented thoroughly on the Mokelumne and Trinity Rivers. We have not prepared a cost estimate for the Englebright Dam Reach spawning habitat rehabilitation action. However, in response to the HEA questionnaire, the stated cost of this action was approximately $3 million, although it is uncertain whether this stated cost includes all project-related requirements.

Prior to the RMT's field tour of potential juvenile salmonid rearing habitat enhancement projects and further identification and refinement of specific actions, the response to the HEA questionnaire stated that the cost of this action was $2 million, although it is uncertain whether this stated cost includes all project-related requirements. We have not prepared a cost estimate for the juvenile salmonid habitat enhancement actions. However, review of Appendix E in the Draft Recovery Plan suggests that "channel restoration" pertinent to Central Valley rivers ranges in cost from $1.2 million to $8.7 million per mile, and USFWS reports that for AFRP habitat enhancement/development actions, cost estimates of $1.0 to $1.5 million per mile were derived. The HEA Steering Committee would likely need to develop their own cost estimates.

The suite of actions considered by the HEA Steering Committee also may include a segregation weir located approximately 6 miles below Englebright Dam to provide spawning segregation of spring-run Chinook salmon from fall-run Chinook salmon. The need for, benefits of, and specific operational considerations for the segregation weir component of the project are presently uncertain, and can be more completely evaluated following results from ongoing studies by the Yuba Accord RMT involving tagging, tracking, redd mapping and genetic analysis. Although resistance board segregation weirs are versatile and have been used in other locations, evaluation of the technical feasibility and full costs associated with implementation in the lower Yuba River have not been conducted. We have not prepared a cost estimate for the segregation weir action. However, in response to the HEA questionnaire, it was suggested that based on a preliminary, reconnaissance-level review, a resistance board weir would cost approximately $220,000 for installation and $52,000 annually for weir operation and monitoring, although it is likely that this stated cost does not include all project-related requirements. At a minimum, careful consideration of the full costs of construction of a hard-mounted fish barrier, the costs of developing and securing access for construction and operations, the cost associated with operations and cleaning, and the costs associated with maintenance and the potential for damage by high or flood flows will need to be undertaken prior to a final decision on this potential project.

Potential alternatives associated with fish passage improvements at the Corps Daguerre Point Dam continue to be part of ongoing investigations. According to the NMFS 2007 Biological Opinion (BO), the Corps shall develop and implement a plan to improve fish passage for adult and juvenile spring-run Chinook salmon, steelhead and green sturgeon at Daguerre Point Dam. Moreover, the NMFS BO requires that the Corps shall complete the feasibility study and PED phases of the ongoing fish passage improvement project, as described in the Corps biological assessment for the proposed project, within five years of the issuance of the BO. It further requires that the Corps shall commence implementation of the preferred alternative to improve fish passage for adult and juvenile spring-run Chinook salmon, steelhead and green sturgeon at Daguerre Point Dam, developed through the feasibility study and PED process, within ten years of the issuance of the BO. Therefore, it may be appropriate to assume that associated costs would be the Corps responsibility, and not necessarily be an appropriate consideration pursuant to the HEA eligibility criteria.

TIMING (EXPECTED TO BE IMPLEMENTED WITHIN A REASONABLE PERIOD OF TIME)

> *As noted in Evaluation Criterion (h), factors important to the success of a project include not only the length of time to implement the project but also the length of time to realize benefits. Thus, the HEP will favor "shovel-ready" projects that can be implemented in a reasonable period of time (e.g., less than approximately 5 years). The more favorable projects will be those that need minimal additional public process, particularly related to permitting, zoning, or land use issues. In addition, projects that benefit spring-run Chinook within a relatively short period of time (e.g., approximately 10 years or less) will be favored.*

The Englebright Dam Reach spawning habitat rehabilitation project is essentially "shovel ready". A 5-year (2003-2008) comprehensive investigation has been conducted to ascertain the linkages between hydrology, geomorphology, and ecology (Pasternack 2009), and a 2007 pilot gravel injection study has been implemented. Located in a remote rural area, this project requires minimal additional public process, particularly related to permitting, zoning, or land use issues. The project could be implemented once final design, plans and specifications are completed, and appropriate permits are obtained (potentially less than one year). By using the SHIRA approach that is in use on the Feather, American, Trinity, and Mokelumne rivers, a project of this magnitude would immediately yield spawning habitat, as has been thoroughly documented on the Mokelumne and Trinity rivers.

It is anticipated that the proposed juvenile salmonid rearing habitat enhancement actions would be designed, access and permits obtained, and selected actions implemented consistent with the approval and implementation schedule established for the HEA implementation process. Given the tools in development and work currently underway (e.g., mapping of entire lower Yuba, 2D hydraulic model of the lower Yuba River, pilot restoration project design), it seems likely that a preliminary design and permitting analysis could be completed within 1 year. Permitting, landowner access and other issues could be resolved within 1 to 2 years, depending on complexities. Construction could be accomplished in one to two seasons.

As previously discussed, the need for, benefits of, and specific operational considerations for the segregation weir component of the project are presently uncertain. Evaluation of the technical feasibility associated with implementation in the lower Yuba River has not been conducted. It is uncertain when evaluation of the infrastructure integrity and operations and management practices, access logistics, a feasibility study, and obtaining appropriate permits would occur.

The NMFS 2007 BO requires that the Corps shall complete the feasibility study and PED phases of the ongoing Daguerre Point Dam fish passage improvement project within five years of the issuance of the BO. It further requires that the Corps shall commence implementation of the preferred alternative to improve fish passage for adult and juvenile spring-run Chinook salmon, steelhead and green sturgeon at Daguerre Point Dam, developed through the feasibility study and PED process, within ten years of the issuance of the BO. However, in consideration that the NMFS 2007 BO is the subject of a legal challenge pending in the United States District Court for the Eastern District of California, specific timing is presently uncertain.

Relationship to Other Parties

> *Actions identified in other venues are eligible for consideration provided that what is implemented under the HEA results in an expansion of habitat over any existing requirements and commitments. As stated in Evaluation Criterion (n), projects required as part of other proceedings… will not be favored and may be considered ineligible.*

Although the cessation of spawning gravel recruitment from areas upstream of the Corps Englebright Dam may be directly attributable to the presence of the dam, some of the shot-rock on Sinoro Bar results from high flows and landslides, and the geomorphic structure also has been influenced by local instream gravel mining. Research conducted by Professor Greg Pasternack (UC Davis) provides substantial evidence that the downstream section of the Englebright Dam Reach (including Sinoro Bar) is primarily impacted by historic hydraulic gold mining and modern mechanized placer mining conducted since 1960 (Pasternack 2009). Thus, the Englebright Dam Reach spawning habitat rehabilitation project addresses physical habitat conditions distinct from those directly associated with construction of the Corps Englebright

Dam. The Englebright Dam Reach spawning habitat rehabilitation project proposed for HEA consideration includes shot-rock removal, localized grading and contouring, placement of hydraulic roughness elements, and initial gravel placement.

Although the Corps is required to implement a long-term gravel augmentation program by the NMFS 2007 BO, such a program would provide minimal benefits to spring-run Chinook salmon and steelhead until the channel is rehabilitated from instream gravel mining and deposition of shot-rock. After initial spawning habitat rehabilitation and the provision of gravel associated with the Englebright Dam Reach spawning habitat rehabilitation project, it is suggested that ongoing gravel supply would then be maintained as per requirements of the Corps in the NMFS 2007 BO, or whatever requirements emanate from the legal challenge pending in the United States District court for the Eastern District of California. That ongoing process injects additional uncertainty regarding the timing of the Corps participation in this project. It has been estimated that ongoing annual maintenance of the spawning habitat could be accomplished through the injection of approximately 10,000 cubic yards of gravel per year (Pasternack 2009).

The juvenile salmonid rearing habitat enhancement project is not required under other venues, and would be appropriate for funding under the HEA. As stated in SYRCL's response to the questionnaire for this project, funding partners could include the Corps, Western Aggregates, PG&E, BLM, USFWS AFRP and project partners could include the Corps and SYRCL. It is presently undetermined what parties would be responsible for continued maintenance of the juvenile salmonid rearing habitat enhancement project. However, considering that construction of Englebright Dam by the Corps has resulted in the reduced functionality of juvenile salmonid rearing habitat in the lower Yuba River, it may be appropriate to consider the Corps as the primary responsible party for continued maintenance. Although the Corps is required to implement by 2012 a program of large wood supply to the lower Yuba River by the NMFS 2007 BO (legal challenge pending), that requirement does not include the proposed juvenile salmonid rearing habitat enhancement project.

The Yuba Accord RMT subcommittee does not specifically recommend the segregation weir project for the lower Yuba River at this time. However, as the HEA Steering Committee continues to consider numerous specific projects, it is noted that, as stated in SYRCL's response to the questionnaire for this project, funding partners could include PG&E (per the Narrows Mitigation Fund) and the USFWS AFRP, and project partners could include the Corps.

Potential alternatives associated with fish passage improvements at Daguerre Point Dam continue to be part of ongoing investigations. According to the NMFS 2007 BO, the Corps shall develop and implement a plan to improve fish passage for adult and juvenile spring-run Chinook salmon, steelhead and green sturgeon at Daguerre Point Dam. Moreover, the NMFS BO requires that the Corps shall complete the feasibility study and PED phases of the ongoing fish passage improvement project, as described in the Corps biological assessment for the proposed project, within five years of the issuance of the biological opinion. It further requires that the Corps shall commence implementation of the preferred alternative to improve fish passage for adult and juvenile spring-run Chinook salmon, steelhead and green sturgeon at Daguerre Point Dam, developed through the feasibility study and PED process, within ten years of the issuance of the biological opinion. Although the NMFS 2007 BO is the subject of a legal challenge pending in the United States District Court for the Eastern District of California, it is anticipated that fish passage improvements at Daguerre Point Dam will remain the Corps' responsibility.

SUPPORTS ESTABLISHING A GEOGRAPHICALLY SEPARATE, SELF-SUSTAINING POPULATION OF SPRING-RUN

> *As discussed in Evaluation Criterion (g), the proposed projects should support development of a viable population of spring-run Chinook salmon within the Sacramento River Basin, in addition to those that already exist in Mill, Deer, and Butte Creeks.*

A priority within the HEA is the development of a new, geographically separate, self-sustaining population of spring-run Chinook salmon (see Section 4.2.3[c] of the HEA). NMFS has identified presently viable spring-run Chinook populations in Mill, Deer and Butte Creeks (Lindley *et al.* 2007). NMFS Approval Criteria (items a–f contained in Section 4.2.3 of the HEA) includes the development of a viable population of spring-run Chinook salmon within the Sacramento River Basin, in addition to those that already exist in Mill, Deer and Butte Creeks.

NMFS Approval Criteria (item 4.2.3[c] of the HEA) further states that, in addition to being geographically separate, the proposed actions need to provide habitat that is of sufficient quantity (e.g., watershed size of 500 km^2 or greater as a guideline) and quality, and sufficiently separate to support a self-sustaining population of spring-run Chinook salmon. The Yuba River Watershed drains 1,339 square miles of the western slope of the Sierra Nevada and includes portions of Sierra, Placer, Yuba, and Nevada counties (YCWA *et al.* 2007).

Implementation of the Englebright Dam Reach spawning habitat rehabilitation project and the juvenile salmonid rearing habitat enhancement project, and associated establishment of a viable spring-run Chinook salmon population in the lower Yuba River (in addition to presently viable spring-run Chinook salmon populations in Mill, Deer and Butte creeks), may satisfy the criteria of:

- *Favorable spatial separation from other spawning streams to minimize population impacts of a stream-specific adverse event (geographic distribution is favored over centralization)*

- *Supports establishing a geographically separate, self-sustaining population of Spring-Run*

SUPPORTS SEGREGATING SPRING-RUN HABITAT FROM CENTRAL VALLEY FALL-RUN CHINOOK SALMON

As discussed in Evaluation Criterion (f), the proposed projects should support segregation of spring-run and fall-run Chinook salmon populations. Segregating the two runs can involve creating a segregation barrier, increasing instream flow, or enhancing habitat for spring-run over fall-run Chinook.

As previously discussed, separation may be achieved either through physical barriers or through the development of habitat conditions that favor spring-run Chinook salmon over fall-run Chinook salmon. Clearly, the intent is to achieve separation of fall-run and spring-run Chinook salmon to minimize/avoid genetic introgression, to be accomplished by reproductive isolation.

As previously mentioned, to some extent spatial and temporal segregation presently occurs in the lower Yuba River. Previously conducted reconnaissance-level redd surveys, carcass surveys, and the more intensive 2008 pilot redd survey demonstrate that the majority of redds constructed during September to early October (phenotypically consistent with spring-run Chinook salmon spawning timing) were observed in the uppermost portion of the survey area (i.e., upstream of the Highway 20 Bridge). Preliminary data obtained from early season redd surveys conducted from August 31 through October 1, 2009 demonstrate that of the total 714 redds constructed during this period throughout the lower Yuba River, 520 (73%) were constructed upstream of the Highway 20 Bridge. By contrast, redds constructed later in the season (phenotypically consistent with fall-run Chinook salmon spawning timing) were primarily observed further downstream in the lower Yuba River. Preliminary 2009 data demonstrate of the 1,598 redds constructed since October 1 through October 29, 2009, 952 (60%) were constructed downstream of the Highway 20 Bridge.

HEA STEERING COMMITTEE OUTSTANDING QUESTIONS AND ISSUES

At the RMT meeting held on September 23, 2009, the HEA Steering Committee provided the RMT with a list of questions regarding habitat expansion project in the lower Yuba River.

BIOLOGICAL

1.0 What is the potential contribution for each component of the proposed project to the Habitat Expansion Threshold?

As previously discussed, preliminary estimates indicate that spawning habitat rehabilitation in the Englebright Dam Reach of the lower Yuba River could provide additional spawning habitat for up to 4,764 spring-run Chinook salmon, and thereby achieve the specific HET to accommodate an estimated net increase of 2,000 to 3,000 spring-run Chinook salmon spawning annually. The juvenile salmonid rearing habitat enhancement project and resultant increased habitat complexity (e.g., create/restore backwater and side-channel habitat, physical structure, SRA, riparian vegetation, and instream object and overhanging cover) would provide for increased growth, protection from predators, and overall increased survival of juvenile spring-run Chinook salmon and steelhead, and thereby contribute to increased annual spawning run abundance. Preliminary estimates indicate that up to 22,450 lineal feet (4.25 miles), or 10 to 21 acres of in-river rearing habitat could be created, with an additional 10 to 20 acres of riparian habitat.

As also previously discussed, a segregation weir does not, unto itself, expand habitat and directly contribute to achieving the goals of the HET. Rather, the stated intent is to accomplish geographic distinction and thereby reduce the potential for genetic introgression between fall-run Chinook salmon and spring-run Chinook salmon. Similarly, although improved fish passage at the Corps Daguerre Point Dam would help to facilitate access to available upstream habitat, it would not expand the amount of habitat with the physical characteristics necessary to support spawning, rearing and adult holding of spring-run Chinook salmon and steelhead.

2.0 How would juvenile habitat enhancement and fish passage improvements translate into numbers of fish?

Explicit quantification of the "numbers of fish" associated with these two project components cannot be estimated at this time. Although estimates of benefit were provided to the HEA Steering Committee of the Englebright Dam Reach spawning habitat restoration action *via* the initial questionnaires, which have been refined in this document, the RMT is presently not prepared to provide additional quantitative estimation until the results of RMT studies currently underway are available. It is expected that results obtained through the Yuba Accord M&E Program will provide information allowing development of annual instream production estimates, relating the numbers of juveniles produced and emigrating from the lower Yuba River annually to the number of spawners. However, as previously mentioned, resultant increased habitat complexity (see above) would provide for increased growth, protection from predators, and overall increased survival of juvenile spring-run Chinook salmon and steelhead.

Also, as previously discussed, fish passage improvements at the Corps Daguerre Point Dam could be expected to reduce occurrence of disease in upstream migrating adults, provide additional opportunities for upstream spawning distribution, reduce adult pre-spawning mortality, and increase egg viability, all of which may result in the reduction in abundance and productivity of spring-run Chinook salmon and steelhead. Fish passage improvements at Daguerre Point Dam also could be expected to reduce juvenile salmonid injury, direct mortality and predation rates, and thereby potentially increase juvenile numbers and their contribution to year class strength and recruitment. Improving rearing habitat and fish passage is expected to work in concert with the improvements to spawning habitat in the Englebright Dam Reach.

3.0 Are there fish passage issues at Daguerre Point Dam?

[See the previous discussion of Daguerre Point Dam passage improvement considerations.]

4.0 Where is the best location to place a segregation weir on the Lower Yuba River?

In practical terms, there are a limited number of locations that would be most suitable for installation and maintenance of a segregation weir in the lower Yuba River. Evaluation of the technical feasibility (including potential site locations) associated with implementation of a segregation weir in the lower Yuba River remains to be conducted. At a minimum, careful consideration of the feasibility and full costs of construction of a hard-mounted fish barrier (including in-river construction techniques and impacts), the costs of developing and securing access for construction and operations, the challenges of operations and cleaning, and the risk and potential for damage by high or flood flows will need to be undertaken prior to a final decision on this potential project. If future implementation of a segregation weir in the lower Yuba River is considered, then additional monitoring (acoustic tracking, spawning surveys, genetic analysis) being conducted by the Yuba Accord RMT will provide additional information regarding the specific locational and operational considerations for the segregation weir project.

5.0 Where are phenotypic spring-run Chinook salmon spawning, above or below the proposed location of the segregation weir?

[See the previous discussions regarding spatial and temporal distribution of Chinook salmon spawning, and issues surrounding the segregation weir project.]

PROJECT RELATED

1.0 What are the resource agencies positions on the segregation weir?

[Response to this question requires direct consultation with resource agencies]

2.0 Are the Narrows gravel augmentation and Daguerre Point Dam fish passage improvement actions the responsibility of the Corps under the biological opinions?

As previously described, although the cessation of spawning gravel recruitment from areas upstream of the Corps Englebright Dam may be directly attributable to the presence of the dam, some of the shot-rock on Sinoro Bar results from high flows and landslides, and the geomorphic structure also has been influenced by local instream gravel mining. The Englebright Dam Reach spawning habitat rehabilitation project proposed for HEA consideration includes shot-rock removal, localized grading and contouring, placement of hydraulic roughness elements, and initial gravel placement.

Although the Corps is required to implement a long-term gravel augmentation program by the NMFS 2007 BO, such a program would provide minimal benefits to spring-run Chinook salmon and steelhead until the channel is rehabilitated from instream gravel mining and deposition of shot-rock. After initial spawning habitat rehabilitation and the provision of gravel associated with the Englebright Dam Reach spawning habitat rehabilitation project, it is suggested that ongoing gravel supply would then be maintained as per requirements of the Corps in the NMFS 2007 BO, or whatever requirements emanate from the legal challenge pending in the United States District court for the Eastern District of California. It has been estimated that ongoing annual maintenance of the spawning habitat could be accomplished through the injection of approximately 10,000 cubic yards of gravel per year (Pasternack 2009).

Potential alternatives associated with fish passage improvements at Daguerre Point Dam continue to be part of ongoing investigations. According to the NMFS 2007 BO, the Corps shall develop and implement a plan to improve fish passage for adult and juvenile spring-run Chinook salmon, steelhead and green sturgeon at Daguerre Point Dam. Although the NMFS 2007 BO is the subject of a legal challenge pending in the United States District Court for the Eastern District of California, it is anticipated that fish passage improvements at Daguerre Point Dam will remain the Corps' responsibility.

3.0 Are there accurate cost estimates for the individual project components including permitting, construction, and long term operation and maintenance costs?

We have not prepared cost estimates for proposed habitat enhancement projects in the lower Yuba River. Additional cost information is provided under the previous discussion regarding feasibility, which includes economic feasibility.

4.0 Are there potential funding partners for operation and maintenance activities?

Anticipated potential funding partners were preliminarily identified in the questionnaire responses for each of the considered habitat expansion project for the lower Yuba River, and were discussed above under the section titled “Relationship to Other Parties”. Potential funding partners suggested in the responses to the questionnaires have not necessarily confirmed their participation or approval of identified habitat expansion projects in the lower Yuba River.

For summary purposes, information regarding potential funding partners for each of the four considered projects in the lower Yuba River is presented below.

After initial spawning habitat rehabilitation and the provision of gravel associated with the Englebright Dam Reach spawning habitat rehabilitation project, ongoing gravel supply would then be maintained as per requirements of the Corps in the NMFS 2007 BO, or subsequent requirements pending the outcome of the legal challenge being considered by the United States District Court of the Eastern District of California.

As stated in SYRCL questionnaire response, funding partners for juvenile salmonid rearing habitat enhancement project could potentially include the Corps, Western Aggregates, PG&E, BLM, USFWS AFRP, and project partners could potentially include the Corps and SYRCL. As previously discussed, potential funding partners suggested in the responses to the questionnaires have not necessarily confirmed their participation or approval of identified habitat expansion projects in the lower Yuba River. Moreover, it is likely that all of the potential funding partners have funding limits or constraints for a project of the necessary scope and magnitude.

It is presently undetermined what parties would be responsible for continued maintenance of the juvenile salmonid rearing habitat enhancement project.

As stated in SYRCL’s response to the questionnaire for the segregation weir project, funding partners could potentially include PG&E and the USFWS AFRP, and project partners could potentially include the Corps. As part of the NMFS 2007 BO, the Corps shall maintain the current fish passage facilities, including fish ladder clearing and sediment management, at Daguerre Point Dam until it develops and implements a plan to improve passage at Daguerre Point Dam. Although the NMFS 2007 BO is the subject of a legal challenge pending in the United States District Court for the Eastern District of California, it is anticipated that fish passage improvements, including ongoing maintenance activities at Daguerre Point Dam will remain the Corps’ responsibility.

5.0 Who would own, operate, and maintain a segregation weir?

It is presently undetermined what parties would be responsible for the segregation weir. As discussed above, SYRCL’s questionnaire response stated that potential funding partners for segregation weir implementation could potentially include PG&E and the USFWS AFRP, and project partners involved with ongoing operation and maintenance activities could potentially include the Corps.

REFERENCES

Anderson, J., F. Chung, M. Anderson, L. Brekke, D. Easton, M. Ejeta, R. Peterson, and R. Snyder. 2008. Progress on Incorporating Climate Change into Management of California's Water Resources. Climatic Change (2008) 87 (Suppl 1):S91–S108. DOI 10.1007/s10584-007-9353-1.

Battin, J., M.W. Wiley, M.H. Ruckelshaus, R.N. Palmer, E. Korb, K.K. Bartz, and H. Imaki. 2007. Projected Impacts of Climate Change on Salmon Habitat Restoration. Proceedings of the National Academy of Sciences, 104(16), 6720-6725.

CALFED and YCWA. 2005. Draft Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration: Multi-Agency Plan to Direct Near-Term Implementation of Prioritized Restoration and Enhancement Actions and Studies to Achieve Long-Term Ecosystem and Watershed Management Goals. Prepared by Lower Yuba River Fisheries Technical Working Group. Funded by CALFED and Yuba County Water Agency. October 2005.

CDFG. 1991. Lower Yuba River Fisheries Management Plan. The Resources Agency, CDFG, Stream Evaluation Report No. 91-1. February 1991.

CDFG. 1996. Steelhead Restoration and Management Plan for California. Prepared by D. McEwan and T. Jackson. Inland Fisheries Division, Sacramento, CA.

CDFG and NMFS. 2001. Final Report on Anadromous Salmonid Fish Hatcheries in California. California Department of Fish and Game and National Marine and Fisheries Service Southwest Region. NMFS Southwest Regional Office, Long Beach, CA.

Francis, R. C. and N. J. Mantua. 2003. Climatic Influences on Salmon Populations in the Northeast Pacific. In: Assessing Extinction Risk for West Coast Salmon [MacCall, A.D. and T.C. Wainwright (eds.)]. NOAA technical memo NMFS-NWFSC-56. National Marine Fisheries Service, [Washington, DC], pp. 37-67. Fisheries Research Institute. Joint Institute for the Study of the Atmosphere and Oceans. University of Washington. Seattle WA. URL = http://cses.washington.edu/db/pdf/Francis_Mantua_ClimateInfluences23.pdf

Good, T. P., R. S. Waples, and P. Adams. 2005. Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-NWFSC-66.

Hallock, R.J., W.F. Van Woert, and L. Shapavalov. 1961. An Evaluation of Stocking Hatcher-reared Steelhead Rainbow Trout (Salmo guirdneri gairdneri) in the Sacrametno River System. California Fish and Game Fish Bulletin 114, 73 p.

Intergovernmental Panel on Climate Change (IPCC). 2007. Summary for Policymakers: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, pp 18.

Lindley, S.T., Schick, R.S., Mora, E., Adams, P.B., Anderson, J.J., Greene, S., Hanson, C., May, B.P., McEwan, D.R., MacFarlane, R.B., Swanson, C., and Williams, J.G. 2007. Framework for Assessing Viability of Threatened and Endangered Chinook Salmon and Steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science. February 2007.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-42, 156 pp.

National Marine Fisheries Service (NMFS). 2007. Biological Opinion on the Operation of Englebright and Daguerre Point Dam on the Yuba River, California. File Number 151422-SWR-2006-SA00071:MET (PCTS # 2007/01232). November 21, 2007.

NMFS. 2009. Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead. Available online at: http://swr.nmfs.noaa.gov/recovery/centralvalleyplan.htm

Oreskes, N. 2004. The Scientific Consensus on Climate Change. Science 306:1686.

Pasternack, Greg. 2009. 2009 SHIRA-Based River Analysis and Field-Based Manipulative Sediment Transport Experiments to Balance Habitat and Geomorphic Goals on the Lower Yuba River. Final Report. U.C. Davis Cooperative Ecosystems Studies Unit.

Smith, J.G. 1990. Fishery Investigations in the Yuba River Goldfields Area Near Daguerre Point Dam on the Yuba River in 1989. U.S. Fish and Wildlife Service Report No. AFF1-FAO-90-9. Fisheries Assistance Office, Red Bluff, CA, pg. 15.

Thomas R. Karl, J. M. Melillo, and T. C. Peterson (eds.). 2009. Global Climate Change Impacts in the United States. Cambridge University Press. 2009. Available online at: http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf

Vogel, D.A., K.R. Marine, and J.G. Smith. 1988. Fish Passage Action Program for Red Bluff Diversion Dam. Final Report. U.S. Fish and Wildlife Service Report No. FR1-FAO-88-19.

Wheaton, J. M., Pasternack, G. B., and Merz, J. E. 2004. Spawning Habitat Rehabilitation - 1. Conceptual Approach & Methods. International Journal of River Basin Management 2:1:3-20.

Yuba County Water Agency (YCWA), SWRI and JSA. 2000. Draft Environmental Evaluation Report. Yuba River Development Project (FERC No. 2246). Submitted to the Federal Energy Regulatory Commission. December 2000.

YCWA, DWR and Reclamation. 2007. Draft Environmental Impact Report/ Environmental Impact Statement for the Proposed Lower Yuba River Accord. Prepared by HDR|Surface Water Resources, Inc., June 2007.

Appendix N

Methodology for Estimating the Contribution of Recommended Actions to the Habitat Expansion Threshold

Appendix N

Methodology for Estimating the Contribution of Recommended Actions to the Habitat Expansion Threshold

One measure of the adequacy of the actions recommended in the Habitat Expansion Plan (HEP) is their estimated contribution to the Habitat Expansion Threshold (HET). The Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead (HEA) specifies that the HEP should “expand spawning, rearing and adult holding habitat sufficiently to accommodate an estimated net increase of 2,000 to 3,000 Spring Run [Chinook salmon] for spawning (“Habitat Expansion Threshold”) in the Sacramento River Basin as compared to the habitat available under any relevant Existing Requirements or Commitments” (Section 2.2 of the HEA). The National Marine Fisheries Service (NMFS) is instructed to use the extent to which the HEP recommended actions achieve the HET in its evaluation of the actions.

The HEA also states that “The Habitat Expansion Threshold is focused on Spring-Run [Chinook salmon] as the priority species, as expansion of habitat for Spring-Run typically accommodates Steelhead as well” (Section 2.2 of the HEA). The HEP provides habitat to support spring-run Chinook salmon and steelhead recognizing that actual abundance of fish that return to the Sacramento River system is the result of conditions across the life-history expanse of the species and outside the domain of the HEA. In other words, the HEP actions need to increase the potential of habitat in the Sacramento River Basin to support spring-run Chinook salmon and steelhead by providing sufficient quantity of habitat to support the numeric goal of the HET and with qualities consistent with the habitat needs of spring-run Chinook salmon.

The HEA does not describe a method for evaluating the contribution of actions to the HET. As a result, the Steering Committee developed a method of estimating contribution to the HET. The evaluation method documents a logical procedure that informed the Steering Committee conclusions regarding the adequacy of recommended actions to meet the HET. The procedure involves evaluating the recommended actions first in terms of the quantity of habitat for Chinook salmon provided and second in terms of the quality of that habitat with respect to the needs of spring-run Chinook salmon.

The methodology of evaluating contribution to the HET used in preparing the Final HEP is similar to that described in Chapter 3 of the Draft HEP. In the Draft HEP, the Steering Committee estimated the contribution of recommended actions in Battle Creek, Antelope Creek, Big Chico Creek, and the Lower Yuba River. A uniform methodology was needed that could be applied across actions in all watersheds and accommodate the limited information available. For the Final HEP, the Steering Committee was able to significantly refine the methodology and take advantage of new information, specifically for the recommended Lower Yuba River Habitat Expansion Actions (Lower Yuba River Actions). The primary components of the Lower Yuba River Actions pertinent to the HET calculation are spawning habitat expansion actions at Sinoro Bar and Narrows Gateway (the HEP action sites). The HEP action area includes Englebright Dam to below the Narrows in the Lower Yuba River.

N.1 Overview of the Methodology

The methodology of estimating contribution to the HET for the recommended actions is based on a conceptual framework that uses potential spawner abundance as a biological surrogate for habitat conditions at points along a continuum of possible habitat conditions (Figure N-1). The distance between potential spawner abundance under the Current Habitat Potential and the Maximum Habitat Potential defines the Restoration Potential. *Restoration Potential* is a function of habitat conditions and describes habitat improvements that can be addressed by restoration actions.

N.1.1 Current Habitat Potential

The *Current Habitat Potential* describes the existing capability of the habitat to support spawning by spring-run Chinook salmon. It is presumed that the potential of the existing habitat at Sinoro Bar and Narrows Gateway is quite limited because very few Chinook salmon currently spawn in the area despite the fact that Chinook salmon spawn in other areas of the Lower Yuba River. While there is no systematic assessment of fish abundance above Timbuctoo Bend, anecdotal observations support the contention that current abundance is low, with the few spring-run Chinook salmon spawning only in pockets of suitable habitat (Pasternack pers. comm.). For purposes of estimating contribution to the HET, it was assumed that the Current Habitat Potential is 200 spawners.

N.1.2 Maximum Habitat Potential

The *Maximum Habitat Potential* describes fish performance under “best possible” habitat conditions. The maximum potential of the habitat does not describe a historical or unregulated condition. This is because the Lower Yuba River has been radically and arguably fundamentally altered relative to its condition prior to anthropogenic impacts to sediment, channel form, substrate, flow, and temperature. To evaluate the contribution to the HET, the Maximum Habitat Potential was based on estimates of Chinook salmon spawning potential for restored conditions at Sinoro Bar and Narrows Gateway that were provided by Dr. Gregory Pasternack of the University of California at Davis (Pasternack 2010a, 2010c). Dr. Pasternack's reports to the Licensees regarding his analysis of the recommended actions are provided in Appendix H and Appendix K of the Final HEP.

The contribution to the HET represents partial fulfillment of the Restoration Potential through completion of the recommended actions in the HEP.

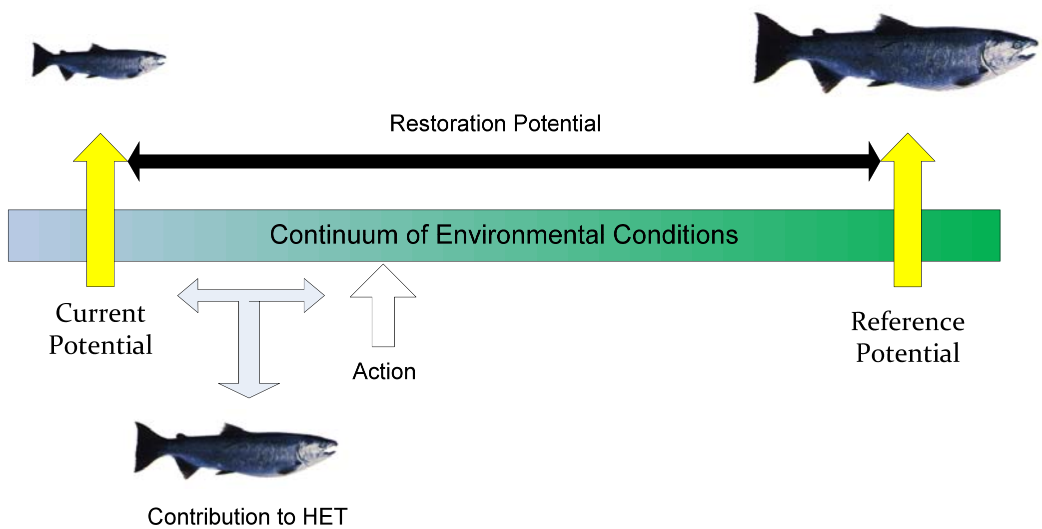


Figure N-1. Conceptual Framework for the Methodology of DeterminingContribution to the Habitat Expansion Threshold

The remainder of this appendix provides details of the methodology to estimate contribution to the HET.

N.2 Determination of Maximum Habitat Potential

The Maximum Habitat Potential of the habitat at the HEP action sites was based on Pasternack's analysis of the Sinoro Bar and Narrows Gateway sites (Pasternack 2010a, 2010c [Appendices H and K in the Final HEP]). Pasternack analyzed the geomorphology of the proposed actions at the two sites and estimated the quantity of habitat provided by restoration of channel and substrate conditions. He then adjusted the total HEP action area downward to account for non-spawnable habitat types such as pools and for other areas he concluded would not provide suitable spawning conditions. The result was an estimate of the total potential spawning area provided by the recommended actions (Table N-1). Based on Pasternack's analysis, the recommended spawning habitat expansion actions would provide 40,738 square meters (m^2) of potential Chinook salmon spawning area.

Table N-1. Estimated Capacity of Expanded Habitat to Support Chinook Salmon Spawners

HEP Recommended Action	Area of Expanded Habitat (m2)	Area of Spawning Habitat (m2)	Estimated Redd Capacity (redd = 11.1 m2)	Estimated Chinook Salmon Spawner Capacity (2 fish/redd)
Rehabilitation of Sinoro Bar	46,486	28,072	2,529	5,058
Rehabilitation of Narrows Gateway	15,833	12,666	1,141	2,282
Total	62,319	40,738	3,670	7,340

Sources: Pasternack 2010a, 2010c.

To estimate the number of Chinook salmon redds that could be accommodated by the expanded habitat, Pasternack divided the total area in the two HEP action sites (Table N-1) by the assumed area of a Chinook salmon redd. Redd size is highly variable and dependent on spawner density, habitat conditions, and other factors. Pasternack relied on his personal observations of Chinook spawning in the Mokelumne River and in the Timbuctoo Bend area of the Yuba River to estimate the size of typical Chinook salmon redds. He also made adjustments for the typical spacing of redds across a gravel bar. The result was a range of estimates of Central Valley Chinook salmon redd size, from 5.5 m^2 at Timbuctoo Bend to 18.3 m^2 in the Mokelumne River. Pasternack concluded that an amount of 11.1 m^2/redd was "most reasonable" for estimating potential redd abundance at Sinoro Bar and Narrows Gateway.

The Steering Committee used Pasternack's "most reasonable" estimate of potential redd abundance at the two action sites to determine the Maximum Habitat Potential of the two areas (Table N-1). Because the HET is expressed in terms of adult Chinook spawners, the estimated number of redds was related to spawners by multiplying redds by 2.0, assuming that each redd represents at least one male and one female fish. For purposes of evaluating the contribution to the HET, the Steering Committee used the lowest possible redd-fish multiplier and set the Maximum Habitat Potential of the two sites to be 7,340 Chinook salmon spawners.

N.3 Adjustment of Habitat Potential due to Habitat Quality

Once the Maximum Habitat Potential was determined, it was adjusted to account for conditions not addressed by the recommended actions and the expectation of the recommended actions to address habitat limitations at the two sites. The adjustment of the Maximum Habitat Potential involved diagnosing conditions at the HEP action sites, interpreting the diagnosis from the perspective of spring-run Chinook salmon, and then applying the recommended actions as treatments to address the limiting conditions. The Steering Committee developed an Excel spreadsheet to facilitate the adjustments and to document assumptions and calculations. The spreadsheet uses several worksheets that document the various steps in the HET estimation methodology, including:

- watershed definition,
- species rules,
- watershed diagnosis
- action hypotheses, and
- contribution to the HET.

Each of these worksheets is discussed below. The final HET evaluation spreadsheet is posted on the HEA website (www.sac-basin-hea.com).

N.3.1 Watershed Definition

The *WatershedDefinition* worksheet defines and names the watershed being evaluated, in this case, the HEP action area. The Lower Yuba River was defined as a “large” watershed. This designation is used to select the biological rules set on the next worksheet. Eight environmental attributes were defined for purposes of evaluating the contribution to the HET of the recommended actions (Table N-2). These attributes were believed to capture the major environmental drivers in most Central Valley streams.

Table N-2. Environmental Attributes Used to Evaluate Contribution to the HET

	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Environmental Attributes								

N.3.2 Species Rules

The *SpeciesRules* worksheet documents the biological assumptions for the HET evaluation. Biological interpretation of the environmental conditions at the HEP action areas was based on a ranking of the eight environmental attributes in terms of their biological importance for productivity of spring-run Chinook salmon in fresh water (Table N-2). The ranking of 0 (no importance) to 4 (high importance) represented the professional judgment of the Steering Committee. The committee recognized that all of the attributes were potentially critical in some situations, and their ranking of biological importance of the attributes represents their conclusions specifically for the streams evaluated under the HEA.

The Steering Committee concluded that the ranking of attributes could be different for streams of different size. For example, large wood would be more important in a small headwater stream than it would be in a large river (Vannote et al. 1980). The HET evaluation spreadsheet includes the option of developing rankings for different sized streams; however, the Yuba River was classed as a "large" stream, and a single set of rankings was used (Table N-3). The spreadsheet also includes the option of shaping the differences between rankings and assuming a non-uniform spacing between integer ranks. The Steering Committee opted for the simpler approach of assuming uniform spacing between integer ranks.

Table N-3. Rankings of Importance for Environmental Attributes Affecting Productivity of Spring-Run Chinook Salmon

Stream size	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Large streams	3.0	3.0	3.0	2.0	2.0	4.0	1.0	2.0

N.3.3 Watershed Diagnosis

The *WatershedDiagnosis* worksheet documents the Steering Committee's conclusions regarding the condition of the environmental attributes at Sinoro Bar and Narrows Gateway. This step also interprets the conditions from the perspective of spring-run Chinook, using the species rules to calculate a weighted index of habitat change.

N.3.3.1 Definition of Restoration Potential

Current and Maximum Habitat Potential as described above were entered into the spreadsheet to define the Restoration Potential (Table N-4). As noted earlier, the Maximum Habitat Potential was derived from Pasternack (2010a, 2010c), as summarized in Table N-1. A Current Habitat Potential of 100 spawners was assumed at each site. The remainder of the analysis consisted of adjusting the resulting Restoration Potential to estimate habitat potential at Sinoro Bar and Narrows Gateway with implementation of the recommended actions, in order to evaluate their contribution to HET.

Table N-4. Definition of Restoration Potential for Chinook Salmon at the HEP Action Sites

	Sinoro Bar	Narrows Gateway	Total
Current Habitat Potential	100	100	200
Maximum Habitat Potential	5,058	2,282	7,340
Restoration Potential	**4,958**	**2,182**	7,140

N.3.3.2 Habitat Ratings

The Steering Committee rated conditions in the two HEP action sites for the eight environmental attributes under Current Habitat Potential and Maximum Habitat Potential conditions (Table N-5). For the most part, the committee assumed optimal environmental attributes for the Maximum Habitat Potential within the HEP action area (ratings = 0). The committee assumed less optimal conditions for the environmental attributes of Channel Form and Riparian/ Floodplain because canyon walls constrict the channel in the HEP action area. The ratings of habitat conditions were based on Pasternack's analyses; data and reports from the Yuba Accord River Management Team; and discussions with local resource managers, biologists, and landowners.

The scores for Current and Maximum Habitat Potential conditions were subtracted to compute an index of habitat change (Table N-5). This represents the amount of deviation of current conditions at the actions sites from the maximum condition due to human-induced changes in the HEP action area.

The Steering Committee also assigned a value for degradation of adult and juvenile fish passage at Daguerre Point Dam (Table N-5). While there is ample reason to conclude that conditions at Daguerre Point Dam impair adult and juvenile migration (NMFS 2007), there has been no systematic assessment of mortality at the dam. For purposes of computing the contribution to the HET, the Steering Committee assumed a mortality of 10 percent at Daguerre Point Dam.

Table N-5. Habitat Rating Scores for HEP Action Sites

	Score:	0	Optimal geomorphic condition					
		4	Highly altered condition					
	Habitat Rating Scores							
Passage Mortality 10%	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Sinoro Bar Current	**3**	**3**	**4**	**1**	**1**	**1**	**1**	**1**
Sinoro Bar Maximum	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Narrows Gateway Current	**3**	**2**	**4**	**1**	**1**	**1**	**1**	**1**
Narrows Gateway Maximum	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Sinoro Bar Change Index	-2	-3	-4	-1	-1	-1	-1	0
Narrows Gateway Change Index	-2	-2	-4	-1	-1	-1	-1	0

N.3.3.3 Species Interpretation of Habitat Change

The habitat change indices in Table N-5 were interpreted biologically using the species rules for spring-run Chinook salmon in large rivers (Table N-3). In this step, the change indices for each attribute in Table N-5 were multiplied by the biological ranking for the attribute in Table N-3. The result was increased weight for changes in attributes that were judged to have higher biological significance relative to changes in other attributes (Table N-6). For example, the attribute of substrate was assigned a biological ranking of 3 out of 4 (Table N-3). In Table N-5, the habitat change index at Sinoro Bar was -4 (0 for Maximum; and -4 for Current). The resulting weighted habitat change score was 3 X -4 = -12 (Table N-6). This resulted in an increased biological significance for change in the substrate conditions at Sinoro Bar relative to a change in structure, for example. The biologically weighted habitat change scores were normalized to percentage habitat change for each of the eight environmental attributes (Table N-6).

Table N-6. Species Interpreted Habitat Change for HEP Action Sites

Using rules for Large streams		Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
		Species Interpretation of Habitat Change							
Sinoro Bar	Weighted Scores	-6	-9	-12	-2	-2	-4	-1	0
	Normalized Scores	16.7%	25.0%	33.3%	5.6%	5.6%	11.1%	2.8%	0.0%
Narrows Gateway	Weighted Scores	-6	-6	-12	-2	-2	-4	-1	0
	Normalized Scores	18.2%	18.2%	36.4%	6.1%	6.1%	12.1%	3.0%	0.0%

The biological weighting of habitat change scores resulted in a shift in significance of the habitat change between the eight attributes relative to the raw scores (Figure N-2). For example, change in temperature between current and maximum habitat conditions increased in significance when interpreted for the species using the biological rules, whereas the significance of changes in water quality decreased using the biological rules (Figure N-2).

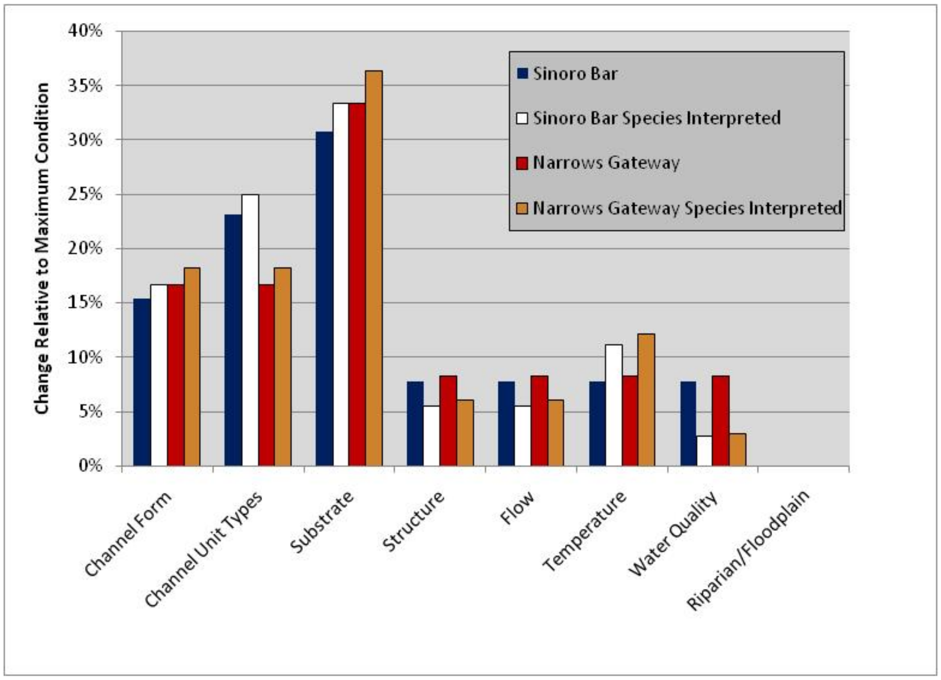


Figure N-2. Comparison of Raw and Species Interpreted Percentage Habitat Change for HEP Action Sites

N.3.3.4 Allocation of Recovery Potential

The final step in the diagnosis was to allocate the Restoration Potential (Table N-4) among the habitat attributes based on the percent change in each attribute in Table N-6. This provided an estimate of the maximum contribution of Chinook salmon to the HET that could be made by addressing habitat change in each attribute at Sinoro Bar and Narrows Gateway (Table N-7).

Table N-7. Allocation of Restoration Potential Based on Habitat Change

		Allocation to Recovery Potential							
	Passage	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Sinoro Bar	496	744	1,116	1,487	248	248	496	124	-
Narrows Gateway	218	357	357	714	119	119	238	60	-

N.3.4 Action Hypotheses

The *ActionHypotheses* worksheet determines the expected change in habitat attributes based on the level of intensity and effectiveness of the recommended actions. The HEP recommended actions are treatments that would address the biologically weighted habitat changes identified in the diagnosis. This step in the methodology consisted of expressing the recommended actions at Sinoro Bar and Narrows Gateway in terms of their expected impact on one or more of the environmental attributes. Treatments were parameterized by developing action hypotheses. The concept of action hypotheses is described in ICF International (2009) and involves three distinct steps:

1. describe the effectiveness of an action type to change one or more environmental attributes,
2. describe the intensity of application of the action at the HEP action sites, and
3. calculate the expectation of change in the attributes as the product of effectiveness and intensity.

The purpose of this procedure was to separate the scientific issues (effectiveness) from policy/economic issues (intensity) and create an explicit working hypothesis describing the actions. *Effectiveness* is a scientific statement regarding how a type of restoration action (e.g., rehabilitation of spawning gravels) touches on environmental attributes. *Intensity* is a statement of how extensive the treatment will be applied at a location (e.g., rehabilitation of Sinoro Bar) and reflects logistical, economic, and political considerations. The resulting *expectation of change* therefore reflects a combination of scientific and policy considerations.

N.3.4.1 Action Effectiveness

The actions at Sinoro Bar and Narrows Gateway are the same type of action; the rehabilitation of channel form and spawning gravels to optimize spawning conditions, thereby expanding usable habitat. The Steering Committee concluded that this type of action had the potential to affect attributes of Channel Form, Channel Unit Types, and Substrate (Table N-8). Further, in theory, it would be possible to address all or most of the habitat change in these three attributes. For example, it would be theoretically possible to address 100 percent of the habitat change in substrate by removing all unsuitable substrate like shot rock and replacing it with optimal spawning gravels. Similarly, practical considerations aside, it should be possible to engineer a stream channel to achieve nearly normative channel form and to develop a normative sequence of channel unit types (e.g., pools and riffles).

Table N-8. Effectiveness of Action Types to Address Changes in Environmental Attributes

		Habitat Attributes							
Action Type	Passage	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Spawning Rehabilitation		95%	95%	100%					

N.3.4.2 Action Intensity

Intensity moderates effectiveness to reflect the degree to which a proposed action can be realistically implemented. Pasternack (2010a, 2010c) assumed that it would be possible to completely address conditions at the HEP action sites. However, the Steering Committee took a more conservative stance and concluded that the intensity of the recommended actions was 90 percent at both sites (Table N-9).

Table N-9. Projected Intensity of HEP Recommended Actions at Sinoro Bar and Narrows Gateway

	Specific Actions			
Action Type	Sinoro Bar Rehabilitation	Narrows Gateway Rehabilitation		
Spawning Rehabilitation	90%	90%		

N.3.4.3 Expectations of Recommended Actions

The expectation of the recommended actions to address identified habitat changes at Sinoro Bar and Narrows Gateway was calculated as the product of effectiveness and intensity (Table N-10). The Steering Committee concluded that the recommended actions would substantially address the Restoration Potential associated with Channel Form, Channel Unit Types, and Substrate at the two action sites. The actions are not expected to change conditions for the remaining attributes.

Table N-10. Expectations of HEP Recommended Actions to Address Change in Environmental Attributes

	Expected change in current attribute								
Action	Passage	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Sinoro Bar Rehabilitation	0%	86%	86%	90%	0%	0%	0%	0%	0%
Narrows Gateway Rehabilitation	0%	86%	86%	90%	0%	0%	0%	0%	0%

N.3.5 Contribution to the HET

The *HETContribution* worksheet combines results from previous worksheets to determine the contribution of the recommended actions to the HET. The actual contribution of the actions at Sinoro Bar and Narrows Gateway to the HET (Table N-11) was evaluated by multiplying the allocation of spring-run Chinook to the Recovery Potential for each attribute (Table N-7) by the action expectations (Table N-10). This expressed the change in condition of that attribute due to the recommended actions, in terms of the potential increase in fish abundance. For example, in Table N-7 the allocation of the Recovery Potential to the habitat attribute "Substrate" at Sinoro Bar is 1,487 Chinook salmon. The action expectation of the recommended action at Sinoro Bar is that it will address 90 percent of the limitation of substrate, leading to an estimated contribution to the HET of 1,339 Chinook (1,487 X .90). The total contribution to the HET from restoration of each attribute was calculated for each of the two action sites. Total HET contribution was calculated as the sum of total contributions from each of the two actions (Table N-11). The "Total Chinook habitat potential" in the table includes the assumed Current Habitat Potential of 200 spawners.

Table N-11. Estimated Contribution of HEP Actions to the HET

Results for Habitat Actions

		Contribution to Chinook (all) from the Actions								
Action	Passage	Channel Form	Channel unit types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/floodplain	Chinook
Sinoro Bar Rehabilitation	-	636	954	1,339	-	-	-	-	-	2,928
Narrows Gateway Rehabilitation	-	305	305	643	-	-	-	-	-	1,253
									Chinook added	**4,182** **HET Contribution**
										4,382 Total Chinook habitat potential

Note: The discrepancy in the totals is due to rounding. The estimated contribution of the recommended actions to the Habitat Expansion Threshold (HET) represents an index of the increase in quality and quantity of habitat for spring-run Chinook salmon.

N.4 Discussion

The methodology for estimating the HET contribution developed by the Steering Committee provides a uniform and transparent approach that relates the recommended actions to identified habitat limitations. The estimated contribution consists of a reduction of the area-based calculations of Pasternack (2010a, 2010c) to account for:

1. Habitat limitations at the action sites not addressed by the recommended actions, including
    a. Temperature
    b. Flow
    c. Water quality
    d. Habitat structure

   e. Passage at Daguerre Point Dam

2. The Steering Committee's conclusions regarding the extent to which the recommended actions address limitations in the target attributes:

   f. Channel form

   g. Channel unit types

   h. Substrate

3. Current potential of the habitat

The result was a 41-percent reduction of Pasternack's estimates of potential benefits of habitat restoration at Sinoro Bar and Narrows Gateway.

Based on this analysis and the results in Table N-11, the Steering Committee concludes that the recommended actions provide sufficient quantity of habitat to exceed the HET, with qualities consistent with the needs of spring-run Chinook salmon. Two important qualifiers should be added.

First, the HET contribution is an estimate of the increase in habitat potential in the Sacramento River system for spring-run Chinook salmon and is not necessarily an estimate of abundance of fish expected to return to the Yuba River. The actual number of fish that return to spawn over both the short and long term reflects habitat potential over the entire life cycle of Chinook salmon that, in turn, is a function of conditions in the Yuba River, Sacramento River, Bay-Delta, and the Pacific Ocean. The HEP recommended actions, while making a significant contribution to overall capabilities of the Sacramento River system, do not address all conditions currently limiting salmon in the HEP action area.

The second qualifier on the estimated contribution to the HET relates to the use of the expanded habitat by both spring-run and fall-run Chinook salmon. The HEP recommended actions provide the quantity and quality of habitat to significantly expand habitat for spring-run Chinook salmon and to meet the HET. It is to be expected, however, that both spring-run and fall-run fish will use the expanded habitat. There is some risk that spring-run fish might be excluded by the abundance of spawning fall-run fish or that genetic mixing of the two runs would prevent development of a self-sustaining population of spring-run Chinook in the Yuba River[1]. For these reasons, the Steering Committee added the action of constructing a weir to mechanically separate fall-run and spring-run Chinook, if deemed necessary by the resource agencies (NMFS, U.S. Fish and Wildlife Service, and California Department of Fish and Game). The weir might be used early on to allow a spring-run population to develop, or in years in which disparity in abundance between the two runs would indicate the need to provide spring-run fish with additional protection. Chapter 3 and Appendix J of the Final

[1] As noted in Chapter 4 of the Final HEP (Section 4.3.2), there is evidence that, despite spatial and temporal overlap, spring-run and fall-run populations of Chinook salmon in the Central Valley have maintained genetic separation (Banks et al. 2000), presumably due to behavioral factors.

HEP provide additional details about the optional segregation weir and an adaptive management approach to its use.

N.5 References Cited

Banks, M. A., V. K. Rashbrook, M. J. Calavetta, C. A. Dean, and H. D. Hedgecock. 2000. Analysis of microsatellite DNA resolves genetic structure and diversity of chinook salmon (*Oncorhynchus tshawytscha*) in California's Central Valley. *Canadian Journal of Fisheries and Aquatic Sciences* 57:915-927.

ICF International. 2009. Use of action hypothese for evaluating the effects of actions on environmental conditions. *Prepared for* California Department of Water Resources and Pacific Gas and Electric Company. May 15.

National Marine Fisheries Service. 2007. *Biological Opinion for the operation of Englebright and Daguerre Point Dam on the Yuba River, California*. File Number, 151422-SWR-2006-SA00071:MET (PCTS #2007/01232. , Sacramento, CA.

NMFS. See National Marine Fisheries Service.

Pasternack, G. B. 2010a. Estimate of the number of spring-run Chinook salmon that could be supported by spawning habitat rehabilitation at Sinoro Bar on the lower Yuba River. *Prepared for* the Habitat Expansion Agreement Steering Committee (California Department of Water Resources and Pacific Gas and Electric Company). July 2.

Pasternack, G. B. 2010c. Estimate of the number of spring-run Chinook salmon supportable by river rehabilitation in the Narrows Reach of the Lower Yuba River. *Prepared for* the Habitat Expansion Agreement Steering Committee (California Department of Water Resources and Pacific Gas and Electric Company). November 9.

Vannote, R. L., G. W. Minshall, K. W. Cummins, J. R. Sedell, and C. C. Cushing. 1980. The river continuum concept. *Canadian Journal of Fisheries and Aquatic Sciences* 37:130-137.