Environmental Appendix D
Attachment 1

Biological Assessment and Essential Fish Habitat Assessment

Section 7 ESA Consultation with National Marine Fisheries Service

Yuba River Ecosystem Restoration Feasibility Study

January 2018

U.S. Army Corps of Engineers

Sacramento District

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1.0 Introduction

The purpose of this initiation package is to review the proposed Yuba River Ecosystem Restoration Project in sufficient detail to determine to what extent the proposed action may affect any of the threatened, enangered, proposed, or sensitive species and designated or proposed critical habitats under the jurisdiction of the National Marine Fisheries Service and listed below. In addition, the following information is provided to comply with statutory requirements to use the best scientific and commercial information available when assessing the risks posed to listed and/or proposed species and designated and/or proposed critical habitat by proposed federal actions. This initiation package is prepared in accordance with legal requirements set forth under regulations implementing Section 7 of the Endangered Species Act (50 CFR 402; 16 U.S.C. 1536 (c)).

Threatened, Endangered, Proposed Threatened or Proposed Endangered Species

The following listed and proposed species were identified through the NMFS West Coast Region California Species List online tool as having the potential to be affected by the proposed action (Attachment 1):

Spring-run Chinook salmon Central Valley Evolutionary Significant Unit (ESU) (*Oncorhynchus tshawytscha*), **T**

California Central Valley steelhead ESU (*Oncorhynchus mykiss*), **T**

North American green sturgeon (*Acipenser medirostris*) southern Distinct Population Segment (DPS), **T**

The Federally listed Endangered Winter-run Chinook salmon Sacramento River ESU (*O. tshawytscha*) were also Identified as having the potential to occur in the action area; however, winter-run Chinook are not known to occur on the Yuba River and would not be affected by the proposed action.

Candidate Species, Sensitive Species, and Species of Concern

The following candidate species, sensitive species, and species of concern are known to occur in the project area and may be affected by the proposed action:

Central Valley Fall-run/ late Fall-run Chinook salmon ESU (*O. tshawytscha*), Species of Concern

Critical Habitat

The action addressed within this document falls within Critical Habitat for Cental Valley spring-run Chinook salmon ESU, Central Valley steelhead ESU, and North American green sturgeon southern DPS.

Essential Fish Habitat

Essential Fish Habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 1802[10]). Public Law 104-297, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) to establish new requirements for EFH descriptions in federal fishery management plans. In addition, the MSFCMA established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. Pursuant to the MSFCMA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH;
- NMFS must provide conservation recommendations for any federal or state action that would adversely affect EFH;
- Federal agencies must provide a detailed response in writing to the NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the NMFS' EFH conservation recommendations, the federal agency must explain its reasons for not following the recommendations.

According to the Pacific Coast Salmon Fisheries Management Plan, the project location contains designated EFH for Pacific Coast Chinook salmon. There are four major components of Pacific Coast Chinook Salmon EFH under 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Plan, which the project area contains: 1) Spawning and incubation, 2) juvenile rearing, 3) juvenile migration corridors, and 4) adult migration corridors and adult holding habitat (NMFS, 2011). Furthermore, there are three EFH Habitat Areas of Particular Concern (HAPC) within the Action Area: 1) complex channels and floodplain habitats, 2) thermal refugia, and 3) spawning habitat.

2.0 Consultation to Date

USACE has conducted informal coordination throughout the USACE plan formulation process with USFWS and NMFS to discuss project impacts related to federally listed special status species. Coordination included participation by USFWS and NMFS staff in a multi-day, multi-agency planning workshop (charrette) at the onset of the Feasibility Study process as well as meetings with the Project Delivery Team throughout the plan formulation process. In addition USACE used the NMFS West Coast Region California Species List online tool to obtain an official species list for the project area.

3.0 Description of the Proposed Action

The U.S. Army Corps of Engineers (USACE), in partnership with the Yuba County Water Agency (YCWA) propose to restore 178.6 acres of aquatic and riparian habitat along the lower Yuba River in Yuba County, California (Figure 1). The feasibility study is being conducted under the general authority for flood control investigations in the Rivers and Harbors Act of 1962, Public Law [PL] 87-874, Section 209, and Title III of Public Law 85-500. The principal features of the proposed action include restoration of 42.5 acres of aquatic habitat including side channels, backwater areas, bank scallops, and channel stabilization. These features will provide shallow, low velocity, rearing habitat and refugia for juvenile anadromous salmonids and potentially increase benthic macroinvertebrate producing habitat. Engineered log jams (ELJs) and placement of boulders and large woody material have been incorporated in the proposed action at strategic locations. ELJs and boulders will be placed at actively eroding banks or sites with high velocities and shear stresses. These features will promote bank stabilization, add structural complexity, provide velocity refuge for juvenile fish, and modify local hydraulics and sediment transport.

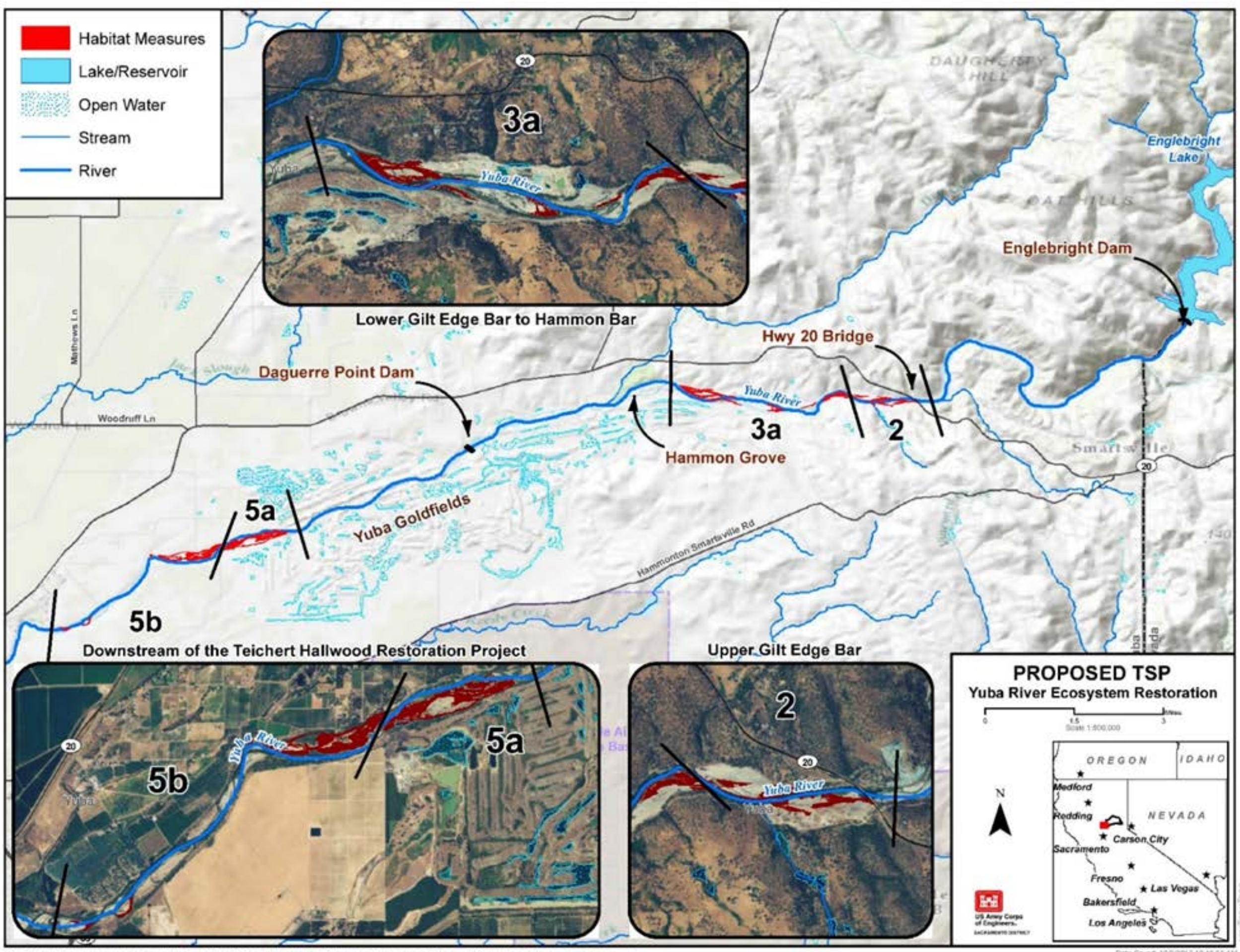

Figure 1. Proposed action area on the lower Yuba River

The proposed action also includes about 136 acres of riparian habitat restoration consisting of floodplain lowering and grading and riparian vegetation plantings, which will increase the quantity and quality of riparian habitat in the river corridor. The proposed action addresses fragmentation of habitat by targeting areas adjacent to existing vegetation that have been unable to initiate revegetation through natural processes due to substrate composition and depth to groundwater.

Floodplain lowering reconnects the river to its floodplain and makes planting feasible where it was not previously due to excessive groundwater depths.

The proposed action includes increments 2, 5b, 5a, and 3a at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, Bar C, Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, and North Silica Bar. Habitat increment details are provided below.

3.1 Habitat Increment 2 (Upper Gilt Edge Bar)

Just downstream of the Highway 20 Bridge at Upper Gilt Edge Bar, the floodplain would be lowered to facilitate inundation at 3,000 cubic feet per second (cfs) and riparian vegetation would be planted along the channel edge.

On the southern bank of Upper Guilt Edge Bar, where the bank is 8-15 feet high, and the edge of the channel is relatively monotonous with little habitat complexity, small scallops would be excavated into the tall and steep banks to increase local topographic diversity and wetted edge.

These scallops are designed to create an inundated alcove at all discharges with the steep slopes surrounding the alcoves feathered to at least a 10:1 slope, providing additional shallow inundated areas with desirable depth/velocity combinations. Initially, these scallops would provide year round rearing habitat to juvenile salmonids. Over time, it is expected that fine sediment may deposit in the scallops creating nursery sites where natural woody vegetation recruitment could occur. The scallops would further facilitate natural recruitment of riparian vegetation, due to shallow access to the water table, and the fine texture of deposited sediments.

In addition, Large Woody Material (LWM) would be placed within and protruding from the scallops. An existing backwater area would be restored allowing for inundation in a typical 50% to 100% Annual Chance Exceedance (ACE) flood. Riparian vegetation would be planted to increase the structural diversity and extent of existing riparian vegetation. Additional fine material would be introduced to the upper 3 feet of the soil column in excavated areas to increase soil absorption and the amount of soil moisture available to riparian vegetation. LWM would be placed within the backwater to provide aquatic structure.

Riparian vegetation would be planted at the Unnamed Bar on the north side of the river near River Mile (RM) 17. The site would be restored by lowering areas to increase lateral floodplain connectivity and provide additional opportunity to plant riparian vegetation. Table 1 shows details for features on Increment 2.

3.2 Habitat Increment 3a (Lower Gilt Edge Bar)

At Lower Gilt Edge Bar, the existing swale feature (at upstream end of Lower Gilt Edge Bar) would be lowered and connected to the channel to become inundated at 3,000 cfs. A patchwork floodplain network of LWM surrounding the restored groundwater-fed swale would be constructed to encourage fine sediment deposition and potential riparian recruitment, as well as provide edgewater refugia at flows above baseflow.

Table 1: Habitat Increment 2 Details

Feature ID	Original Measure ID	Feature Type	Acres	Volume (Cubic Feet)	Length (feet)	Width (feet)
2.1	19	Floodplain Lowering	8.1	497,237.3	2,800	340
2.2	19	Riparian Planting	2.5			
2.3	20	Bank Scalloping	0.3			
2.4	20	Riparian Planting	0.4			
2.5	21	Backwater Area	0.3	67,198.3	240	150
2.6	21	Riparian Planting	0.6			
2.7	22	Floodplain Lowering	5.9	330,942.4	680	430
2.8	22	Riparian Planting	5.2			

Downstream of Lower Gilt Edge Bar, on Hidden Island, the alluvial bar on the north side of the river, riparian vegetation would be planted.

First Island has large expanses of floodplain and high floodplain, and a side channel on river left provides spawning and rearing habitat. This area may provide immediate benefit to emerging salmonid fry if they are allowed access to larger expanses of shallow habitat with riparian cover. To encourage sediment deposition and riparian vegetation recruitment, Engineered Log Jams (ELJs) would be installed in a patchwork configuration, particularly along the apex of First Island just above bankfull elevation. For the purposes of documenting benefits in this report, direct planting of riparian vegetation was substituted for ELJ placement.

Rock and sediment would be deposited along the left bank of Silica Bar, and ELJs would be placed to aid constriction at this location. LWM would be placed along the margins of the downstream terminus of the existing side channel/backwater that is surrounded by an existing stand of diverse, mature, native riparian vegetation, in areas that would not disrupt existing riparian vegetation along the banks of the side channel/backwater area. Floodplain areas would be lowered to facilitate more frequent inundation and riparian vegetation would be planted.

North Silica Bar is located on the river right just downstream of First Island, floodplain surfaces would be lowered and riparian vegetation would be planted to facilitate more frequent inundation between 3,000 and 5,000 cfs. Rock and sediment would be deposited along the left bank of Silica Bar, coupled with placement of ELJs to aid river constriction at this location.

A side channel would be created that activates above 3,000 cfs and connects to the low lying area downstream, providing beneficial off-channel habitat with established riparian vegetation. This would create an anabranching side channel (stable multiple-thread channels) in an existing swale within a stand of relatively dense vegetation that presently includes willows and cottonwoods.

Habitat Increment 3a would increase habitat connectivity between Habitat Increment 2 and SYRCL's Long Bar Restoration Project and Hammon Bar Restoration Project. Table 2 shows details for features on Increment 3a.

Table 2 Habitat Increment 3a Details

Feature ID	Original Measure ID	Feature Type	Acres	Volume (Cubic Feet)	Length (feet)	Width (feet)
3.1	24	Floodplain Lowering	6.2	312,326.5	650	380
3.2	24	Riparian Planting	5.0			
3.3	24	Side Channel	0.8	343,737	1,200	40
3.4	26	Riparian Planting	2.3			
3.5	28	Riparian Planting	6.3			
3.6	29	Channel Constriction	1.6			
3.7	30	Floodplain Lowering	1.6	74,862.5	1,610	150
3.8	30	Riparian Planting	3.5			
3.9	32	Floodplain Lowering	5.2	365,324	1,900	760
3.10	32	Riparian Planting	11.6			
3.11	33	Channel Constriction	1.9			
3.12	34	Side Channel	10.5	4,696,875	3,357	227

3.3 Habitat Increment 5a

Immediately downstream of the Teichert Hallwood Restoration Project, a historical channel alignment on the north side of Bar C would be restored to inundate at 3,000 cfs and function as swale habitat. The side channel and adjacent floodplain would be lowered and graded. Additionally, riparian vegetation would be planted on each side of the restored swale/side channel. ELJs would be placed in a patchwork configuration at the inflow of the swale, at the upstream end of Bar C. In addition, LWM would be placed in the backwater area at the downstream end of Bar C to increase structural and habitat complexity in the area.

A historical channel alignment on the south side of the bar would be restored by lowering and grading a side channel within a stand of riparian vegetation. The side channel would extend into an existing backwater habitat located at the downstream edge of the Yuba Goldfields. The floodplain on the north side of the side channel would be lowered and planted with riparian vegetation. Boulder structures would be placed to provide hydraulic stability at the inflow section of the side channel at the upstream end of Bar C.

Habitat Increment 5a would connect riparian and aquatic habitat corridors to the Teichert Hallwood Restoration Project. Table 3 shows details for features on Increment 5a.

Table 3. Habitat Increment 5a details

Feature ID	Original Measure ID	Feature Type	Acres	Volume (Cubic Feet)	Length (feet)	Width (feet)
5.1	46	Floodplain Lowering	13.0	905,713.1	3,350	306
5.2	46	Riparian Planting	16.6			
5.3	46	Side Channel	10.3	3,188,033	5,100	100
5.4	47	Riparian Planting	4.7			
5.5	47	Side Channel	4.8	2,058,083	5,035	40

3.4 Habitat Increment 5b

A side channel would be constructed at Narrow Bar that would connect to an existing swale at the downstream end of the bar. Existing riparian vegetation would border the created side channel. Another side channel would be created, splitting off from the other side channel through the middle of the bar in the southwest direction. Boulders would be placed to maintain stable hydraulic conditions at the inflow. There is a large expanse of shallow depth to groundwater on Narrow Bar, with some areas of high floodplain. The high floodplain areas would be graded and planted with riparian vegetation. Additionally, floodplain along the main channel would be graded to increase inundation duration and frequency at 3,000 cfs. ELJs would be placed in a patchwork configuration to facilitate riparian recruitment and to restore swale habitat. At the terminus of the anabranching side channel, a backwater area would be created.

River Mile 6.5. A backwater area would be created on the right bank of River Mile 6.5 to provide shallow water refugia for salmonids.

Riparian vegetation would be planted in the downstream portion of Bar E surrounding a historical channel alignment to restore species and structural diversity. LWM would be placed in the swale/backwater downstream from the existing diversion channel.

Riparian vegetation would be planted along the upstream portion of Island B to create species and structural diversity. ELJs would be placed in a patchwork configuration to encourage native plant recruitment and improve survivability of plantings. Table 4 shows details for features on Increment 5b.

3.5 Construction Schedule, Access, and Staging

Construction of the proposed action would take place over 4 years. The primary work of excavation, grading, and feature placement on Increments 2, 3a, 5a, and 5b would be expected to be completed in 3 years; one additional year is assumed in the schedule to account for schedule slippage and repair/closeout of construction tasks. Planting would also be expected to be completed over 3 years. Planting would be conducted concurrently with the primary excavation and feature installation, beginning the second year and extending to the end of the 4 year. All in water work is expected to occur downstream of the highway 20 bridge and would be conducted between June 1 and October 31 each year. Planting is expected to occur between October 1 and

November 30 each year. Pending Congressional authorization and funding, the project would be expected to begin in 2021 and be completed by 2024. The construction schedule is shown in Attachment 2.

Table 4. Habitat Increment 5b Details

Feature ID	Original Measure ID	Feature Type	Acres	Volume (Cubic Feet)	Length (feet)	Width (feet)
5.6	48	Side Channel	9.2	3,445,883	3,939	103
5.7	49	Floodplain Lowering	6.9	232,160	2,040	293
5.8	49	Riparian Planting	21.1			
5.9	50	Floodplain Lowering	0.8	30,440	393	148
5.10	50	Riparian Planting	3.7			
5.11	51	Backwater Area	1.9	231,343	792	176
5.12	52	Backwater Area	1.0	129,007	212	216
5.13	53	Riparian Planting	2.4			
5.14	54	Riparian Planting	2.5			
5.15	55	Floodplain Terracing	12.5	3,883,041	1,319	781
5.16	55	Riparian Planting	3.5			
5.17	55	Side Channel	1.9	6,233,722	1,085	70

3.6 General Avoidance, Minimization, and Conservation Measures

Avoidance, minimization, and conservation measures are measures and practices adopted to reduce or avoid adverse effects that could result from project construction or operation. The following sections describe the avoidance, minimization, and conservation measures adopted for the proposed alternative. These measures would be incorporated in construction documents (plans and specifications) prepared for the proposed alternative and would thus be contractually required of all construction contractors.

BMPs shall be implemented to prevent soil erosion and sediment incursion into the active channel.

- Straw bales, straw wattles and silt fences would be installed at source sites for each project, as appropriate.
- Operation of heavy machinery in the active channel would be minimized to avoid disturbance of substrates.
- Turbidity and settleable solids would be monitored according to water quality permits. If acceptable limits are exceeded, work would be suspended until acceptable measured levels are achieved.
- Equipment used for the project would be thoroughly cleaned off-site to remove any invasive plant material or invasive aquatic biota prior to use in the Action Area.
- Environmentally sensitive areas, sensitive plant species and wetland areas would be avoided during project activities to the maximum extent practicable.
- High visibility fencing would be placed around these areas to minimize disturbance.

- Soil and excavated material and/or fill material would be stockpiled in existing clearings when possible.
- The project limits would be clearly demarcated. Erosion control fencing would be placed at the edges of construction where the construction activities are upslope of aquatic habitats to prevent washing of sediments into these features. All fencing would be installed prior to any construction activities beginning and would be maintained throughout the construction period.
- During construction operations, stockpiling of construction materials, portable equipment, vehicles, and supplies would be restricted to the designated construction staging areas. To eliminate an attraction to predators, all food-related trash items, such as wrappers, cans, bottles, and food scraps, would be disposed of in closed containers. Revegetation would occur on all areas temporarily disturbed from construction activities.
- All temporary impact areas would be restored to pre-project contour and revegetated.
- A revegetation plan would be developed to address all temporarily impacted native areas.
- A Spill Prevention and Response Plan would be prepared that identifies any hazardous materials to be used during construction; describes measures to prevent, control, and minimize spillage of hazardous substances; describes transport, storage and disposal procedures for these substances; and outlines procedures to be followed in case of a spill of a hazardous material. The Spill Prevention and Response Plan would require that hazardous and potentially hazardous substances stored onsite be kept in securely closed containers located away from drainage courses, agricultural areas, storm drains, and areas where stormwater is allowed to infiltrate. It would also stipulate procedures, such as the use of spill containment pans, to minimize hazard during onsite fueling and servicing of construction equipment. Finally, the Spill Prevention and Response Plan would require that all agencies listed in the Spill Prevention and Response Plan be notified immediately of any substantial spill or release.

Measures that will be implemented to avoid or minimize effects to special status fish species would include:

- Equipment used for the project shall be thoroughly cleaned off-site to remove any invasive plant material or invasive aquatic biota prior to use in the Action Area.
- In water work would be restricted to a window of July 1 – October 31 downstream of Highway 20 and July 1 – August 31 upstream of Highway 20 to minimize impacts to spawning and rearing fish. In water work windows would be subject to final approval by the National Marine Fisheries Service. In-channel activities (i.e., grading activities associated with the Proposed Action) shall be conducted “in the dry”.
- If necessary a *Dewatering/Diversion Plan* would be created to address any dewatering activities. The plan would include utilizing a qualified biologist to exclude all fishes utilizing areas to be dewatered. The plan shall be provided to NMFS and CDFW for review and approval prior to the onset of construction activities. In the case that dewatering is necessary, impacts to fish affected by dewatering would be reduced by maintain suitable water temperatures, DO, and fish densities for affected fish. Relocated fish would be released in suitable habitat at least 1,000 feet from the construction site. The fish biologist

on site would contact NMFS and CDFW immediately if any steelhead or Chinook salmon were found dead or injured.

- USACE would provide a NMFS-approved Worker Environmental Awareness Training Program for construction personnel to be conducted by a NMFS-approved biologist for all construction workers prior to the commencement of construction activities. The program shall provide workers with information on their responsibilities with regard to Federally-listed fish, their critical habitat, an overview of the life-history of all the species, information on take prohibitions, protections under the ESA, and an explanation of terms and conditions identified in this BO.

3.7 Interrelated and Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are actions that have no independent utility apart from the action under consideration. There are no interrelated or interdependent actions associated with the Proposed Project.

4.0 Action Area

The regulations governing consultations under the federal ESA define the "action area" as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). Direct effects are defined as "the direct or immediate effects of the project on the species or its habitat" (USFWS and NMFS 1998). Indirect effects are defined as "those [effects] that are caused by the proposed action and are later in time, but still are reasonably certain to occur" (50 CFR 9 §402.02). Consistent with 50 CFR 402.02, the Action Area for this consultation is determined considering the extent of the direct and indirect effects of the Proposed Action. The proposed Action Area includes 4 project increments, staging, and access areas. Refer to Figures 1 for Action Area Maps.

The overall project area is located northeast of Marysville, Yuba County, within and adjacent to the lower Yuba River. The lower Yuba River is the combined flow of the North Fork, Middle Fork, and South Fork of the Yuba River. Elevations range from 158 to 285 feet above mean sea level (Google Earth, 2017). The majority of the 3proposed action is within the channel of the Lower Yuba, as well as side channels in the floodplain, riparian areas, and the Yuba Goldfields. The Yuba Goldfields, which are the remnant debris piles of past hydraulic mining, have greatly altered the natural environment. Staging areas would be located primarily in agricultural, forested, grassland, and barren areas. Access would occur along previously established roads (both paved and un-paved) located primarily in agricultural areas.

5.0 Status of the Species and Critical Habitat in the Action Area

Federally listed species known to occur in the action area, or may be affected by the project are the Central Valley ESU of spring-run Chinook salmon (*Oncorhynchus tshawytscha*) listed as "threatened", the California Central Valley steelhead (*Oncorhynchus mykiss)* ESU listed as "threatened", and the Southern DPS of North American green sturgeon (*Acipenser medirostris*) listed as "threatened". In addition critical habitat has been designated for each of the listed species that includes the Lower Yuba River or portions of it. Spring-run Chinook salmon and steelhead can access the Lower Yuba River up to Englebright Dam, and their critical habitat is designated accordingly. Green sturgeon do not access the Yuba River above Daguerre Point Dam, so their critical habitat is designated only up to Daguerre Point Dam.

5.1 Central Valley Spring-run Chinook Salmon ESU

5.1.1 ESA Listing Status

On September 16, 1999, NMFS listed the Central Valley ESU of spring-run Chinook salmon (*Oncorhynchus tshawytscha*) as a "threatened" species (64 FR 50394). On June 14, 2004, following a five-year species status review, NMFS proposed that the Central Valley spring-run Chinook salmon remain listed as a threatened species based on the Biological Review Team strong majority opinion that the Central Valley spring-run Chinook ESU is ''likely to become endangered within the foreseeable future'' due to the greatly reduced distribution of Central Valley spring-run Chinook salmon and hatchery influences on the natural population. On June 28, 2005, NMFS reaffirmed the threatened status of the Central Valley spring-run Chinook salmon ESU, and included the FRFH spring-run Chinook salmon population as part of the Central Valley spring-run Chinook salmon ESU (70 FR 37160). Section 4(c)(2) of the ESA requires that NMFS review the status of listed species under its authority at least every five years and determine whether any species should be removed from the list or have its listing status changed. In August 2011, NMFS completed a second 5-year status review of the Central Valley spring-run Chinook salmon ESU. Prior to making a determination on whether the listing status of the ESU should be uplisted (i.e., threatened to endangered), downlisted, or remain unchanged, NMFS considered: (1) new scientific information that has become available since the 2005 status review (Good et al. 2005); (2) an updated biological status summary report (Williams et al. 2011) intended to determine whether or not the biological status of spring-run Chinook salmon has changed since the 2005 status review was conducted (referred to as the "viability report"); (3) the current threats to the species; and (4) relevant ongoing and future conservation measures and programs.

Based on a review of the available information, NMFS (2011) recommended that the Central Valley spring-run Chinook salmon ESU remain classified as a threatened species. NMFS' review also indicates that the biological status of the ESU has declined since the previous status review in 2005 and, therefore, NMFS recommended that the ESU's status be reassessed in 2 to 3 years if it does not respond positively to improvements in environmental conditions and management actions. As part of the 5-year review, NMFS also re-evaluated the status of the FRFH stock and concluded that it still should be considered part of the Central Valley spring-run Chinook salmon ESU.

In addition to Federal regulations, the California Endangered Species Act (CESA, Fish and Game Code Sections 2050 to 2089) establishes various requirements and protections regarding species listed as threatened or endangered under state law. California's Fish and Game Commission is responsible for maintaining lists of threatened and endangered species under CESA. Spring-run

Chinook salmon in the Sacramento River Basin, including the lower Yuba River, was listed as a threatened species under CESA on February 2, 1999.

5.1.2 Critical habitat

Critical Habitat was designated for the Central Valley spring-run Chinook salmon ESU on September 2, 2005 (70 FR 52488), and includes stream reaches of the Feather and Yuba rivers,

Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, and portions of the northern Delta (NMFS 2009a). On the lower Yuba River, critical habitat is designated from the confluence with the Feather River upstream to Englebright Dam. This critical habitat includes the stream channels in the designated stream reaches and their lateral extents, as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent would be defined by the bankfull elevation (defined as the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a 50% to 100% ACE; Bain and Stevenson 1999; 70 FR 52488, September 2, 2005).

5.1.3 Distribution and Habitat

The central valley Spring-run Chinook salmon has been extirpated from much of its historical range. The species past range typically included the headwaters of major rivers within the Central Valley, but due to dams, water diversions, urbanization/development, logging, grazing, agriculture, and mining, the population of the species has declined. In addition, hybridization of the species with fall-run Chinook salmon and hatchery populations has also affected the species numbers (HDR/SWRI 2007).

In April and June, adult spring-run Chinook salmon will migrate into the lower Yuba River. Spawning will begin in September and continue through October. Although dependent upon water temperatures, central valley Spring-run Chinook salmon embryo incubation occurs September through March within the lower Yuba River (HDR/SWRI 2007) and the fry then disperse downstream after emerging.

5.1.4 Potential for Occurrence in Project Area

Central valley Spring-run Chinook salmon are known to occur within the lower Yuba River and would be subject to effects of the project.

5.2 Central Valley Steelhead ESU

5.2.1 ESA Listing Status

On March 19, 1998 (63 FR 13347) NMFS listed the California Central Valley steelhead ESU as “threatened”, concluding that the risks to Central Valley steelhead had diminished since the completion of the 1996 status review based on a review of existing and recently implemented state conservation efforts and federal management programs (e.g., CVPIA, AFRP, CALFED) that address key factors for the decline of this species. The California Central Valley steelhead ESU included all naturally spawned populations of steelhead in the Sacramento and San Joaquin rivers and their tributaries, but excluded steelhead from the tributaries of San Francisco and San Pablo bays (NMFS 2004b).

On June 14, 2004, NMFS proposed listing determinations for 27 ESUs of West Coast salmon and *O. mykiss,* including the California Central Valley steelhead ESU. In the proposed rule, NMFS concluded that steelhead were not in danger of extinction, but were likely to become endangered within the foreseeable future throughout all or a significant portion of their range and, thus, proposed that steelhead remain listed as threatened under the ESA. Steelhead from the Coleman National Fish Hatchery and the FRFH, as well as resident populations of *O. mykiss* (rainbow trout) below impassible barriers that co-occur with anadromous populations, were included in the California Central Valley steelhead ESU and, therefore, also were included in the proposed listing.

During the 2004 comment period on the proposed listings, the USFWS provided comments that the USFWS does not use NMFS' ESU policy in any USFWS ESA listing decisions. As a result of the comments received, NMFS re-opened the comment period to receive comments on a proposed alternative approach to delineating ''species'' of West Coast *O. mykiss* (70 FR 67130). NMFS proposed to depart from past practice of applying the ESU Policy to *O. mykiss* stocks, and instead proposed to apply the DPS Policy in determining ''species'' of *O. mykiss* for listing consideration. NMFS noted that within a discrete group of *O. mykiss* populations, the resident and anadromous life forms of *O. mykiss* remain ''markedly separated'' as a consequence of physical, physiological, ecological, and behavioral factors, and may therefore warrant delineation as separate DPSs (71 FR 834).

NMFS issued a policy for delineating distinct population segments of Pacific salmon in 1991 (56 FR 58612; November 20, 1991). Under this policy, a group of Pacific salmon populations is considered an ''Evolutionarily Significant Unit'' if it is substantially reproductively isolated from other conspecific populations, and it represents an important component in the evolutionary legacy of the biological species. Further, an ESU is considered to be a ''Distinct Population Segment'' (and thus a ''species'') under the ESA. In 1996, NMFS and USFWS adopted a joint policy for recognizing DPSs under the ESA (DPS Policy; 61 FR 4722; February 7, 1996). The DPS Policy adopted criteria similar to, but somewhat different from, those in the ESU Policy for determining when a group of vertebrates constitutes a DPS – The group must be discrete from other populations, and it must be significant to its taxon. A group of organisms is discrete if it is ''*markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors*.'' Significance is measured with respect to the taxon (species or subspecies) as opposed to the full species (71 FR 834). Although the ESU Policy did not by its terms apply to steelhead, the DPS Policy stated that NMFS will continue to implement the ESU Policy with respect to ''Pacific salmonids'' (which included *O. mykiss*).

Given NMFS and USFWS shared jurisdiction over *O. mykiss,* and consistent with joint NMFS and USFWS approaches for Atlantic salmon, it was concluded that application of the joint DPS policy to was logical, reasonable, and appropriate for identifying DPSs of *O. mykiss (*71 FR 834). Moreover, NMFS determined that use of the ESU policy — originally intended for Pacific salmon — should not continue to be extended to *O. mykiss,* a type of salmonid with characteristics not typically exhibited by Pacific salmon (71 FR 834).

On January 5, 2006 NMFS issued a final decision that defined Central Valley steelhead as a DPS rather than an ESU, and retained the status of Central Valley steelhead as threatened (71 FR 834). The DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and manmade impassable barriers in the Sacramento and San Joaquin Rivers and their tributaries, excluding steelhead from San Francisco and San Pablo Bays and their tributaries (63 FR 13347). Steelhead in two artificial propagation programs — the Coleman National Fish Hatchery, and FRFH steelhead hatchery programs are considered to be part of the DPS. NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the DPS (71 FR 834).

5.2.2 Critical Habitat Designation

On February 16, 2000 (65 FR 7764), NMFS published a final rule designating critical habitat for Central Valley steelhead. This critical habitat includes all river reaches accessible to listed steelhead in the Sacramento and San Joaquin rivers and their tributaries in California, including the lower Yuba River upstream to Englebright Dam. NMFS proposed new Critical Habitat for spring-run Chinook salmon and Central Valley steelhead on December 10, 2004 (69 FR 71880) and published a final rule designating critical habitat for these species on September 2, 2005. This critical habitat includes the lower Yuba River (70 FR 52488) from the confluence with the lower Feather River upstream to Englebright Dam.

5.2.3 Distribution and Habitat

Historically, the CCV steelhead migrated to the upper reaches of Central Valley Streams and rivers up into the foothills for spawning and juvenile rearing. The geographic distribution of the species on the Central Valley rivers has been significantly impaired from the construction of dams and impoundments. The current distribution of the species is now limited to the valley due to impoundments in the lower foothills, therefore restricting movement upstream. This especially impacts the spawning and juvenile rearing of the species, as they are not able to migrate to suitable spawning habitat and have a smaller area to inhabit. The main distribution of the species is limited to the main-stem of the Sacramento River downstream of Keswick Dam, the Feather River downstream of Oroville Dam, the American River downstream of Nimbus Dam, the Mokelumne River downstream of Comanche Dam, and the various tributaries to the Sacramento River system, Delta and San Francisco Bay. The CCV steelhead have access to the Yuba River up to Englebright Dam as the Yuba River is a tributary to the Feather River.

The CCV steelhead is a very complex species with geographically distributed life stages. The adult holding period in the lower Yuba River is typically from August through March, and the spawning generally occurs from January through April. The majority of downstream movement of the juveniles typically occurs from April through September, but some may stay for one to three years for rearing (USACE 2014).

5.2.4 Potential for Occurrence in Project Area

CCV steelhead are present in the lower Yuba River and would be subject to effects of the project.

5.3 Southern DPS of North American Green Sturgeon

5.3.1 ESA Listing Status

The green sturgeon (*Acipenser medirostris*) is the most widely distributed member of the sturgeon family Acipenseridae (70 FR 17386). North American green sturgeon are found in rivers from British Columbia south to the Sacramento River, California, and their ocean range is from the Bering Sea to Ensenada, Mexico. In assessing North American green sturgeon status, NMFS determined that two DPSs exist. The northern DPS is made up of known North American green sturgeon spawning (or single stock populations) in the Rogue, Klamath and Eel rivers. In 2005, the southern DPS was believed to contain only a single spawning population in the Sacramento River (70 FR 17386). However, four fertilized green sturgeon eggs collected in 2011 near the Thermalito Afterbay Outlet provide the first documentation of at least some successful spawning in the Feather River (A. Seesholtz, CDWR, pers. comm., June 16, 2011).

The Southern DPS of North American green sturgeon was listed as a federally threatened species on April 7, 2006 (71 FR 17757) and includes the green sturgeon population spawning in the Sacramento River and utilizing the Sacramento-San Joaquin River Delta, and San Francisco Estuary. NMFS (2009b) *Draft Environmental Assessment for the Proposed Application of Protective Regulations Under Section 4(D) of the Endangered Species Act for the Threatened Southern Distinct Population Segment of North American Green Sturgeon* indicated that the Southern DPS of North American green sturgeon faces several threats to its survival, including the loss of spawning habitat in the upper Sacramento River, and potentially in Section 4(c)(2) of the ESA requires that NMFS review the status of listed species under its authority at least every five years and determine whether any species should be removed from the list or have its listing status changed. In October 2012, NMFS noticed the initiation of the 5- year status review of the Southern DPS of North American green sturgeon (77 FR 64959).

The purpose of the 5-year review is to ensure the accuracy of the listing classification for the Southern DPS of North American green sturgeon. A 5-year review is based on the best scientific and commercial data available; therefore, NMFS is requesting submission of any such information on the Southern DPS that has become available since the listing determination in

2006. To ensure that the 5-year review is complete and based on the best available scientific and commercial information, NMFS is soliciting new information from the public, governmental agencies, Tribes, the scientific community, industry, environmental entities, and any other interested parties concerning the status of the Southern DPS since the listing determination in 2006 (77 FR 64959).

5.3.2 Critical Habitat Designation

On October 9, 2009, NMFS (74 FR 52300) designated critical habitat for the Southern DPS of North American green sturgeon. This designated critical habitat includes most of the DPS's occupied range, including: (1) coastal marine waters from Monterey Bay to the Washington/Canada border; (2) coastal bays and estuaries in California, Oregon, and Washington; and (3) fresh water rivers in the Central Valley, California. In the Central Valley, critical habitat for green sturgeon includes the Sacramento River, lower Feather River, lower Yuba River, the Sacramento-San Joaquin River Delta, and San Francisco Estuary. NMFS (74 FR 52300) defined specific habitat areas in the Sacramento, Feather, and Yuba rivers in California to include riverine habitat from each river mouth upstream to and including the furthest known site of historic and/or current sighting or capture of North American green sturgeon, as long as the site is still accessible. Critical habitat in the lower Yuba River includes the stream channels to the ordinary high water line extending from the confluence with the mainstem Feather River upstream to Daguerre Point Dam.

5.3.3 Distribution and Habitat

Green Sturgeon live in both freshwater and saltwater from the Sacramento River north to British Columbia. It is typical for adults to spend time in oceanic waters, bays, or estuaries when they aren't spawning. While the southern DPS' spawning preferences and specific distribution is unclear, it is believed that their spawning habitat is large cobble substrates in turbulent fresh river mainstem rivers from April through July. They also spawn in deep pools or "holes" (NOAA, 2015). While most of the green sturgeon spawning is believed to occur in the Sacramento River, evidence also suggests that they may spawn in the lower Yuba River too. During May 2011, video surveys conducted on the lower Yuba River show five adult sturgeon immediately below Daguerre Point Dam. Additionally, spawning behavior was noted by two of the individuals (AECOM, 2015). While Daguerre Point Dam does have fish ladders designed for salmonid passage, it is believed that the adult sturgeon are unable to ascend the ladders (YCWA 2011).

5.3.4 Potential for Occurrence in Project Area

Southern DPS of North American green sturgeon are known to occur within the project areas below Daguerre Point Dam and would be subject to project effects in the area.

6.0 Environmental Baseline

6.1 Physical Features and Habitat Conditions

The Yuba River watershed is approximately 1,340 square miles covering Sierra, Placer, Yuba, and Nevada counties (SRWP 2010). The water flows west from the Sierra Nevada Mountains carrying melted snow run-off and water from the three main Yuba tributary forks all the way down to the confluence with the Feather River. While the primary location of the project is in the Lower Yuba River, the overall watershed quality plays a large role in water quality in the project area. Multiple factors affect the water quality of the Lower Yuba River including: hydroelectric power generation, dams and reservoirs, mining activities, urbanization, and timber harvesting.

Major dams in the Yuba River watershed completed in dates from 1913 to 1969 include Spaulding, Bowman, Fordyce, Englebright, Jackson Meadows, and New Bullards Bar. Part of the reason the first dams in the Yuba River Watershed were created were for gold mining, but later on the use of dams shifted for emphasis on flood control, waters supply, and hydropower. The lower Yuba River is currently operating under the Lower Yuba River Accord flow regime, which is a joint project between the Yuba County Water Agency and the United States Department of the Interior-Bureau of Reclamation to manage the interests of approximately 17 stakeholders in the area to balance interests of irrigation, conservation, water supply, and fisheries concerns (USACE 2014). The physical, thermal, and chemical changes that occur from water being retained behind dams can greatly affect the downstream quality and temperature of the river.

The lower Yuba River experiences temperature fluctuation from inflows of Deer Creek (RM 22.7), irrigation diversions at Daguerre Point Dam (RM 11.6), and operational releases from Englebright Dam (RM 24). Furthermore, the general width to flow ratio in conjunction with low riparian cover provide opportunity for solar heating of the water. The water within the lower Yuba River can increase up to 7°C from the release at Englebright Dam to the City of Marysville (LYRA 2010), but this is seasonally dependent and influenced by amount of water released from Englebright Dam, solar input, and air temperature. Data taken near Marysville, showed that dissolved oxygen concentrations, total dissolved solids, pH, alkalinity, and turbidity are well within acceptable or preferred ranges for salmonids and other key freshwater organisms (USACE 2012). In 2007, instream flow requirements were codified by the Yuba Accord (YCWA 2007) to maintain suitable habitat in the lower Yuba River for fish and wildlife.

Mercury contamination from hydraulic mining in the watershed poses a risk to environmental and human health. Mercury was used in hydraulic gold mining to increase the removal of gold from hard rock, but mercury particles would wash through the sluice before they could settle and be confined. The accumulated mercury in river sediments pose a risk to human health through consumption of contaminated fish, drinking potentially unsafe water, and improper handling of sediments (USGS, 2005). From an environmental standpoint, mercury methylation and biomagnificaiton are a problem, especially when the biomagnificaiton occurs in great geographic distribution. Many environmental factors such as temperature, dissolved organic carbon levels, salinity, oxidation-reduction conditions, acidity (pH), and concentration of sulfur in the water and sediments influence the rates of mercury methylation as well as demethylation (USGS, 2005). In a statewide survey conducted by the SWRCB's Surface Water Ambient Monitoring Program, the fish tested for mercury in the tributaries of the Yuba River were the highest in the state (Yuba County IRWMP, 2015).

6.1.2 Hydrology and Hydraulics:

The hydrology of the Yuba River watershed is complex, consisting of numerous dams, reservoirs, and diversion facilities that store and/or transfer water within and out of the basin, altering both the volume and pattern of water, sediment, organic material, and wildlife. Hydrology in the Yuba

River watershed has been significantly altered through historic and current human activities. Initially these changes were driven by large scale hydraulic mining and were later driven by construction of dams, reservoirs, and diversions to address watershed issues and manage water resources. The primary factors affecting hydrology and hydraulics of the Yuba River watershed are historic and ongoing mining; the construction and operation of an extensive system of dams, reservoirs, and diversions; and land use changes.

6.1.3 Mining

The Yuba River suffered perhaps the most significant damage from hydraulic mining of any California river. Approximately 1.5 billion cubic yards of mining debris were washed into the Central Valley from five rivers, with the Yuba River accounting for 40 percent of that total (Mount 1995). Gilbert (1917) as cited in Yoshiyama et al. (2001) estimates that "*…during the period 1849-1909, 684 million cubic yards of gravel and debris due to hydraulic mining were washed into the Yuba River system – more than triple the volume of earth excavated during the construction of the Panama Canal*", and Beak Consultants, Inc. (1989) states "*The debris plain ranged from about 700 feet wide and up to 150 feet thick near the edge of the foothills to nearly 3 miles wide and 26 feet tall near Marysville*" (Beak Consultants, Inc. 1989).

Hydraulic gold mining during the second half of the 19th century resulted in 684 million cubic yards of gravel and debris washing into the Yuba River system. The material moved from the foothills to the valley floor where it raised the river bed by up to 100ft, resulting in increased frequency and intensity of floods. The California Debris Commission worked to mitigate the impacts of hydraulic mining by constructing debris dams, including Englebright Dam and Daguerre Point Dam, as well as dredging the debris deposited in the lower Yuba River. Dredging of the lower Yuba River continued past initial efforts driven by gold extraction, then later as a source of aggregate. Dredging has resulted in a large 10,000 acre area of undulating dredger spoils berms and ponds. The Goldfields area is porous and acts as a drain for the Lower Yuba River above Daguerre Point Dam.

6.1.4 Dam and Diversions

Dam construction and diversions in the Yuba watershed began to supply gold mining operations with necessary flow to support hydraulic nozzles. Later dams were constructed to sequester the large volumes of mine tailings moving downstream. Several large dams operated by various agencies were built for a variety of purposes, including water supply, flood control, hydroelectric power generation and sediment retention (James 2005). The contemporary system is elaborate and complex, consisting of several dams (including 6 over 150 ft in height, and over 50 additional smaller dams) with facilities in place to store and/or transfer water between the subwatersheds of the Yuba Basin (i.e., North Yuba, Middle Yuba, South Yuba and Deer Creek), as well as out of basin transfers to major watersheds to the north and south (i.e., Feather River, Bear River and American River) (CBEC 2010).

The hydrology of the Yuba River has been altered by a series of reservoirs and water conveyance facilities that are operated for water supply, hydropower production, and flood control (Mitchell

2010).Three projects export significant amounts of water from the Yuba River watershed. South Feather Water and Power Agency (formerly Oroville-Wyandotte Irrigation District) diverts water from Slate Creek (a tributary to the North Yuba River) to the South Fork Feather River via its South Feather Power Project. PG&E's South Yuba Canal diverts water from the South Yuba River, some of which is consumptively used by the Nevada Irrigation District (NID) and some of which is released into the Bear River watershed. These diversions also support NID's Yuba-Bear Hydroelectric Project. PG&E's Drum-Spaulding Project diverts water from the South Yuba watershed, via the Drum Canal, to the Drum Forebay. If that water is used at PG&E's Drum Powerhouse, it is released to the Bear River watershed. If the water is not used there, it is released to Canyon Creek (a tributary of the North Fork American River), where it is eventually used for consumptive purposes by Placer County Water Agency and other entities.

The size and position within the Yuba Basin of these dams provide the ability to store large volumes of water, and therefore regulate the flow regime. The North Yuba has New Bullards Bar Reservoir, located relatively low in the watershed, functioning as the dominant flood control and water supply reservoir in the basin (LYRFTWG 2005). Storage capability in the Middle Yuba and South Yuba basins is comparably small, totaling ~307 thousand acre-feet (TAF), with Lake Spaulding, Bowman Lake, Jackson Meadows Reservoir, Fordyce Lake and several smaller impoundments located in the upper extents of the Yuba Basin (YCWA, 2009). The size and position of these impoundments allow the South Yuba and Middle Yuba to respond to larger precipitation and snow-melt events by sending large flood pulses downstream to Englebright Reservoir, and beyond to the lower Yuba River when the capacity of Englebright Reservoir is exceeded. Since 1969 when New Bullards Bar (the last of large dams built in the system) was completed, over 100 uncontrolled flow events have overtopped Englebright Dam.

6.1.5 Lower Yuba River Flows

The Yuba River downstream of Englebright Dam is a single-thread channel, confined in a bedrock canyon in the uppermost 2 miles, then transitions to a wider bedrock valley and finally, to a wide alluvial valley for 19 miles (YCWA 2013). In the lower Yuba River, Englebright and Daguerre Point Dams play an important role in the altered movement of water, sediment and organic matter.

Englebright is a 260ft concrete arch dam originally constructed to trap mining sediments and debris. The dam also provides for the generation of hydroelectric power, recreational activities, and serves as an afterbay for peak power generation at the New Colgate Powerhouse. During normal flow conditions, water is released from Englebright reservoir through PG&E's Narrows I hydropower facility and YCWA's Narrows II power facility. Water releases are administered by PG&E and YCWA to generate hydroelectric power, irrigation, and other beneficial uses. During high flows, unregulated flows pass over Englebright dam into the lower Yuba River.

Approximately halfway between Englebright Dam and the Yuba-Feather River confluence is Daguerre Point Dam. This 25 ft dam was originally constructed to trap hydraulic mining debris. In later years, the head of water created by the dam was leveraged to support several water diversions. Daguerre Point Dam affects the hydrology and hydraulics of the lower Yuba River by providing base level control for incision for the reach immediately upstream. The dam also creates a river stage differential; the river stage above Daguerre Point Dam is more than 20 feet greater than the river stage below the dam. As a result of this differential and as a result of the high permeability of the Goldfield's rocky soil, water from the Yuba River enters the Goldfield area from above Daguerre Point Dam and then migrates downgradient through the Goldfields, forming interconnected ponds and canals throughout the area (DWR, 1999). During all flows, water passes over the crest of the dam.

Despite the presence of several significant dams in the watershed, the lower Yuba River still experiences floods capable of inducing geomorphic changes to the mainstem (Pasternack 2009). A study of the geomorphic thresholds in the Timbuctoo Bend Reach identified several values including: 1) a preferential riffle scouring discharge of <11,000 cfs, 2) a preferential run scouring discharge range of ~9,000-25,000 cfs, 3) a preferential pool-scouring discharge of >45,000 cfs, and 4) a floodplain filling discharge of ~20,000 cfs (Pasternack 2009).

The past and present flood regime of the lower Yuba River is divided into two meaningful hydrologic periods: a transitional period, WYs 1904-1969, and the contemporary, regulated period, WYs 1970-2009, the period following the completion of all major storage projects within the basin (CBEC 2010). Regulation has reduced flood intensity in the lower Yuba River; flood flows with 67% ACE was reduced 67% from 20,100 cfs to 6,700 cfs; flood flows with a 20% ACE were reduced 40% from 61,400 cfs to 36,900 cfs (CBEC 2010). In addition to reducing peak flow values, the large storage reservoirs and in and out of basin transfers alter the annual runoff volume and pattern in the mainstem. In 2007 the Yuba River Accord established minimum flow requirements in the watershed (YCWA 2007) that maintain habitat suitability for fish and wildlife in the lower Yuba River.

In 1986, the Corps developed a 1% ACE flood simulation model for the Yuba River to evaluate the effects of such an event. This model produced various flow and stage relationships at various points along the Yuba River. The flows modeled by the Corps ranged from 5,000 cfs to a 100-year event of 135,000 cfs (DWR, 1999). The data obtained from the Corps and Smartville gaging stations were also used to estimate flow event probabilities. The lower Yuba River consists of the approximately 24-mile stretch of river extending from Englebright Dam, downstream to the confluence with the Feather River near Marysville. Recently, the RMT (2013) conducted specific studies to rigorously investigate spatial structure in the lower Yuba River by developing an approach to identify the fluvial geomorphologic dynamics affecting: (1) adult spatial structure components, including the availability of fish habitat for immigrating, holding, and spawning adult salmonids; and (2) the seasonal availability of rearing habitat for 1 juvenile salmonids. The RMT (2013) morphological unit and mesohabitat classification studies: (1) identified morphological units throughout the lower Yuba River; (2) evaluated the quality, number, size and distribution of mesohabitats for various life stages of adult and juvenile anadromous salmonids; and (3) evaluated the maintenance of watershed processes in the lower Yuba River. Part of the RMT (2013) process included the identification of morphological reaches in the lower Yuba River, described in Table 6.

Table 6. Morphological reaches and delineating transparent geomorphic features in the lower Yuba River.

Reach	Description
Englebright Dam Reach	Englebright Dam to confluence with Deer Creek
Narrows Reach	Deer Creek to onset of emergent gravel floodplain
Timbuctoo Bend Reach	Emergent gravel floodplain to upstream of Blue Point Mine
Parks Bar Reach	Upstream of Blue Point Mine to Highway 20 Bridge
Dry Creek Reach	Highway 20 Bridge to Yuba River confluence with Dry Creek
Daguerre Reach	Yuba River confluence with Dry Creek downstream to Daguerre Point Dam
Hallwood Reach	Daguerre Point Dam downstream to Eddie Drive aims at Slope Break
Marysville Reach	Eddie Drive aims at Slope Break downstream to the mouth of the lower Yuba River

Source: RMT 2013

7.0 Effects Determination and Conclusion

7.1 Effects of the proposed action to the listed species

Project implementation has the potential to affect various life stages of the Central Valley ESU spring-run Chinook salmon, California Central Valley steelhead, and Southern DPS of North American green sturgeon. The potential effects to these species include short term, construction related impacts from increased turbidity, sedimentation, and related contamination/pollution. With implementation of BMPs and avoidance, minimization, and conservation measures during construction, impacts to listed fish species in the lower Yuba River are expected to be minimal. Furthermore, the proposed ecosystem restoration activities would result in a net increase in functions and services within the lower Yuba River.

The proposed alternative would directly improve or create 178.6 acres of riparian and riverine habitat. While it is difficult to quantify the indirect benefits of the proposed alternative, an overall increase in ecosystem diversity, productivity, and stability would occur from the proposed alternative. The proposed alternative would have beneficial effects for CCV steelhead, CCV spring-run Chinook, and sDPS green sturgeon through increased habitat complexity, restored floodplain habitat, increase in complexity and diversity of riparian habitat, and channel habitat complexity. Although, salmonids occur in the Yuba River year round, in water work would be performed during the from July 1 to October 31, which would avoid the primary spawning windows and juvenile out migration of anadromous salmonids in the system. However, CCV spring-run Chinook, CCV steelhead, and sDPS green sturgeon may still be present in the Action Area during work, and thus may be impacted by the proposed alternative. Direct and indirect effects are discussed below in detail.

7.1.1 In Stream Construction Activities, Fish Passage, and Dewatering

To the extent possible, in-channel work would be completed in the dry to avoid and minimize impacts to special status species. If CCV steelhead, CCV spring-run Chinook, and sDPS green sturgeon species are present within the project area during in channel work, individuals may be injured or crushed by heavy equipment. Fish exposed to the presence of construction activities may encounter short-term and long-term blockage of migration or stranding, construction related noise, water quality changes that may harm or injure species by disruption normal behaviors and sheltering abilities, and physical disturbance. Changing the normal behavior of fish species may also render the species vulnerable to predation.

There is the potential that the project would need to temporarily de-water a portion of the stream to conduct work in the dry. If necessary, this would have direct impacts on species that are present, specifically impeding movement of species. Depending upon the method of dewatering used, there is also the potential to harm or injure fish during diversion or movement. Dewatering would occur slowly so that present fish may move out of the area. Although de-watering is unanticipated for the project, relocation of fish could cause stress, physical injury, and mortality from handling, crowding, and being out of water.

7.1.2 Sedimentation and Turbidity

Implementation of the project has the potential to increase sedimentation and turbidity to higher levels than what is found under existing conditions. During instances of sudden localized turbidity, normal behavior of anadromous special status species would be directly and indirectly affected. Aside from causing the fish to deviate from normal pattern and behavior, this has the potential to affect their physiology such as respiratory impairment, stress and fatigue, reduced tolerance to environmental stressors, and gill trauma. Chronic exposure to increased sedimentation and turbidity can affect respiratory function and affect the survival of the species, however project caused turbidity and sedimentation is expected to be localized and short term.

Sedimentation and turbidity, as well as dewatering, would cause a temporary reduction in the benthic aquatic macroinvertebrates. The proposed in channel work, such as lowering and excavating the floodplain to facilitate more frequent inundation or for the placement of Engineered Log Jams, would temporarily disturb soil and sediments therefore causing an increase in suspended sediment, which can reduce light penetration and disrupt photosynthesis. Furthermore, these effects could potentially interfere with feeding, social organization, spawning, rearing, and juvenile survival in fish species; however, these effects would be short term and localized to the project area. The number of special status fish species within the Action Area is unknown, but is expected to be low based on the time of year the project would be conducted as well as the low quality existing habitat. Mitigation measures would be implemented to minimize effects of sedimentation and turbidity to special status species and habitat.

7.2 Effects to Critical Habitat and EFH

The proposed alternative is anticipated to have direct short- and long-term effects on the designated Critical Habitat of CCV Steelhead, CV spring-run Chinook salmon, and Green Sturgeon and EFH for Chinook salmon. Localized impacts to water quality may occur due to temporary increases in turbidity and suspended sediment but these effects are expected to be minor and short-term.

Despite the short term impacts, the project would be beneficial overall by increasing habitat quality and quantity. Excavating gravel to create additional floodplain and side channels would emulate a more natural river system and create more suitable habitat. Placement of Large Woody Material and Engineered Log Jams would not only stabilize channel features but provide valuable habitat that special status species may use for feeding, resting, concealment from predators, and rearing. These would also help increase organic matter in the lower Yuba River system and increase habitat complexity. Another long term benefit of the project is to create a more diversified riparian community, which can provide spawning habitat as well as provide shade which can help regulate water temperatures. The lowering and grading of floodplains would improve the availability of habitats used by rearing fish. The proposed alternative would have long term beneficial effects on the critical habitat complex channels and floodplain habitats.

Sedimentation and turbidity from the construction of the project may have an adverse effect on Essential Fish Habitat including channels and floodplain habitat, thermal refugia, and spawning habitat. Sedimentation and turbidity may temporarily reduce habitat complexity, water quality, availability of spawning substrate, and connectivity of spawning patches. While the proposed alternative would temporarily impact EFH, it is expected to increase the quantity and quality of EFH for Chinook salmon.

7.3 Cumulative effects

The Federal ESA requires NMFS and USFWS to evaluate the cumulative effects of the proposed actions on listed species and designated critical habitat, and to consider cumulative effects in formulating Biological Opinions. Cumulative effects are defined by Federal regulations as "…those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR 402.02). Cumulative effects must be considered in the analysis of the effects of the Proposed Action (50 CFR 402.12(f)(4)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Federal ESA. Federal actions, including, but not limited to FERC relicensing, maintenance and operation of dams, reservoirs, and diversions, restoration projects, management of fisheries, management of dams, and land management activities are, therefore, not included. For the purposes of this BA, the area of cumulative effects analysis is defined as the lower Yuba River from Englebright Dam to the confluence of the Yuba and Feather Rivers.

In general, private or State activities that may occur in the action area and result in cumulative effects include changes to ongoing mining activities, changes to water diversion activities, and /or changes to agricultural practices. Sand and gravel mining operations along the lower Yuba River, especially in the Yuba Goldfields, are ongoing, including operations by Teichert Aggregates, Western Aggregates, and Baldwin Contracting Company and Springer Family Trust Hallwood Aggregate. Mining activities could disrupt or remove naturally recovering patches of vegetation that support riparian habitats that listed species rely on. Mining activities at these facilities is ongoing, and future potential effects to listed species from their operation would likely be similar to the current conditions; however, periodically changes are made to the intensity and location of mining activities, which could result in a larger or smaller cumulative impact.

Direct water diversions from the lower Yuba River include Browns Valley Irrigation District Diversion, South Yuba/Brophy Diversion Canal and Facilities, and the Hallwood-Cordua North Canal. It is generally expected that the continued operation of these diversions would be similar to existing conditions and not represent a significant impact in the future; however, if changes were to occur to the frequency, duration, or amount of diverted water, cumulative impacts, primarily to water quality and dependent habitats could occur. Changes in surrounding area land use, including agricultural and urban activities as described in the Yuba County General Plan Update (Yuba County 2015), could result in further degradation to conditions that support wildlife and natural habitats, including listed species and their habitat. A number of other commercial and private activities, including timber harvest, recreation, as well as urban and rural development, could potentially affect listed species along the lower Yuba River.

7.4 Conclusion

Overall, the activities associated with this project have the potential to directly and indirect affect CCV Steelhead, CV spring-run Chinook salmon, and Green Sturgeon, critical habitat, and EFH. The proposed alternative may affect, and is likely to adversely affect listed fish species in the lower Yuba River. While there are temporary adverse effects to species, the overall project would cause a net increase in quality in quantity of habitat and ecosystem.

The proposed alternative may temporarily alter critical habitat and EFH adversely, but the beneficial effects of project far outweigh the adverse effects. The proposed action is not likely to destroy or adversely modify designated critical habitat of CCV Steelhead, CV spring-run Chinook salmon, and Green Sturgeon or EFH of Pacific Coast Chinook Salmon. The Proposed alternative would not adversely affect and is expected to increase the amount and quality of EFH for Chinook salmon. Based upon the project design, the short-term impacts, and use of BMPs, the proposed action would not adversely affect EFH. The project would have long term beneficial effects on critical habitat and EFH.

Implementation of the project has the potential to increase sedimentation and turbidity to higher levels than what is found under existing conditions. During instances of sudden localized turbidity, normal behavior of anadromous special status species would be directly and indirectly affected. Aside from causing the fish to deviate from normal pattern and behavior, this has the potential to affect their physiology such as respiratory impairment, stress and fatigue, reduced tolerance to environmental stressors, and gill trauma. Chronic exposure to increased sedimentation and turbidity can affect respiratory function and affect the survival of the species, however project caused turbidity and sedimentation is expected to be localized and short term.

Sedimentation and turbidity, as well as dewatering, would cause a temporary reduction in the benthic aquatic macroinvertebrates. The proposed in channel work, such as lowering and excavating the floodplain to facilitate more frequent inundation or for the placement of Engineered

Log Jams, would temporarily disturb soil and sediments therefore causing an increase in suspended sediment, which can reduce light penetration and disrupt photosynthesis. Furthermore, these effects could potentially interfere with feeding, social organization, spawning, rearing, and juvenile survival in fish species and other nekton species; however, these effects would be short term and localized to the project area. The number of special status fish species within the Action Area is unknown, but is expected to be low based on the time of year the project would be conducted as well as the low quality existing habitat. Avoidance and minimization measures would be implemented to reduce effects of sedimentation and turbidity to special status species and habitat.

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(NMFS) John H. Stadler1 , Kerry F. Griffin2 , Eric J. Chavez1 , Brian C. Spence1 , Phil Roni1 , Charleen A. Gavette1 , Barbara A. Seekins1 , and Adam K. Obaza1. “Pacific Coast Salmon 5-Year Review of Essential Fish Habitat Final Report to the Pacific Fishery Management Council.” 25 May 2011.

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Attachment 1 – Official NMFS Species List – Obtained through NMFS West Coast Region California Species List online tool August 16, 2017.

From:	Pascus, Kaitlyn A CIV (US)
To:	"nmfswcrca.specieslist@noaa.gov"
Subject:	U.S. Army Corps of Engineers, Project: Yuba River Ecosystem Restoration Feasibility Study (UNCLASSIFIED)
Date:	Wednesday, August 16, 2017 9:52:00 AM

CLASSIFICATION: UNCLASSIFIED

Hello,

Quads: Yuba City, Browns Valley, Smartville

Quad Name	**Yuba City**
Quad Number	**39121-B5**
ESA Anadromous Fish	
SONCC Coho ESU (T) -	
CCC Coho ESU (E) -	
CC Chinook Salmon ESU (T) -	
CVSR Chinook Salmon ESU (T) -	**X**
SRWR Chinook Salmon ESU (E) -	**X**
NC Steelhead DPS (T) -	
CCC Steelhead DPS (T) -	
SCCC Steelhead DPS (T) -	
SC Steelhead DPS (E) -	
CCV Steelhead DPS (T) -	**X**
Eulachon (T) -	
sDPS Green Sturgeon (T) -	**X**
ESA Anadromous Fish Critical Habitat	
SONCC Coho Critical Habitat -	
CCC Coho Critical Habitat -	
CC Chinook Salmon Critical Habitat -	
CVSR Chinook Salmon Critical Habitat -	**X**
SRWR Chinook Salmon Critical Habitat -	
NC Steelhead Critical Habitat -	
CCC Steelhead Critical Habitat -	
SCCC Steelhead Critical Habitat -	
SC Steelhead Critical Habitat -	
CCV Steelhead Critical Habitat -	**X**
Eulachon Critical Habitat -	
sDPS Green Sturgeon Critical Habitat -	**X**
ESA Marine Invertebrates	
Range Black Abalone (E) -	
Range White Abalone (E) -	
ESA Marine Invertebrates Critical Habitat	

Black Abalone Critical Habitat -

ESA Sea Turtles

East Pacific Green Sea Turtle (T) -

Olive Ridley Sea Turtle (T/E) -

Leatherback Sea Turtle (E) -

North Pacific Loggerhead Sea Turtle (E) -

ESA Whales

Blue Whale (E) -

Fin Whale (E) -

Humpback Whale (E) -

Southern Resident Killer Whale (E) -

North Pacific Right Whale (E) -

Sei Whale (E) -

Sperm Whale (E) -

ESA Pinnipeds

Guadalupe Fur Seal (T) -

Steller Sea Lion Critical Habitat -

Essential Fish Habitat

Coho EFH -

Chinook Salmon EFH - **X**

Groundfish EFH -

Coastal Pelagics EFH -

Highly Migratory Species EFH -

MMPA Species (See list at left)

ESA and MMPA Cetaceans/Pinnipeds

See list at left and consult the NMFS Long Beach office
562-980-4000

MMPA Cetaceans -

MMPA Pinnipeds -

Quad Name **Browns Valley**

Quad Number **39121-B4**

ESA Anadromous Fish

SONCC Coho ESU (T) -

CCC Coho ESU (E) -

CC Chinook Salmon ESU (T) -

CVSR Chinook Salmon ESU (T) - **X**

SRWR Chinook Salmon ESU (E) - **X**

NC Steelhead DPS (T) -

CCC Steelhead DPS (T) -

SCCC Steelhead DPS (T) -

SC Steelhead DPS (E) -

CCV Steelhead DPS (T) - **X**

Eulachon (T) -

sDPS Green Sturgeon (T) - **X**

ESA Anadromous Fish Critical Habitat

SONCC Coho Critical Habitat -

CCC Coho Critical Habitat -

CC Chinook Salmon Critical Habitat -

CVSR Chinook Salmon Critical Habitat - **X**

SRWR Chinook Salmon Critical Habitat -

NC Steelhead Critical Habitat -

CCC Steelhead Critical Habitat -

SCCC Steelhead Critical Habitat -

SC Steelhead Critical Habitat -

CCV Steelhead Critical Habitat - **X**

Eulachon Critical Habitat -

sDPS Green Sturgeon Critical Habitat - **X**

ESA Marine Invertebrates

Range Black Abalone (E) -

Range White Abalone (E) -

ESA Marine Invertebrates Critical Habitat

Black Abalone Critical Habitat -

ESA Sea Turtles

East Pacific Green Sea Turtle (T) -

Olive Ridley Sea Turtle (T/E) -

Leatherback Sea Turtle (E) -

North Pacific Loggerhead Sea Turtle (E) -

ESA Whales

Blue Whale (E) -

Fin Whale (E) -

Humpback Whale (E) -

Southern Resident Killer Whale (E) -

North Pacific Right Whale (E) -

Sei Whale (E) -

Sperm Whale (E) -

ESA Pinnipeds

Guadalupe Fur Seal (T) -

Steller Sea Lion Critical Habitat -

Essential Fish Habitat

Coho EFH -

Chinook Salmon EFH - **X**

Groundfish EFH -

Coastal Pelagics EFH -

Highly Migratory Species EFH -

MMPA Species (See list at left)

ESA and MMPA Cetaceans/Pinnipeds

See list at left and consult the NMFS Long Beach office 562-980-4000

MMPA Cetaceans -

MMPA Pinnipeds -

Quad Name **Smartville**

Quad Number **39121-B3**

ESA Anadromous Fish

SONCC Coho ESU (T) -

CCC Coho ESU (E) -

CC Chinook Salmon ESU (T) -

CVSR Chinook Salmon ESU (T) - **X**

SRWR Chinook Salmon ESU (E) -

NC Steelhead DPS (T) -

CCC Steelhead DPS (T) -

SCCC Steelhead DPS (T) -

SC Steelhead DPS (E) -

CCV Steelhead DPS (T) - **X**

Eulachon (T) -

sDPS Green Sturgeon (T) -

ESA Anadromous Fish Critical Habitat

SONCC Coho Critical Habitat -

CCC Coho Critical Habitat -

CC Chinook Salmon Critical Habitat -

CVSR Chinook Salmon Critical Habitat - **X**

SRWR Chinook Salmon Critical Habitat -

NC Steelhead Critical Habitat -

CCC Steelhead Critical Habitat -

SCCC Steelhead Critical Habitat -

SC Steelhead Critical Habitat -

CCV Steelhead Critical Habitat - **X**

Eulachon Critical Habitat -

sDPS Green Sturgeon Critical Habitat -

ESA Marine Invertebrates

Range Black Abalone (E) -

Range White Abalone (E) -

ESA Marine Invertebrates Critical Habitat

Black Abalone Critical Habitat -

ESA Sea Turtles

East Pacific Green Sea Turtle (T) -
Olive Ridley Sea Turtle (T/E) -
Leatherback Sea Turtle (E) -
North Pacific Loggerhead Sea Turtle (E) -

ESA Whales

Blue Whale (E) -
Fin Whale (E) -
Humpback Whale (E) -
Southern Resident Killer Whale (E) -
North Pacific Right Whale (E) -
Sei Whale (E) -
Sperm Whale (E) -

ESA Pinnipeds

Guadalupe Fur Seal (T) -
Steller Sea Lion Critical Habitat -

Essential Fish Habitat

Coho EFH -
Chinook Salmon EFH - **X**
Groundfish EFH -
Coastal Pelagics EFH -
Highly Migratory Species EFH -

MMPA Species (See list at left)
ESA and MMPA Cetaceans/Pinnipeds
See list at left and consult the NMFS Long Beach office
562-980-4000

MMPA Cetaceans -
MMPA Pinnipeds -

Send to: USACE, Attn: Kaitlyn Pascus
CA North Section- Regulatory Division
1325 J Street, Room 1350
Sacramento, California 95814-2922

Point of Contact: Kaitlyn Pascus, [redacted]
CLASSIFICATION: UNCLASSIFIED

From:	NMFSWCRCA Specieslist - NOAA Service Account
To:	Pascus, Kaitlyn A CIV (US)
Subject:	[Non-DoD Source] Auto reply - NMFS CA Species List Re: U.S. Army Corps of Engineers, Project: Yuba River Ecosystem Restoration Feasibility Study (UNCLASSIFIED)
Date:	Wednesday, August 16, 2017 9:53:03 AM

Thank you for using NMFS' California Species List. Receipt of this message confirms that NMFS has received your email to nmfswcrca.specieslist@noaa.gov. If you have used the tools and followed the steps outlined on the California Species List Tools webpage (Blockedhttp://www.westcoast.fisheries.noaa.gov/maps_data/california_species_list_tools.html), you have generated an official species list.

Messages sent to this email address are not responded to directly. For project specific questions, please contact your local NMFS office.

Northern California/Klamath (Arcata) 707-822-7201

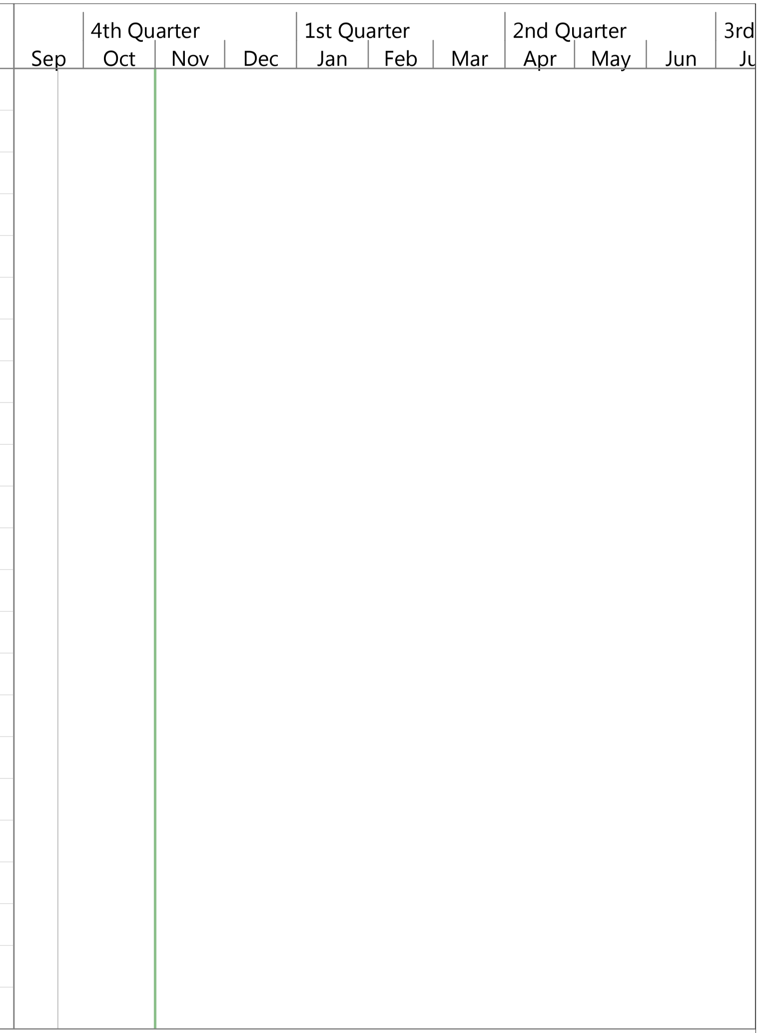
North-Central Coast (Santa Rosa) 707-387-0737

Southern California (Long Beach) 562-980-4000

California Central Valley (Sacramento) 916-930-3600

Attachment 2 – Project Schedule for Construction

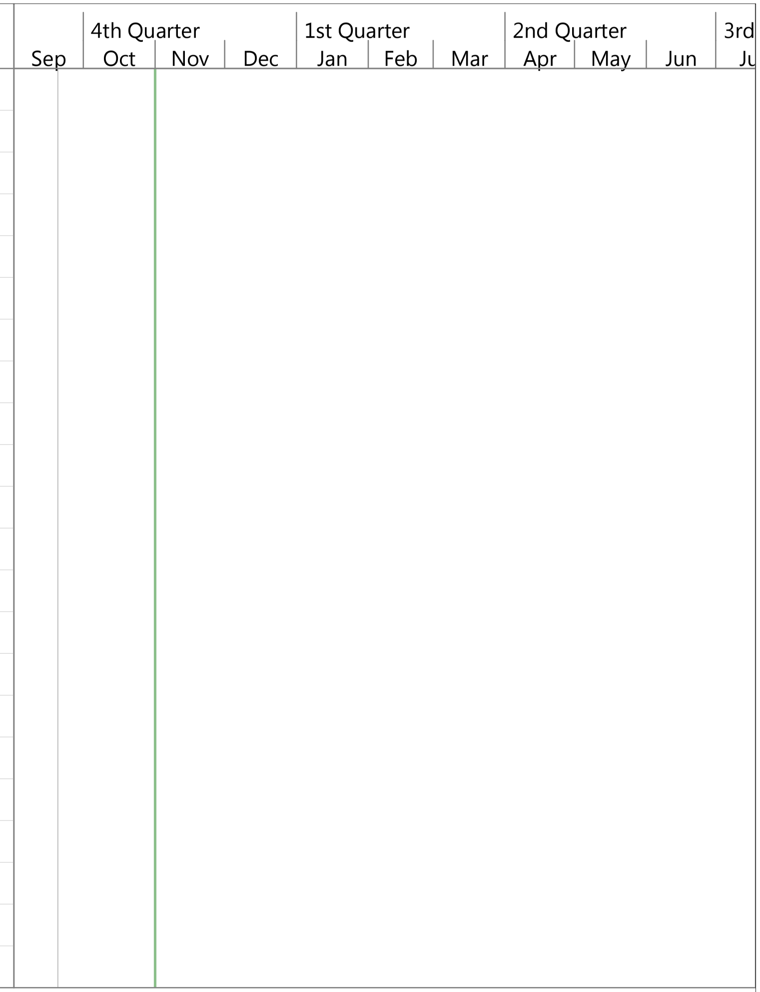
ID	Task Mode	Task Name	Duration	Start	Finish
1		**Construction Year 1**	**152 days**	**Mon 5/3/21**	**Tue 11/30/21**
2		**Boulders and LWM**	**109 days**	**Mon 5/3/21**	**Thu 9/30/21**
3		Staging (Boulder/Large Wo	22 days	Mon 5/3/21	Tue 6/1/21
4		Placement of Boulders and	87 days	Wed 6/2/21	Thu 9/30/21
5		**Excavation**	**109 days**	**Mon 5/3/21**	**Thu 9/30/21**
6		Staging (Excavation)	21 days	Mon 5/3/21	Mon 5/31/21
7		Excavation (in-water work)	88 days	Tue 6/1/21	Thu 9/30/21
8		**Plantings**	**65 days**	**Wed 9/1/21**	**Tue 11/30/21**
9		Scout and Mark Trees	22 days	Wed 9/1/21	Thu 9/30/21
10		Harvest an Transport Trees	43 days	Fri 10/1/21	Tue 11/30/21
11		Stinger Site, Install Planting	43 days	Fri 10/1/21	Tue 11/30/21
12		**Construction Year 2**	**152 days**	**Tue 5/3/22**	**Wed 11/30/22**
13		**Boulders and LWM**	**109 days**	**Tue 5/3/22**	**Fri 9/30/22**
14		Staging (Boulder/Large Wo	22 days	Tue 5/3/22	Wed 6/1/22
15		Placement of Boulders and	87 days	Thu 6/2/22	Fri 9/30/22
16		**Excavation**	**109 days**	**Tue 5/3/22**	**Fri 9/30/22**
17		Staging (Excavation)	21 days	Tue 5/3/22	Tue 5/31/22
18		Excavation (in-water work)	88 days	Wed 6/1/22	Fri 9/30/22
19		**Plantings**	**65 days**	**Thu 9/1/22**	**Wed 11/30/22**
20		Scout and Mark Trees	22 days	Thu 9/1/22	Fri 9/30/22
21		Harvest an Transport Trees	43 days	Mon 10/3/22	Wed 11/30/22
22		Stinger Site, Install Planting	43 days	Mon 10/3/22	Wed 11/30/22
23					



Project: Project1
Date: Wed 11/1/17

Task	Inactive Summary	External Tasks
Split	Manual Task	External Milestone
Milestone	Duration-only	Deadline
Summary	Manual Summary Rollup	Progress
Project Summary	Manual Summary	Manual Progress
Inactive Task	Start-only	
Inactive Milestone	Finish-only	

ID		Task Mode	Task Name	Duration	Start	Finish
24			**Construction Year 3**	**152 days**	**Wed 5/3/23**	**Thu 11/30/23**
25			**Boulders and LWM**	**109 days**	**Wed 5/3/23**	**Mon 10/2/23**
26			Staging (Boulder/Large Wo	22 days	Wed 5/3/23	Thu 6/1/23
27			Placement of Boulders and	87 days	Fri 6/2/23	Mon 10/2/23
28			**Excavation**	**109 days**	**Wed 5/3/23**	**Mon 10/2/23**
29			Staging (Excavation)	21 days	Wed 5/3/23	Wed 5/31/23
30			Excavation (in-water work)	88 days	Thu 6/1/23	Mon 10/2/23
31			**Plantings**	**65 days**	**Fri 9/1/23**	**Thu 11/30/23**
32			Scout and Mark Trees	22 days	Fri 9/1/23	Mon 10/2/23
33			Harvest an Transport Trees	43 days	Tue 10/3/23	Thu 11/30/23
34			Stinger Site, Install Planting	43 days	Tue 10/3/23	Thu 11/30/23
35			**Construction Year 4**	**152 days**	**Fri 5/3/24**	**Mon 12/2/24**
36			**Boulders and LWM**	**109 days**	**Fri 5/3/24**	**Wed 10/2/24**
37			Staging (Boulder/Large Wo	22 days	Fri 5/3/24	Mon 6/3/24
38			Placement of Boulders and	87 days	Tue 6/4/24	Wed 10/2/24
39			**Excavation**	**109 days**	**Fri 5/3/24**	**Wed 10/2/24**
40			Staging (Excavation)	21 days	Fri 5/3/24	Fri 5/31/24
41			Excavation (in-water work)	88 days	Mon 6/3/24	Wed 10/2/24
42			**Plantings**	**152 days**	**Fri 5/3/24**	**Mon 12/2/24**
43			Scout and Mark Trees	22 days	Fri 5/3/24	Mon 6/3/24
44			Harvest an Transport Trees	43 days	Thu 10/3/24	Mon 12/2/24
45			Stinger Site, Install Planting	43 days	Thu 10/3/24	Mon 12/2/24



Project: Project1
Date: Wed 11/1/17

Task	Inactive Summary	External Tasks
Split	Manual Task	External Milestone
Milestone	Duration-only	Deadline
Summary	Manual Summary Rollup	Progress
Project Summary	Manual Summary	Manual Progress
Inactive Task	Start-only	
Inactive Milestone	Finish-only	

Environmental Appendix D
Attachment 2

Biological Assessment
Section 7 ESA Consultation with U.S. Fish and Wildlife Service

Yuba River Ecosystem Restoration Feasibility Study

January 2018

U.S. Army Corps of Engineers

Sacramento District

Contents

1.0 Introduction

The purpose of this initiation package is to review the proposed Yuba River Ecosystem Restoration Project in sufficient detail to determine to what extent the proposed action may affect any of the threatened, endangered, proposed, or sensitive species and designated or proposed critical habitats under the jurisdiction of the National Marine Fisheries Service and listed below. In addition, the following information is provided to comply with statutory requirements to use the best scientific and commercial information available when assessing the risks posed to listed and/or proposed species and designated and/or proposed critical habitat by proposed federal actions. This initiation package is prepared in accordance with legal requirements set forth under regulations implementing Section 7 of the Endangered Species Act (50 CFR 402; 16 U.S.C. 1536 (c)).

Threatened, Endangered, Proposed Threatened or Proposed Endangered Species

The following listed and proposed species were identified through the USFWS ECOS-IPaC website as having the potential to be affected by the proposed action:

Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*), **T**

California Red-legged Frog (*Rana aurora draytonii*), **T**

Western Yellow-Billed Cuckoo (*Coccyzus americanus*), **T**

In addition to the species above the official species list identified 10 listed Endangered and Threatened species with the potential to occur in the action area; however, these species are not expected to occur in the action area due to lack of available habitat or lack of demonstrated habitat use and were not included in this analysis. The official species list is included at the end of the document (Attachment 1)

Critical Habitat

No designated critical habitat for species under the jurisdiction of the USFWS has been identified within the action area.

2.0 Consultation to Date

USACE has conducted informal coordination throughout the USACE plan formulation process with USFWS and NMFS to discuss project impacts related to federally listed special status species. Coordination included participation by USFWS and NMFS staff in a multi-day, multi-agency planning workshop (charrette) at the onset of the Feasibility Study process as well as meetings with the Project Delivery Team throughout the plan formulation process. In addition USACE used the NMFS West Coast Region California Species List online tool to obtain an official species list for the project area.

3.0 Description of the Proposed Action

The U.S. Army Corps of Engineers (USACE), in partnership with the Yuba County Water Agency (YCWA) propose to restore 178.6 acres of aquatic and riparian habitat along the lower Yuba River in Yuba County, California (Figure 1). The feasibility study is being conducted under the general authority for flood control investigations in the Rivers and Harbors Act of 1962, Public Law [PL] 87-874, Section 209, and Title III of Public Law 85-500. The principal features of the proposed action include restoration of 42.5 acres of aquatic habitat including side channels, backwater areas, bank scallops, and channel stabilization. These features will provide shallow, low velocity, rearing habitat and refugia for juvenile anadromous salmonids and potentially increase benthic macroinvertebrate producing habitat. Engineered log jams (ELJs) and placement of boulders and large woody material have been incorporated in the proposed action at strategic locations. ELJs and boulders will be placed at actively eroding banks or sites with high velocities and shear stresses. These features will promote bank stabilization, add structural complexity, provide velocity refuge for juvenile fish, and modify local hydraulics and sediment transport.

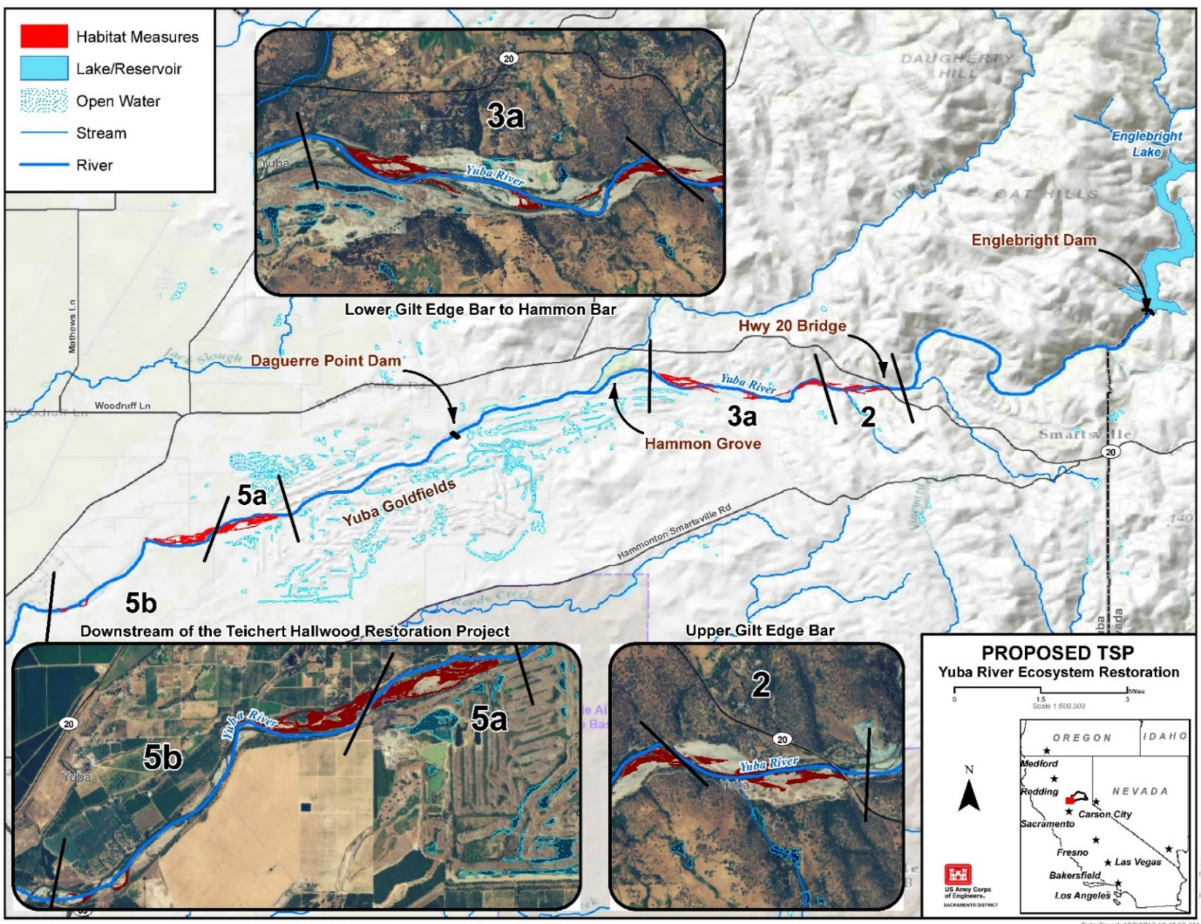


Figure 1. Proposed action area on the lower Yuba River

The proposed action also includes about 136 acres of riparian habitat restoration consisting of floodplain lowering and grading and riparian vegetation plantings, which will increase the quantity and quality of riparian habitat in the river corridor. The proposed action addresses fragmentation of habitat by targeting areas adjacent to existing vegetation that have been unable to initiate revegetation through natural processes due to substrate composition and depth to groundwater. Floodplain lowering reconnects the river to its floodplain and makes planting feasible where it was not previously due to excessive groundwater depths.

The proposed action includes increments 2, 5b, 5a, and 3a at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, Bar C, Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, and North Silica Bar. Habitat increment details are provided below.

3.1 Habitat Increment 2 (Upper Gilt Edge Bar)

Just downstream of the Highway 20 Bridge at Upper Gilt Edge Bar, the floodplain would be lowered to facilitate inundation at 3,000 cubic feet per second (cfs) and riparian vegetation would be planted along the channel edge.

On the southern bank of Upper Guilt Edge Bar, where the bank is 8-15 feet high, and the edge of the channel is relatively monotonous with little habitat complexity, small scallops would be excavated into the tall and steep banks to increase local topographic diversity and wetted edge. These scallops are designed to create an inundated alcove at all discharges with the steep slopes surrounding the alcoves feathered to at least a 10:1 slope, providing additional shallow inundated areas with desirable depth/velocity combinations. Initially, these scallops would provide year round rearing habitat to juvenile salmonids. Over time, it is expected that fine sediment may deposit in the scallops creating nursery sites where natural woody vegetation recruitment could occur. The scallops would further facilitate natural recruitment of riparian vegetation, due to shallow access to the water table, and the fine texture of deposited sediments.

In addition, Large Woody Material (LWM) would be placed within and protruding from the scallops. An existing backwater area would be restored allowing for inundation in a typical 50% to 100% Annual Chance Exceedance (ACE) flood. Riparian vegetation would be planted to increase the structural diversity and extent of existing riparian vegetation. Additional fine material would be introduced to the upper 3 feet of the soil column in excavated areas to increase soil absorption and the amount of soil moisture available to riparian vegetation. LWM would be placed within the backwater to provide aquatic structure.

Riparian vegetation would be planted at the Unnamed Bar on the north side of the river near River Mile (RM) 17. The site would be restored by lowering areas to increase lateral floodplain connectivity and provide additional opportunity to plant riparian vegetation. Table 1 shows details for features on Increment 2.

Table 1. Habitat Increment 2 Details

Feature ID	Original Measure ID	Feature Type	Acres	Volume (Cubic Feet)	Length (feet)	Width (feet)
2.1	19	Floodplain Lowering	8.1	497,237.3	2,800	340
2.2	19	Riparian Planting	2.5			
2.3	20	Bank Scalloping	0.3			
2.4	20	Riparian Planting	0.4			
2.5	21	Backwater Area	0.3	67,198.3	240	150
2.6	21	Riparian Planting	0.6			
2.7	22	Floodplain Lowering	5.9	330,942.4	680	430
2.8	22	Riparian Planting	5.2			

3.2 Habitat Increment 3a (Lower Gilt Edge Bar)

At Lower Gilt Edge Bar, the existing swale feature (at upstream end of Lower Gilt Edge Bar) would be lowered and connected to the channel to become inundated at 3,000 cfs. A patchwork floodplain network of LWM surrounding the restored groundwater-fed swale would be constructed to encourage fine sediment deposition and potential riparian recruitment, as well as provide edgewater refugia at flows above baseflow.

Downstream of Lower Gilt Edge Bar, on Hidden Island, the alluvial bar on the north side of the river, riparian vegetation would be planted.

First Island has large expanses of floodplain and high floodplain, and a side channel on river left provides spawning and rearing habitat. This area may provide immediate benefit to emerging salmonid fry if they are allowed access to larger expanses of shallow habitat with riparian cover. To encourage sediment deposition and riparian vegetation recruitment, Engineered Log Jams (ELJs) would be installed in a patchwork configuration, particularly along the apex of First Island just above bankfull elevation. For the purposes of documenting benefits in this report, direct planting of riparian vegetation was substituted for ELJ placement.

Rock and sediment would be deposited along the left bank of Silica Bar, and ELJs would be placed to aid constriction at this location. LWM would be placed along the margins of the downstream terminus of the existing side channel/backwater that is surrounded by an existing stand of diverse, mature, native riparian vegetation, in areas that would not disrupt existing riparian vegetation along the banks of the side channel/backwater area. Floodplain areas would be lowered to facilitate more frequent inundation and riparian vegetation would be planted.

North Silica Bar is located on the river right just downstream of First Island, floodplain surfaces would be lowered and riparian vegetation would be planted to facilitate more frequent inundation between 3,000 and 5,000 cfs. Rock and sediment would be deposited along the left bank of Silica Bar, coupled with placement of ELJs to aid river constriction at this location.

A side channel would be created that activates above 3,000 cfs and connects to the low lying area downstream, providing beneficial off-channel habitat with established riparian vegetation. This would create an anabranching side channel (stable multiple-thread channels) in an existing swale within a stand of relatively dense vegetation that presently includes willows and cottonwoods.

Habitat Increment 3a would increase habitat connectivity between Habitat Increment 2 and SYRCL's Long Bar Restoration Project and Hammon Bar Restoration Project. Table 2 shows details for features on Increment 3a.

Table 2. Habitat Increment 3a Details

Feature ID	Original Measure ID	Feature Type	Acres	Volume (Cubic Feet)	Length (feet)	Width (feet)
3.1	24	Floodplain Lowering	6.2	312,326.5	650	380
3.2	24	Riparian Planting	5.0			
3.3	24	Side Channel	0.8	343,737	1,200	40
3.4	26	Riparian Planting	2.3			
3.5	28	Riparian Planting	6.3			
3.6	29	Channel Constriction	1.6			
3.7	30	Floodplain Lowering	1.6	74,862.5	1,610	150
3.8	30	Riparian Planting	3.5			
3.9	32	Floodplain Lowering	5.2	365,324	1,900	760
3.10	32	Riparian Planting	11.6			
3.11	33	Channel Constriction	1.9			
3.12	34	Side Channel	10.5	4,696,875	3,357	227

3.3 Habitat Increment 5a

Bar C: Immediately downstream of the Teichert Hallwood Restoration Project, a historical channel alignment on the north side of Bar C would be restored to inundate at 3,000 cfs and function as swale habitat. The side channel and adjacent floodplain would be lowered and graded. Additionally, riparian vegetation would be planted on each side of the restored swale/side channel. ELJs would be placed in a patchwork configuration at the inflow of the swale, at the upstream end of Bar C. In addition, LWM would be placed in the backwater area at the downstream end of Bar C to increase structural and habitat complexity in the area.

A historical channel alignment on the south side of the bar would be restored by lowering and grading a side channel within a stand of riparian vegetation. The side channel would extend into an existing backwater habitat located at the downstream edge of the Yuba Goldfields. The floodplain on the north side of the side channel would be lowered and planted with riparian vegetation. Boulder structures would be placed to provide hydraulic stability at the inflow section of the side channel at the upstream end of Bar C.

Habitat Increment 5a would connect riparian and aquatic habitat corridors to the Teichert Hallwood Restoration Project. Table 3 shows details for features in Habitat Increment 5a.

Table 3. Habitat Increment 5a details

Feature ID	Original Measure ID	Feature Type	Acres	Volume (Cubic Feet)	Length (feet)	Width (feet)
5.1	46	Floodplain Lowering	13.0	905,713.1	3,350	306
5.2	46	Riparian Planting	16.6			
5.3	46	Side Channel	10.3	3,188,033	5,100	100
5.4	47	Riparian Planting	4.7			
5.5	47	Side Channel	4.8	2,058,083	5,035	40

3.4 Habitat Increment 5b

Narrow Bar: A side channel would be constructed at Narrow Bar that would connect to an existing swale at the downstream end of the bar. Existing riparian vegetation would border the created side channel. Another side channel would be created, splitting off from the other side channel through the middle of the bar in the southwest direction. Boulders would be placed to maintain stable hydraulic conditions at the inflow. There is a large expanse of shallow depth to groundwater on Narrow Bar, with some areas of high floodplain. The high floodplain areas would be graded and planted with riparian vegetation. Additionally, floodplain along the main channel would be graded to increase inundation duration and frequency at 3,000 cfs. ELJs would be placed in a patchwork configuration to facilitate riparian recruitment and to restore swale habitat. At the terminus of the anabranching side channel, a backwater area would be created.

River Mile 6.5: A backwater area would be created on the right bank of the river to provide shallow water refugia for salmonids.

Bar E: Riparian vegetation would be planted in the downstream portion of Bar E surrounding a historical channel alignment to restore species and structural diversity. LWM would be placed in the swale/backwater downstream from the existing diversion channel.

Island B: Riparian vegetation would be planted along the upstream portion of this island to create species and structural diversity. ELJs would be placed in a patchwork configuration to encourage native plant recruitment and improve survivability of plantings. Table 4 shows details for features on Increment 5b.

Table 4. Habitat Increment 5b Details

Feature ID	Original Measure ID	Feature Type	Acres	Volume (Cubic Feet)	Length (feet)	Width (feet)
5.6	48	Side Channel	9.2	3,445,883	3,939	103
5.7	49	Floodplain Lowering	6.9	232,160	2,040	293
5.8	49	Riparian Planting	21.1			
5.9	50	Floodplain Lowering	0.8	30,440	393	148
5.10	50	Riparian Planting	3.7			
5.11	51	Backwater Area	1.9	231,343	792	176
5.12	52	Backwater Area	1.0	129,007	212	216
5.13	53	Riparian Planting	2.4			
5.14	54	Riparian Planting	2.5			
5.15	55	Floodplain Terracing	12.5	3,883,041	1,319	781
5.16	55	Riparian Planting	3.5			
5.17	55	Side Channel	1.9	6,233,722	1,085	70

3.5 Construction Schedule, Access, and Staging

Construction of the proposed action would take place over 4 years. The primary work of excavation, grading, and feature placement on Increments 2, 3a, 5a, and 5b would be expected to be completed in 3 years; one additional year is assumed in the schedule to account for schedule slippage and repair/closeout of construction tasks. Planting would also be expected to be completed over 3 years. Planting would be conducted concurrently with the primary excavation and feature installation, beginning the second year and extending to the end of the 4 year. All in water work is expected to occur downstream of the highway 20 bridge and would be conducted between June 1 and October 31 each year. Planting is expected to occur between October 1 and November 30 each year. Pending Congressional authorization and funding, the project would be expected to begin in 2021 and be completed by 2024. The construction schedule is shown in Attachment 2.

3.6 General Avoidance, Minimization, and Conservation Measures

Avoidance, minimization, and conservation measures are measures and practices adopted to reduce or avoid adverse effects that could result from project construction or operation. The following sections describe the avoidance, minimization, and conservation measures adopted for the proposed alternative. These measures would be incorporated in construction documents (plans and specifications) prepared for the proposed alternative and would thus be contractually required of all construction contractors.

BMPs shall be implemented to prevent soil erosion and sediment incursion into the active channel.

- Straw bales, straw wattles and silt fences would be installed at source sites for each project, as appropriate.
- Operation of heavy machinery in the active channel would be minimized to avoid disturbance of substrates.

- Turbidity and settleable solids would be monitored according to water quality permits. If acceptable limits are exceeded, work would be suspended until acceptable measured levels are achieved.
- Equipment used for the project would be thoroughly cleaned off-site to remove any invasive plant material or invasive aquatic biota prior to use in the Action Area.
- Environmentally sensitive areas, sensitive plant species and wetland areas would be avoided during project activities to the maximum extent practicable.
- High visibility fencing would be placed around these areas to minimize disturbance.
- Soil and excavated material and/or fill material would be stockpiled in existing clearings when possible.
- The project limits would be clearly demarcated. Erosion control fencing would be placed at the edges of construction where the construction activities are upslope of aquatic habitats to prevent washing of sediments into these features. All fencing would be installed prior to any construction activities beginning and would be maintained throughout the construction period.
- During construction operations, stockpiling of construction materials, portable equipment, vehicles, and supplies would be restricted to the designated construction staging areas. To eliminate an attraction to predators, all food-related trash items, such as wrappers, cans, bottles, and food scraps, would be disposed of in closed containers. Revegetation would occur on all areas temporarily disturbed from construction activities.
- All temporary impact areas would be restored to pre-project contour and revegetated.
- A revegetation plan would be developed to address all temporarily impacted native areas.
- A Spill Prevention and Response Plan would be prepared that identifies any hazardous materials to be used during construction; describes measures to prevent, control, and minimize spillage of hazardous substances; describes transport, storage and disposal procedures for these substances; and outlines procedures to be followed in case of a spill of a hazardous material. The Spill Prevention and Response Plan would require that hazardous and potentially hazardous substances stored onsite be kept in securely closed containers located away from drainage courses, agricultural areas, storm drains, and areas where stormwater is allowed to infiltrate. It would also stipulate procedures, such as the use of spill containment pans, to minimize hazard during onsite fueling and servicing of construction equipment. Finally, the Spill Prevention and Response Plan would require that all agencies listed in the Spill Prevention and Response Plan be notified immediately of any substantial spill or release.

The following avoidance and minimization measures were taken from May 2017, Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*) and will be incorporated into the project to avoid and minimize effects to VELB and its habitat:

- Fencing. All areas to be avoided during construction activities will be fenced and/or flagged as close to construction limits as feasible.

- Avoidance area. Activities that may damage or kill an elderberry shrub (e.g., trenching, paving, etc.) may need an avoidance area of at least 6 meters (20 feet) from the drip-line, depending on the type of activity.
- Worker education. A qualified biologist will provide training for all contractors, work crews, and any onsite personnel on the status of the VELB, its host plant and habitat, the need to avoid damaging the elderberry shrubs, and the possible penalties for noncompliance.
- Construction monitoring. A qualified biologist will monitor the work area project-appropriate intervals to assure that all avoidance and minimization measures are implemented. The amount and duration of monitoring will depend on the project specifics and should be discussed with the Service biologist.
- Timing. As much as feasible, all activities that could occur within 50 meters (165 feet) of an elderberry shrub, will be conducted outside of the flight season of the VELB (March - July).
- Trimming. Trimming may remove or destroy VELB eggs and/or larvae and may reduce the health and vigor of the elderberry shrub. In order to avoid and minimize adverse effects to VELB when trimming, trimming will occur between November and February and will avoid the removal of any branches or stems that are ≥ 1 inch in diameter. Measures to address regular and/or large scale maintenance (trimming) should be established in consultation with the Service.
- Chemical Usage. Herbicides will not be used within the drip-line of the shrub. Insecticides will not be used within 30 meters (98 feet) of an elderberry shrub. All chemicals will be applied using a backpack sprayer or similar direct application method.
- Mowing. Mechanical weed removal within the drip-line of the shrub will be limited to the season when adults are not active (August - February) and will avoid damaging the elderberry.
- Erosion Control and Re-vegetation. Erosion control will be implemented and the affected area will be re-vegetated with appropriate native plants.
- Transplanting: While transplanting is unanticipated, if necessary, coordination with the USFWS would occur and USFWS transplanting guidelines would be followed.

No species specific avoidance, minimization, or conservation measures have been issued for the western yellow billed cuckoo; however, general avoidance, minimization, and conservation measures will be followed.

- Conduct preconstruction surveys of potential breeding habitat in and within 500 feet of project activities. It may be necessary to conduct the breeding bird surveys during the preceding year depending on when construction is scheduled to start. Implement protective measures in occupied areas.
- If an active nest site is present, a 250-foot non-disturbance buffer will be established around nest sites and a 500-foot non-disturbance buffer around western yellow-billed cuckoo nest sites during the breeding season (June through late August).

3.7 Interrelated and Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are actions that have no independent utility apart from the action under consideration. There are no interrelated or interdependent actions associated with the Proposed Project.

4.0 Action Area

The regulations governing consultations under the federal ESA define the "action area" as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). Direct effects are defined as "the direct or immediate effects of the project on the species or its habitat" (USFWS and NMFS 1998). Indirect effects are defined as "those [effects] that are caused by the proposed action and are later in time, but still are reasonably certain to occur" (50 CFR 9 §402.02). Consistent with 50 CFR 402.02, the Action Area for this consultation is determined considering the extent of the direct and indirect effects of the Proposed Action. The proposed Action Area includes 4 project increments, staging, and access areas. Refer to Figure 1 for Action Area Map.

The overall project area is located northeast of Marysville, Yuba County, within and adjacent to the lower Yuba River. The overall project is nested within the 3,400 square miles Yuba River Watershed is part of the larger Sacramento River basin. It is located on the western slopes of the Sierra Nevada Mountain Range and located within portions of Sierra, Placer, Yuba, and Nevada Counties. The lower Yuba River is the combined flow of the North Fork, Middle Fork, and South Fork of the Yuba River. Elevations range from 158 to 285 feet above mean sea level (Google Earth, 2017). The majority of the study area is within the channel of the Lower Yuba, as well as side channels in the floodplain, riparian areas, and the Yuba Goldfields. The Yuba Goldfields, which are the remnant debris piles of past hydraulic mining, have greatly altered the natural environment. Staging areas would be located primarily in agricultural, forested, grassland, and barren areas. Access would occur along previously established roads (both paved and un-paved) located primarily in agricultural areas.

5.0 Status of Listed Species and Critical Habitat

Federally listed species considered in this BA include: the Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*), the California Red-legged Frog (*Rana draytonii), and the* Western Yellow Billed Cuckoo (*Coccyzus americanus*). These species are known to occur in the project area, have the potential to occur in the project area, or have been included at the request of coordinating agencies. None of these species have designated Critical Habitat in the study area.

Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*)

Status: The valley elderberry longhorn beetle (VELB) is Federally listed threatened is Federally listed as threatened. The USFWS has designated critical habitat for VELB along the American River Parkway and in an area within the Sacramento metropolitan area (54 FR 48229). The species has no State status (the State of California does not list insects).

Distribution and Habitat: The VELB is endemic to the Central Valley and is found in riparian habitats and associated uplands where the elderberry (*Sambucus* spp.), the beetle's food plant, grows. The beetle is a pith-boring species that depends on elderberry plants during its entire life cycle. Larvae feed on tree pith, while adults eat the foliage and possibly the flowers of the plants. The adult stage of the VELB is short-lived, and most of the life cycle is spent in the larval stage. The adults are active from early March through early June with mating occurring in May. Eggs are laid singly, or in small groups, in crevices in elderberry bark and hatch in about 10 days. Larvae bore into the pith of elderberry roots, branches, and trunks to create an opening in the stem within which they pupate, remaining in this stage for one to two years before emerging as adults. After metamorphosing into an adult, the VELB chews a circular exit hole through which it emerges, sometime during the period of late March to June. It has been suggested that the VELB is a poor disperser, based on the spatial distribution of occupied shrubs.

Potential for Occurrence in Project Area: There are 7 known CNDDB records in the vicinity of the project area. Although elderberry shrubs are known to occur throughout the lower Yuba River, the shrubs were found to be most abundant in the downstream-most reaches near Marysville and Hallwood. The majority of plants are distributed in areas above the valley floor and as proximity to the wetted edge of the river increases, the number of plants declines (YCWA 2013). Given these considerations, elderberry shrubs and VELB may occur in the project area. Pre-project surveys would be conducted by a qualified biologist.

California Red-legged Frog (*Rana draytonii)*:

Status: On May 31, 1996, the California Red Legged Frog (CRLF) was listed as "Threatened" by USFWS under the Endangered Species Act (61 FR 25813). Due to threats from invasive species and habitat loss, critical habitat was designated on March 13, 2001 (66 FR 14626). On April 13, 2006, a Special Rule Exemption Associated with Final Listing for Existing Routine Ranching Activities in conjunction with the designation of critical habitat for the species occurred (75 FR 12816).

Distribution and Habitat: The historic range of the CRLF is primarily along the coast from Point Reyes National Seashore in Marin County inland to Redding in Shasta County and downwards to Baja California and Mexico. The USFWS has quantified the species to live in only 248 streams in 26 counties, whereas it had previously been documents in 46 California Counties. The CRLF is primarily found within wetlands and streams with dense emergent vegetation that is associated with deep still/slow moving water. Other suitable habitat may include backwaters of ponds, marshes, springs, and reservoirs (61 FR 25813). The dense riparian vegetation and leaf detritus provide protection from predators so that they may burrow and also provides shade from the sun to prevent desiccation. Reproduction typically occurs in the late winter or early spring when females will deposit egg masses on emergent vegetation. The eggs will hatch within one to two weeks, metamorphosis occurs between 3.5 to 7 months, and sexual maturity is reached by 3 years of age. The life span of the CRLF is believed to be 8 to 10 years.

Potential for Occurrence in project area: The area of the proposed alternative does not contain suitable habitat for the California red-legged frog due to the presence of bullfrogs and several species of predatory fish, lack of fine sediment substrate used for predator avoidance, and lack of woody material and wrack used for thermal regulation and predator avoidance. These conditions would make it difficult for the species to survive in the project area. The nearest recorded occurrence is approximately 15.45 miles away. Given these considerations this species is not likely to occur within the area of the proposed alternative.

Western Yellow Billed Cuckoo (*Coccyzus americanus*)

Status: The Western Yellow-billed Cuckoo was listed as "Threatened" on October 3. 2014, by USFWS (79 FR 59991). On August 15, 2014, the USFWS proposed a designation of critical habitat for the Western Yellow-billed Cuckoo.

Distribution and Habitat: The Western Yellow-billed Cuckoo tends to exclusively nest in low to moderate elevations with riparian woodlands that cover greater than 50 acres. Their species range occupies riparian areas from southern British Columbia down to Sinaloa, Mexico. Biologists believe that they're restricted to such a habitat because of the humidity requirements for successful hatching and rearing of their young (78 FR 61621). Mature riparian habitat greater than 100m in width, are also preferred by the Western Yellow-billed Cuckoo; sites with less than 100m in width are rarely occupied. From a landscape perspective, the species nesting habitat requires tracts of willow-cottonwood or mesquite forest or woodland. Habitat patches from 50 to 100 acres are considered suitable habitat. The patches of large continuous habitats provide adequate cover and space for foraging and nesting. Threats to riparian habitats and breeding areas include land conversion to agriculture or urbanization, dams or hydrology management, livestock grazing, and stream channelization or stabilization activities (78 FR 48548).

Potential for Occurrence in project area: There is a low potential for the Western Yellow-billed Cuckoo to occur in the project due to the necessary habitat requirements and known occurrences in the surrounding areas. Furthermore, there are a few areas within the project area where the riparian habitat width is greater than 100m wide and greater than 20 ha.

6.0 Environmental Baseline

6.1 Physical Features and Habitat Conditions

The Yuba River watershed is approximately 1,340 square miles covering Sierra, Placer, Yuba, and Nevada counties (SRWP 2010). The water flows west from the Sierra Nevada Mountains carrying melted snow run-off and water from the three main Yuba tributary forks all the way down to the confluence with the Feather River. While the primary location of the project is in the Lower Yuba River, the overall watershed quality plays a large role in water quality in the project area. Multiple factors affect the water quality of the Lower Yuba River including: hydroelectric power generation, dams and reservoirs, mining activities, urbanization, and timber harvesting.

Major dams in the Yuba River watershed completed in dates from 1913 to 1969 include Spaulding, Bowman, Fordyce, Englebright, Jackson Meadows, and New Bullards Bar. Part of the reason the first dams in the Yuba River Watershed were created were for gold mining, but later on the use of dams shifted for emphasis on flood control, waters supply, and hydropower. The lower Yuba River is currently operating under the Lower Yuba River Accord flow regime, which is a joint project between the Yuba County Water Agency and the United States Department of the Interior-

Bureau of Reclamation to manage the interests of approximately 17 stakeholders in the area to balance interests of irrigation, conservation, water supply, and fisheries concerns (USACE 2014). The physical, thermal, and chemical changes that occur from water being retained behind dams can greatly affect the downstream quality and temperature of the river.

The lower Yuba River experiences temperature fluctuation from inflows of Deer Creek (RM 22.7), irrigation diversions at Daguerre Point Dam (RM 11.6), and operational releases from Englebright Dam (RM 24). Furthermore, the general width to flow ratio in conjunction with low riparian cover provide opportunity for solar heating of the water. The water within the lower Yuba River can increase up to 7°C from the release at Englebright Dam to the City of Marysville (LYRA 2010), but this is seasonally dependent and influenced by amount of water released from Englebright Dam, solar input, and air temperature. Data taken near Marysville, showed that dissolved oxygen concentrations, total dissolved solids, pH, alkalinity, and turbidity are well within acceptable or preferred ranges for salmonids and other key freshwater organisms (USACE 2012). In 2007, instream flow requirements were codified by the Yuba Accord (YCWA 2007) to maintain suitable habitat in the lower Yuba River for fish and wildlife.

Mercury contamination from hydraulic mining in the watershed poses a risk to environmental and human health. Mercury was used in hydraulic gold mining to increase the removal of gold from hard rock, but mercury particles would wash through the sluice before they could settle and be confined. The accumulated mercury in river sediments pose a risk to human health through consumption of contaminated fish, drinking potentially unsafe water, and improper handling of sediments (USGS, 2005). From an environmental standpoint, mercury methylation and biomagnificaiton are a problem, especially when the biomagnificaiton occurs in great geographic distribution. Many environmental factors such as temperature, dissolved organic carbon levels, salinity, oxidation-reduction conditions, acidity (pH), and concentration of sulfur in the water and sediments influence the rates of mercury methylation as well as demethylation (USGS, 2005). In a statewide survey conducted by the SWRCB's Surface Water Ambient Monitoring Program, the fish tested for mercury in the tributaries of the Yuba River were the highest in the state (Yuba County IRWMP, 2015).

6.1.2 Hydrology and Hydraulics

The hydrology of the Yuba River watershed is complex, consisting of numerous dams, reservoirs, and diversion facilities that store and/or transfer water within and out of the basin, altering both the volume and pattern of water, sediment, organic material, and wildlife. Hydrology in the Yuba River watershed has been significantly altered through historic and current human activities. Initially these changes were driven by large scale hydraulic mining and were later driven by construction of dams, reservoirs, and diversions to address watershed issues and manage water resources. The primary factors affecting hydrology and hydraulics of the Yuba River watershed are historic and ongoing mining; the construction and operation of an extensive system of dams, reservoirs, and diversions; and land use changes.

6.1.3 Mining

The Yuba River suffered perhaps the most significant damage from hydraulic mining of any California river. Approximately 1.5 billion cubic yards of mining debris were washed into the Central Valley from five rivers, with the Yuba River accounting for 40 percent of that total (Mount 1995). Gilbert (1917) as cited in Yoshiyama et al. (2001) estimates that "*…during the period 1849-1909, 684 million cubic yards of gravel and debris due to hydraulic mining were washed into the Yuba River system – more than triple the volume of earth excavated during the construction of the Panama Canal*", and Beak Consultants, Inc. (1989) states "*The debris plain ranged from about 700 feet wide and up to 150 feet thick near the edge of the foothills to nearly 3 miles wide and 26 feet tall near Marysville*" (Beak Consultants, Inc. 1989).

Hydraulic gold mining during the second half of the 19th century resulted in 684 million cubic yards of gravel and debris washing into the Yuba River system. The material moved from the foothills to the valley floor where it raised the river bed by up to 100ft, resulting in increased frequency and intensity of floods. The California Debris Commission worked to mitigate the impacts of hydraulic mining by constructing debris dams, including Englebright Dam and Daguerre Point Dam, as well as dredging the debris deposited in the lower Yuba River. Dredging of the lower Yuba River continued past initial efforts driven by gold extraction, then later as a source of aggregate. Dredging has resulted in a large 10,000 acre area of undulating dredger spoils berms and ponds. The Goldfields area is porous and acts as a drain for the Lower Yuba River above Daguerre Point Dam.

6.1.4 Dam and Diversions

Dam construction and diversions in the Yuba watershed began to supply gold mining operations with necessary flow to support hydraulic nozzles. Later dams were constructed to sequester the large volumes of mine tailings moving downstream. Several large dams operated by various agencies were built for a variety of purposes, including water supply, flood control, hydroelectric power generation and sediment retention (James 2005). The contemporary system is elaborate and complex, consisting of several dams (including 6 over 150 ft in height, and over 50 additional smaller dams) with facilities in place to store and/or transfer water between the sub-watersheds of the Yuba Basin (i.e., North Yuba, Middle Yuba, South Yuba and Deer Creek), as well as out of basin transfers to major watersheds to the north and south (i.e., Feather River, Bear River and American River) (CBEC 2010).

The hydrology of the Yuba River has been altered by a series of reservoirs and water conveyance facilities that are operated for water supply, hydropower production, and flood control (Mitchell 2010).Three projects export significant amounts of water from the Yuba River watershed. South Feather Water and Power Agency (formerly Oroville-Wyandotte Irrigation District) diverts water from Slate Creek (a tributary to the North Yuba River) to the South Fork Feather River via its South Feather Power Project. PG&E's South Yuba Canal diverts water from the South Yuba River, some of which is consumptively used by the Nevada Irrigation District (NID) and some of which is released into the Bear River watershed. These diversions also support NID's Yuba-Bear Hydroelectric Project. PG&E's Drum-Spaulding Project diverts water from the South Yuba watershed, via the Drum Canal, to the Drum Forebay. If that water is used at PG&E's Drum Powerhouse, it is released to the Bear River watershed. If the water is not used there, it is released to Canyon Creek (a tributary of the North Fork American River), where it is eventually used for consumptive purposes by Placer County Water Agency and other entities.

The size and position within the Yuba Basin of these dams provide the ability to store large volumes of water, and therefore regulate the flow regime. The North Yuba has New Bullards Bar Reservoir, located relatively low in the watershed, functioning as the dominant flood control and water supply reservoir in the basin (LYRFTWG 2005). Storage capability in the Middle Yuba and South Yuba basins is comparably small, totaling ~307 thousand acre-feet (TAF), with Lake Spaulding, Bowman Lake, Jackson Meadows Reservoir, Fordyce Lake and several smaller impoundments located in the upper extents of the Yuba Basin (YCWA, 2009). The size and position of these impoundments allow the South Yuba and Middle Yuba to respond to larger precipitation and snow-melt events by sending large flood pulses downstream to Englebright Reservoir, and beyond to the lower Yuba River when the capacity of Englebright Reservoir is exceeded. Since 1969 when New Bullards Bar (the last of large dams built in the system) was completed, over 100 uncontrolled flow events have overtopped Englebright Dam.

6.1.5 Lower Yuba River Flows

The Yuba River downstream of Englebright Dam is a single-thread channel, confined in a bedrock canyon in the uppermost 2 miles, then transitions to a wider bedrock valley and finally, to a wide alluvial valley for 19 miles (YCWA 2013). In the lower Yuba River, Englebright and Daguerre Point Dams play an important role in the altered movement of water, sediment and organic matter.

Englebright is a 260ft concrete arch dam originally constructed to trap mining sediments and debris. The dam also provides for the generation of hydroelectric power, recreational activities, and serves as an afterbay for peak power generation at the New Colgate Powerhouse. During normal flow conditions, water is released from Englebright reservoir through PG&E's Narrows I hydropower facility and YCWA's Narrows II power facility. Water releases are administered by PG&E and YCWA to generate hydroelectric power, irrigation, and other beneficial uses. During high flows, unregulated flows pass over Englebright dam into the lower Yuba River.

Approximately halfway between Englebright Dam and the Yuba-Feather River confluence is Daguerre Point Dam. This 25 ft dam was originally constructed to trap hydraulic mining debris. In later years, the head of water created by the dam was leveraged to support several water diversions. Daguerre Point Dam affects the hydrology and hydraulics of the lower Yuba River by providing base level control for incision for the reach immediately upstream. The dam also creates a river stage differential; the river stage above Daguerre Point Dam is more than 20 feet greater than the river stage below the dam. As a result of this differential and as a result of the high permeability of the Goldfield's rocky soil, water from the Yuba River enters the Goldfield area from above Daguerre Point Dam and then migrates downgradient through the Goldfields, forming interconnected ponds and canals throughout the area (DWR, 1999). During all flows, water passes over the crest of the dam.

Despite the presence of several significant dams in the watershed, the lower Yuba River still experiences floods capable of inducing geomorphic changes to the mainstem (Pasternack 2009). A study of the geomorphic thresholds in the Timbuctoo Bend Reach identified several values including: 1) a preferential riffle scouring discharge of <11,000 cfs, 2) a preferential run scouring discharge range of ~9,000-25,000 cfs, 3) a preferential pool-scouring discharge of >45,000 cfs, and 4) a floodplain filling discharge of ~20,000 cfs (Pasternack 2009).

The past and present flood regime of the lower Yuba River is divided into two meaningful hydrologic periods: a transitional period, WYs 1904-1969, and the contemporary, regulated period, WYs 1970-2009, the period following the completion of all major storage projects within the basin (CBEC 2010). Regulation has reduced flood intensity in the lower Yuba River; flood flows with 67% ACE was reduced 67% from 20,100 cfs to 6,700 cfs; flood flows with a 20% ACE were reduced 40% from 61,400 cfs to 36,900 cfs (CBEC 2010). In addition to reducing peak flow values, the large storage reservoirs and in and out of basin transfers alter the annual runoff volume and pattern in the mainstem. In 2007 the Yuba River Accord established minimum flow requirements in the watershed (YCWA 2007) that maintain habitat suitability for fish and wildlife in the lower Yuba River.

In 1986, USACE developed a 1% ACE flood simulation model for the Yuba River to evaluate the effects of such an event. This model produced various flow and stage relationships at various points along the Yuba River. The flows modeled by USACE ranged from 5,000 cfs to a 100-year event of 135,000 cfs (DWR, 1999). The data obtained from USACE and Smartville gaging stations were also used to estimate flow event probabilities.

The lower Yuba River consists of the approximately 24-mile stretch of river extending from Englebright Dam, downstream to the confluence with the Feather River near Marysville. Recently, the RMT (2013) conducted specific studies to rigorously investigate spatial structure in the lower Yuba River by developing an approach to identify the fluvial geomorphologic dynamics affecting: (1) adult spatial structure components, including the availability of fish habitat for immigrating, holding, and spawning adult salmonids; and (2) the seasonal availability of rearing habitat for 1 juvenile salmonids. The RMT (2013) morphological unit and mesohabitat classification studies: (1) identified morphological units throughout the lower Yuba River; (2) evaluated the quality, number, size and distribution of mesohabitats for various life stages of adult and juvenile anadromous salmonids; and (3) evaluated the maintenance of watershed processes in the lower Yuba River. Part of the RMT (2013) process included the identification of morphological reaches in the lower Yuba River, identified and described in Table 6.

Table 6. Morphological reaches and delineating transparent geomorphic features in the lower Yuba River

Reach	Description
Englebright Dam Reach	Englebright Dam to confluence with Deer Creek
Narrows Reach	Deer Creek to onset of emergent gravel floodplain
Timbuctoo Bend Reach	Emergent gravel floodplain to upstream of Blue Point Mine
Parks Bar Reach	Upstream of Blue Point Mine to Highway 20 Bridge
Dry Creek Reach	Highway 20 Bridge to Yuba River confluence with Dry Creek
Daguerre Reach	Yuba River confluence with Dry Creek downstream to Daguerre Point Dam
Hallwood Reach	Daguerre Point Dam downstream to Eddie Drive aims at Slope Break
Marysville Reach	Eddie Drive aims at Slope Break downstream to the mouth of the lower Yuba River

Source: RMT 2013

7.0 Effects Determination and Conclusion

7.1 Effects of the proposed action to the listed species

Valley Elderberry Longhorn Beetle: Because field surveys have not been conducted at the project site, the presence of VELB is unknown. Pre-project field surveys would be conducted by a qualified biologist to detect the presence of the species and/or their habitat. If the species is located within the Action Area, there is the potential to cause temporary disturbance which may adversely affect the VELB. If possible a 100 foot buffers would be used, which is considered complete avoidance (USFWS 1999). With the proposed avoidance and mitigation measures implemented during construction, the impact to VELB would be minimal.

Because the elderberry is the sole host plant of the VELB, any activities that adversely impact the elderberry shrub may also adversely impact the VELB. Adverse impacts to elderberry shrubs can occur either at a habitat scale or at an individual shrub scale. Activities that reduce the suitability of an area of elderberry plants or elderberry recruitment and increase fragmentation may have adverse impacts to mating, foraging, and dispersal of VELB. The patchy nature of VELB habitat and habitat use makes the species particularly susceptible to adverse impacts from habitat fragmentation. The proposed alternative is not likely to adversely affect the VELB.

***California Red Legged Frog*:** The nearest known occurrence of the California Red Legged Frog is approximately 15.45 miles away and was recorded in 2013. The recorded location is not hydrologically connected to the project area. Furthermore, there is low quality habitat with minimal riparian cover within the project area and there are known predators (bullfrogs and predatory fish) on the lower Yuba River. Given these considerations, the CRLF is not expected to occur in the project area and therefore the proposed alternative is not likely to adversely affect the species.

***Western Yellow Billed Cuckoo*:** Based on the necessary habitat requirements for the western Yellow Bill Cuckoo and nearest known recorded occurrence of the species, there is a low possibility for the species within the project area. Furthermore, much of the riparian habitat within and along the lower Yuba River is patchy and not large enough to be considered suitable habitat. Pre-project surveys would be conducted by a qualified biologist to further detect the presence of the species and/or their habitat. With the proposed avoidance and mitigation measures and BMPs implemented during construction, impacts to the western yellow billed cuckoo would be minimal and the proposed alternative would not likely adversely affect the species.

7.2 Cumulative effects

The Federal ESA requires NMFS and USFWS to evaluate the cumulative effects of the proposed actions on listed species and designated critical habitat, and to consider cumulative effects in formulating Biological Opinions. Cumulative effects are defined by Federal regulations as "…those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR 402.02). Cumulative effects must be considered in the analysis of the effects of the Proposed Action (50 CFR 402.12(f)(4)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Federal ESA. Federal actions, including, but not limited to FERC relicensing, maintenance and operation of dams, reservoirs, and diversions, restoration projects, management of fisheries, management of dams, and land management activities are, therefore, not included. For the purposes of this BA, the area of cumulative effects analysis is defined as the lower Yuba River from Englebright Dam to the confluence of the Yuba and Feather Rivers.

In general, private or State activities that may occur in the action area and result in cumulative effects include changes to ongoing mining activities, changes to water diversion activities, and /or changes to agricultural practices. Sand and gravel mining operations along the lower Yuba River, especially in the Yuba Goldfields, are ongoing, including operations by Teichert Aggregates, Western Aggregates, and Baldwin Contracting Company and Springer Family Trust Hallwood Aggregate. Mining activities could disrupt or remove naturally recovering patches of vegetation that support riparian habitats that listed species rely on. Mining activities at these facilities is ongoing, and future potential effects to listed species from their operation would likely be similar to the current conditions; however, periodically changes are made to the intensity and location of mining activities, which could result in a larger or smaller cumulative impact.

Direct water diversions from the lower Yuba River include Browns Valley Irrigation District Diversion, South Yuba/Brophy Diversion Canal and Facilities, and the Hallwood-Cordua North Canal. It is generally expected that the continued operation of these diversions would be similar to existing conditions and not represent a significant impact in the future; however, if changes were to occur to the frequency, duration, or amount of diverted water, cumulative impacts, primarily to water quality and dependent habitats could occur. Changes in surrounding area land use, including agricultural and urban activities as described in the Yuba County General Plan Update (Yuba County 2015), could result in further degradation to conditions that support wildlife and natural habitats, including listed species and their habitat. A number of other commercial and private activities, including timber harvest, recreation, as well as urban and rural development, could potentially affect listed species along the lower Yuba River.

7.3 Conclusion

The proposed alternative may affect, and is likely to adversely affect the VELB. The proposed alternative may affect, but is not likely to adversely affect the California Red Legged Frog and the western Yellow Billed Cuckoo. While the construction may have temporary impacts on the species, these adverse effects will be limited and minimized with the use of avoidance and minimization measures and BMPs. Overall the project would be beneficial for VELB as it intends to increase the area of riparian habitat and it would also help create a more continuous riparian over story for the species to easily disperse. It would also be beneficial for the CRLF by creating backwater habitats, providing woody material, and shade. The western Yellow Billed Cuckoo would also benefit from the additional riparian plantings and creation of a more complex riverine system. Overall, the proposed alternative would provide benefits to the lower Yuba River ecosystem functions and services.

8.0 Literature Cited

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(NMFS) John H. Stadler1 , Kerry F. Griffin2 , Eric J. Chavez1 , Brian C. Spence1 , Phil Roni1 , Charleen A. Gavette1 , Barbara A. Seekins1 , and Adam K. Obaza1. "Pacific Coast Salmon 5-Year Review of Essential Fish Habitat Final Report to the Pacific Fishery Management Council." 25 May 2011.

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Attachment 1 – Official USFWS Species List – Obtained through USFWS ECOS-IPaC website August 16, 2017.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
Phone: (916) 414-6600 Fax: (916) 414-6713

In Reply Refer To: August 16, 2017
Consultation Code: 08ESMF00-2017-SLI-2945
Event Code: 08ESMF00-2017-E-08073
Project Name: Yuba River Ecosystem Restoration Feasibility Study

Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, under the jurisdiction of the U.S. Fish and Wildlife Service (Service) that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

Please follow the link below to see if your proposed project has the potential to affect other species or their habitats under the jurisdiction of the National Marine Fisheries Service:

http://www.nwr.noaa.gov/protected_species/species_list/species_lists.html

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
(916) 414-6600

Project Summary

Consultation Code: 08ESMF00-2017-SLI-2945

Event Code: 08ESMF00-2017-E-08073

Project Name: Yuba River Ecosystem Restoration Feasibility Study

Project Type: LAND - RESTORATION / ENHANCEMENT

Project Description: River Restoration

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/39.203251819066466N121.44995268764443W

Counties: Yuba, CA

Endangered Species Act Species

There is a total of 10 threatened, endangered, or candidate species on this species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

Birds

NAME	STATUS
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is a **proposed** critical habitat for this species. Your location is outside the proposed critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

Reptiles

NAME	STATUS
Giant Garter Snake *Thamnophis gigas* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4482	Threatened

Amphibians

NAME	STATUS
California Red-legged Frog *Rana draytonii* There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2891	Threatened

Fishes

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. Species profile: https://ecos.fws.gov/ecp/species/321	Threatened
Steelhead *Oncorhynchus (=Salmo) mykiss* Population: Northern California DPS There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1007	Threatened

Insects

NAME	STATUS
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus* There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7850	Threatened

Crustaceans

NAME	STATUS
Conservancy Fairy Shrimp *Branchinecta conservatio* There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8246	Endangered
Vernal Pool Fairy Shrimp *Branchinecta lynchi* There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. Species profile: https://ecos.fws.gov/ecp/species/498	Threatened
Vernal Pool Tadpole Shrimp *Lepidurus packardi* There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2246	Endangered

Flowering Plants

NAME	STATUS
Hartweg's Golden Sunburst *Pseudobahia bahiifolia* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1704	Endangered

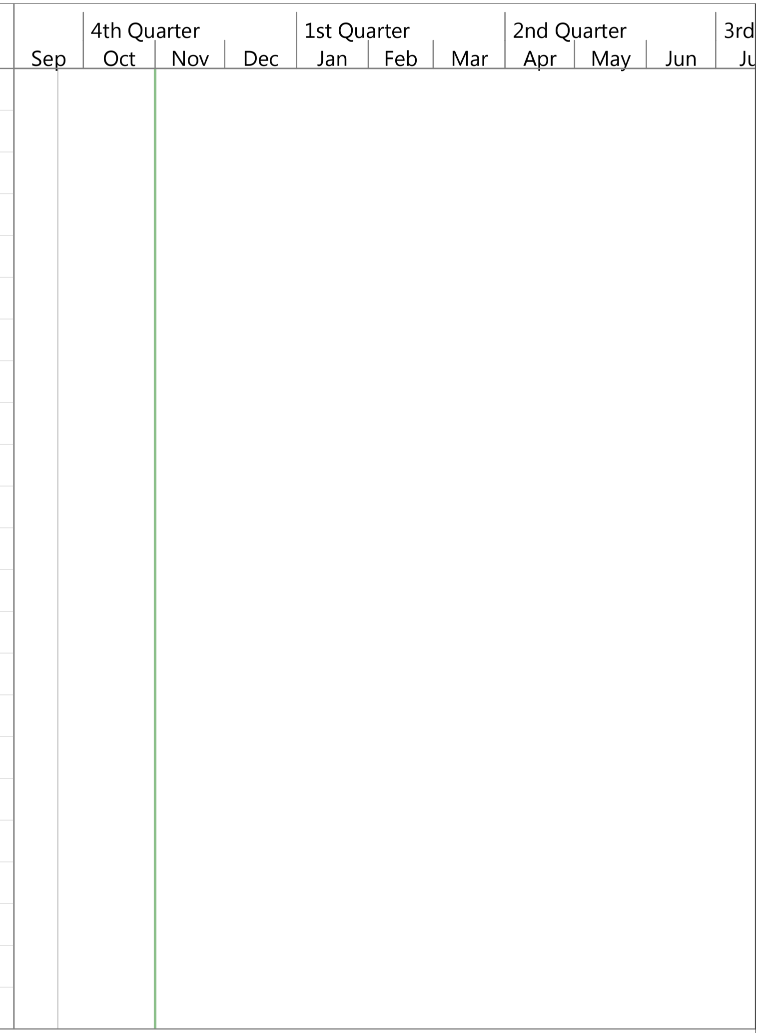
Critical habitats

There are 7 critical habitats wholly or partially within your project area under this office's jurisdiction.

NAME	STATUS
Chinook Salmon *Oncorhynchus (=Salmo) tshawytscha* Population: Central Valley spring-run ESU For information on why this critical habitat appears for your project, even though Chinook Salmon is not on the list of potentially affected species at this location, contact the local field office. https://ecos.fws.gov/ecp/species/8091#crithab	Final designated
Chinook Salmon *Oncorhynchus (=Salmo) tshawytscha* Population: California Coastal ESU For information on why this critical habitat appears for your project, even though Chinook Salmon is not on the list of potentially affected species at this location, contact the local field office. https://ecos.fws.gov/ecp/species/8091#crithab	Final designated
Steelhead *Oncorhynchus (=Salmo) mykiss* Population: Northern California DPS https://ecos.fws.gov/ecp/species/1007#crithab	Final designated
Steelhead *Oncorhynchus (=Salmo) mykiss* Population: South-Central California Coast DPS https://ecos.fws.gov/ecp/species/1007#crithab	Final designated
Steelhead *Oncorhynchus (=Salmo) mykiss* Population: Central California Coast DPS https://ecos.fws.gov/ecp/species/1007#crithab	Final designated
Steelhead *Oncorhynchus (=Salmo) mykiss* Population: California Central Valley DPS https://ecos.fws.gov/ecp/species/1007#crithab	Final designated
Steelhead *Oncorhynchus (=Salmo) mykiss* Population: Southern California DPS https://ecos.fws.gov/ecp/species/1007#crithab	Final designated

Attachment 2 – Project Schedule for Construction

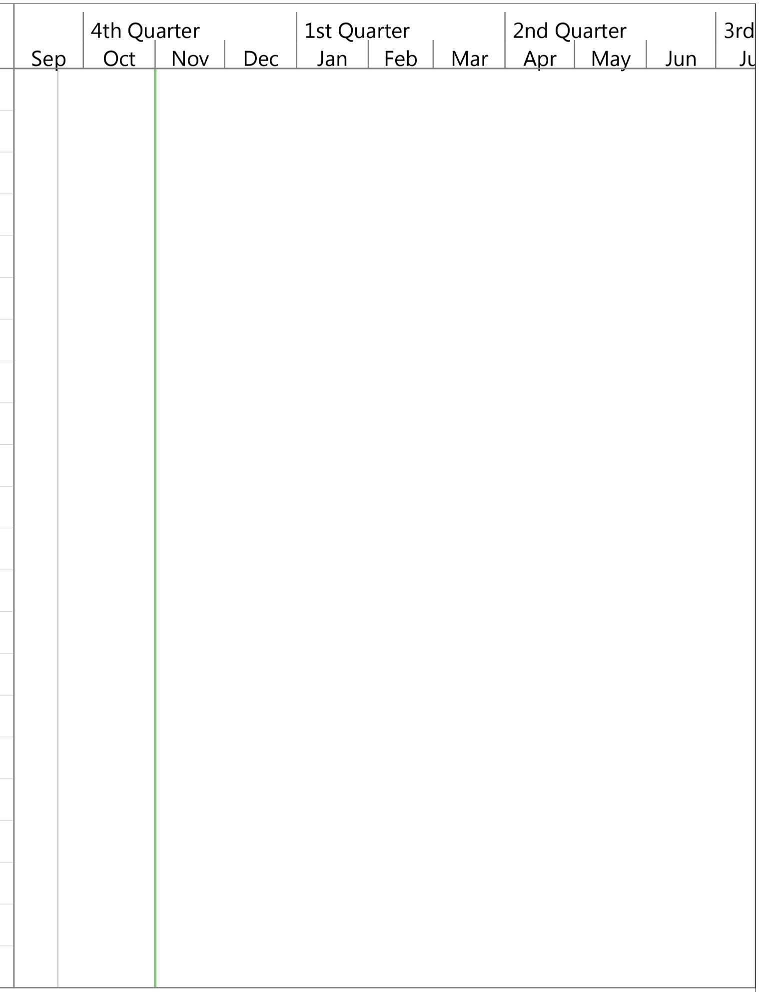
ID		Task Mode	Task Name	Duration	Start	Finish
1			**Construction Year 1**	**152 days**	**Mon 5/3/21**	**Tue 11/30/21**
2			**Boulders and LWM**	**109 days**	**Mon 5/3/21**	**Thu 9/30/21**
3			Staging (Boulder/Large Wo	22 days	Mon 5/3/21	Tue 6/1/21
4			Placement of Boulders and	87 days	Wed 6/2/21	Thu 9/30/21
5			**Excavation**	**109 days**	**Mon 5/3/21**	**Thu 9/30/21**
6			Staging (Excavation)	21 days	Mon 5/3/21	Mon 5/31/21
7			Excavation (in-water work)	88 days	Tue 6/1/21	Thu 9/30/21
8			**Plantings**	**65 days**	**Wed 9/1/21**	**Tue 11/30/21**
9			Scout and Mark Trees	22 days	Wed 9/1/21	Thu 9/30/21
10			Harvest an Transport Trees	43 days	Fri 10/1/21	Tue 11/30/21
11			Stinger Site, Install Planting	43 days	Fri 10/1/21	Tue 11/30/21
12			**Construction Year 2**	**152 days**	**Tue 5/3/22**	**Wed 11/30/22**
13			**Boulders and LWM**	**109 days**	**Tue 5/3/22**	**Fri 9/30/22**
14			Staging (Boulder/Large Wo	22 days	Tue 5/3/22	Wed 6/1/22
15			Placement of Boulders and	87 days	Thu 6/2/22	Fri 9/30/22
16			**Excavation**	**109 days**	**Tue 5/3/22**	**Fri 9/30/22**
17			Staging (Excavation)	21 days	Tue 5/3/22	Tue 5/31/22
18			Excavation (in-water work)	88 days	Wed 6/1/22	Fri 9/30/22
19			**Plantings**	**65 days**	**Thu 9/1/22**	**Wed 11/30/22**
20			Scout and Mark Trees	22 days	Thu 9/1/22	Fri 9/30/22
21			Harvest an Transport Trees	43 days	Mon 10/3/22	Wed 11/30/22
22			Stinger Site, Install Planting	43 days	Mon 10/3/22	Wed 11/30/22
23						



Project: Project1
Date: Wed 11/1/17

Task	Inactive Summary	External Tasks
Split	Manual Task	External Milestone
Milestone	Duration-only	Deadline
Summary	Manual Summary Rollup	Progress
Project Summary	Manual Summary	Manual Progress
Inactive Task	Start-only	
Inactive Milestone	Finish-only	

ID	Task Mode	Task Name	Duration	Start	Finish
24		**Construction Year 3**	**152 days**	**Wed 5/3/23**	**Thu 11/30/23**
25		**Boulders and LWM**	**109 days**	**Wed 5/3/23**	**Mon 10/2/23**
26		Staging (Boulder/Large Wo	22 days	Wed 5/3/23	Thu 6/1/23
27		Placement of Boulders and	87 days	Fri 6/2/23	Mon 10/2/23
28		**Excavation**	**109 days**	**Wed 5/3/23**	**Mon 10/2/23**
29		Staging (Excavation)	21 days	Wed 5/3/23	Wed 5/31/23
30		Excavation (in-water work)	88 days	Thu 6/1/23	Mon 10/2/23
31		**Plantings**	**65 days**	**Fri 9/1/23**	**Thu 11/30/23**
32		Scout and Mark Trees	22 days	Fri 9/1/23	Mon 10/2/23
33		Harvest an Transport Trees	43 days	Tue 10/3/23	Thu 11/30/23
34		Stinger Site, Install Planting	43 days	Tue 10/3/23	Thu 11/30/23
35		**Construction Year 4**	**152 days**	**Fri 5/3/24**	**Mon 12/2/24**
36		**Boulders and LWM**	**109 days**	**Fri 5/3/24**	**Wed 10/2/24**
37		Staging (Boulder/Large Wo	22 days	Fri 5/3/24	Mon 6/3/24
38		Placement of Boulders and	87 days	Tue 6/4/24	Wed 10/2/24
39		**Excavation**	**109 days**	**Fri 5/3/24**	**Wed 10/2/24**
40		Staging (Excavation)	21 days	Fri 5/3/24	Fri 5/31/24
41		Excavation (in-water work)	88 days	Mon 6/3/24	Wed 10/2/24
42		**Plantings**	**152 days**	**Fri 5/3/24**	**Mon 12/2/24**
43		Scout and Mark Trees	22 days	Fri 5/3/24	Mon 6/3/24
44		Harvest an Transport Trees	43 days	Thu 10/3/24	Mon 12/2/24
45		Stinger Site, Install Planting	43 days	Thu 10/3/24	Mon 12/2/24



Project: Project1
Date: Wed 11/1/17

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

Environmental Appendix D
Attachment 3

Clean Water Act Section 404(b)(1) Evaluation
Yuba River Ecosystem Restoration Feasibility Study

November 2017

U.S. Army Corps of Engineers

Sacramento District

Contents

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This document constitutes the Statement of Findings, and review and compliance determination according to the Section 404(b)(1) guidelines for the proposed work (preferred alternative; proposed project). This analysis has been prepared in accordance with 40 CFR Part 230- Section 404(b)(1) guidelines and USACE Planning Guidance Notebook, ER 1105-2-100.

1.0 Project Description

1.1 Proposed Project

The proposed project is a cooperative effort between the United States Army Corps of Engineers (Corps) and Yuba County Water Agency (YCWA), the non-federal sponsor. This document is an attachment to an integrated Feasibility Report/ Environmental Assessment (FR/EA) and portions of the FR/EA will be referenced throughout this document to describe the existing conditions near the project site, as well as some potential impacts of the proposed project and other alternatives. The lower Yuba River would require a discharge of fill material into waters of the U.S. under Section 404 of the Clean Water Act. The following subsections describe measures proposed for all three alternatives and identify any possible discharge of fill material associated with each measure. Additional information about the measures can be found in Chapter 3 of the FR/EA.

1.2 Location

The overall project area is located northeast of Marysville, Yuba County, within and adjacent to the lower Yuba River. The overall project is nested within the 3,400 square miles Yuba River Watershed is part of the larger Sacramento River basin. The Yuba River Watershed is located on the western slopes of the Sierra Nevada Mountain Range and located within portions of Sierra, Placer, Yuba, and Nevada Counties (Figure 1). The lower Yuba River is the combined flow of the North Fork, Middle Fork, and South Fork of the Yuba River. The primary components of the project are located below the ordinary high water mark of the lower Yuba River. Staging areas would be located primarily in agricultural, forested, grassland, and barren areas. Access would occur along previously established roads (both paved and un-paved) located primarily in agricultural areas.

1.3 Purpose and Need

The project purpose and objective is to identify problems and opportunities associated with ecosystem degradation in the Yuba River watershed; to formulate, evaluate, and screen potential solutions to these problems; and to recommend a series of actions and projects that have a Federal interest and are supported by a local entity willing to provide the necessary items of local cooperation.

While the overall goal of the study is to restore degraded ecosystem structure, function, and dynamic processes of the Yuba River watershed to a less degraded, more natural condition. Based on the problems identified in the area planning study objectives include:

- Improve the quantity, quality, and complexity of aquatic habitats.
- Improve the quantity, quality, complexity, and connectivity of riparian habitats.
- Restore longitudinal river connectivity.
- Restore lateral connectivity of the river to its floodplain

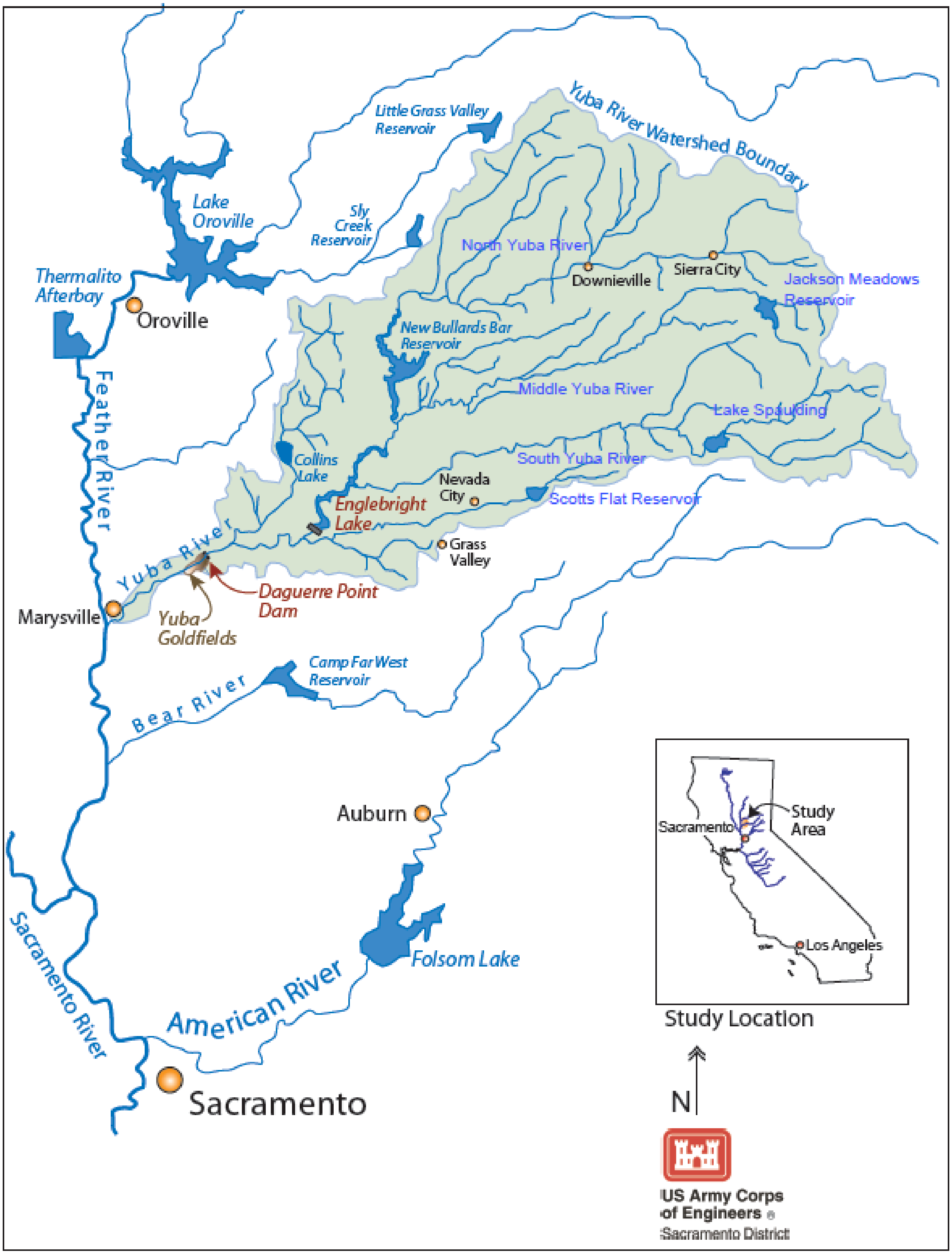

Figure 1. Yuba Watershed.

The current state of riparian and aquatic ecosystems in the Yuba Watershed was largely shaped by extensive hydraulic mining during the late 1800s. Hydraulic mining was the practice of using high pressure water cannons to dislodge rock material or move sediment. The resulting water-sediment slurry was directed through sluice boxes to remove gold or other desirable minerals. Hydraulic mining resulted in torrents of sediment transported downslope, causing rapid aggradation and exacerbating flooding along the lower Yuba River. Public backlash was significant and prompted lawsuits and government intervention. In 1893, Congress passed the Camenitti Act which established the California Debris Commission (CDC) as a regulatory body charged with restoring and protecting the navigability of rivers.

Much of the waste material dislodged by hydraulic mining settled where the grade of the river flattened. The natural riverbed then became suffocated under millions of cubic yards of cobble. Today, many sections of the Lower Yuba River remain primarily composed of cobble and large gravel. The coarse substrate is unfavorable for the natural recruitment of riparian vegetation. Efforts to control the river have further altered natural hydrologic and sediment transfer regimes. The CDC built Daguerre Point and Englebright Dams to prevent additional mining debris from washing downstream and into the Feather and Sacramento Rivers. The Water Resources Development Act of 1986 eliminated the CDC and transferred Daguerre Point and Englebright Dams to USACE.

Due to vast anthropogenic modifications along the lower Yuba River, the quality of aquatic habitat has been degraded by reduced water volume; altered depth, velocity, temperature, substrate, and oxygen levels; and introduced heavy metals. Riparian habitats have also been diminished in quantity, degraded in quality, and fragmented by conversion to agricultural fields and reservoirs; accumulation of mining deposits; and reduced fine sediments. River connectivity has been altered and reduced by hydro-periods and sediment transport leading to blockage and impaired passage of migrating fish. In addition to the longitudinal river impairment, the lateral river connectivity has also been reduced due to disconnection of the river from the floodplain.

1.4 Authority

The authority to study the Sacramento River Basin for flood control and allied purposes, including ecosystem restoration, was granted in the Rivers and Harbors Act of 1962, P.L. 87-874, Section 209, which reads:

> *The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements…in drainage areas of the United States and its territorial possessions, which include the following named localities…Sacramento River Basin and streams in northern California draining into the Pacific Ocean for the purposes of developing, where feasible, multi-purpose water resource projects, particularly those which would be eligible under the provisions of Title III of Public Law 85-500.*

Title III of Public Law 85-500 concerns water supply. On 28 April 2016, a Senate Committee Resolution clarified that ecosystem restoration is to be included in the investigation.

Resolved by the Committee on Environment and Public Works of the United States Senate, that the Secretary of the Army, pursuant to the Rivers and Harbors Act of 1962, Pub. L. 87-874 § 209, is requested to investigate ecosystem restoration opportunities in the Sacramento River Basin and streams in northern California draining into the Pacific Ocean, including the Yuba River watershed.

Further information on authorization for the Yuba River Ecosystem Restoration Study is also discussed in Chapter 1 of the FR/EA.

1.5 Alternatives [40 CFR 230.10]

Three alternatives are evaluated: Alternative 1 -No action alternative, Alternative 5 (TSP), and Alternative 6. Chapter 3 of the FR/EA also discusses several other alternatives that were previously considered, but have since been screened from consideration. Discussion of the current alternatives is below:

Alternative 1- No action

If no Federal action is taken, the Yuba River ecosystem-related problems existing today are expected to continue, and stressors will persist and potentially become exacerbated. Populations of Chinook salmon, steelhead, and water-birds will continue to be significantly reduced from historic conditions. Connectivity of the riverine aquatic habitat will continue to be curtailed by the presence of large dams in the watershed. Regeneration of riparian habitat will continue to be impeded by coarse substrate conditions. Incremental improvements to currently accessible habitat may be made by other entities. However, the cost of large scale excavation is likely a barrier to other entities and the sites requiring minimal excavation have already been addressed, leaving the most problematic and expensive sites in the current state of degradation.

Although the No Action Alternative would not impact waters of the U.S., it does not meet the project purpose since it does not address ecosystem restoration in the study area, and is, therefore, not considered to be one of the least environmentally damaging practicable alternatives (LEDPA) or be discussed further in this document.

Alternative 5 (TSP)

Alternative 5 consists of ecosystem restoration in Habitat Increments 2, 3a, 5a, and 5b, at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, Bar C, Lower Gild Edge Bar, Hidden Island, First Island, Silica Bar, and North Silica Bar, which would result in approximately 178.6 acres of restored habitat by lowering the floodplain to facilitate inundation and riparian vegetation planting. The total cost of this alternative is 89.4 million.

A full description of Alternative 5 can be found in Chapter 3 of the FR/EA. This alternative is considered practicable and will be retained. An evaluation of the impacts of Alternative 5 will be discussed throughout this document in order to determine if it is the least environmentally damaging practicable alternative (LEDPA).

Alternative 6:

Alternative 6 includes increments 2, 5b, 5a, 3a, and 1 at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, Bar C, Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, North Silica Bar, and Upstream of Highway 20, which would result in 197.8 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation. The total cost of this alternative is $109.6 million.

A full description of Alternative 6 can be found in Chapter 3 of the FR/EA. This alternative is considered practicable and will be retained. An evaluation of the impacts of Alternative 6 will be discussed throughout this document in order to determine if it is the least environmentally damaging practicable alternative (LEDPA).

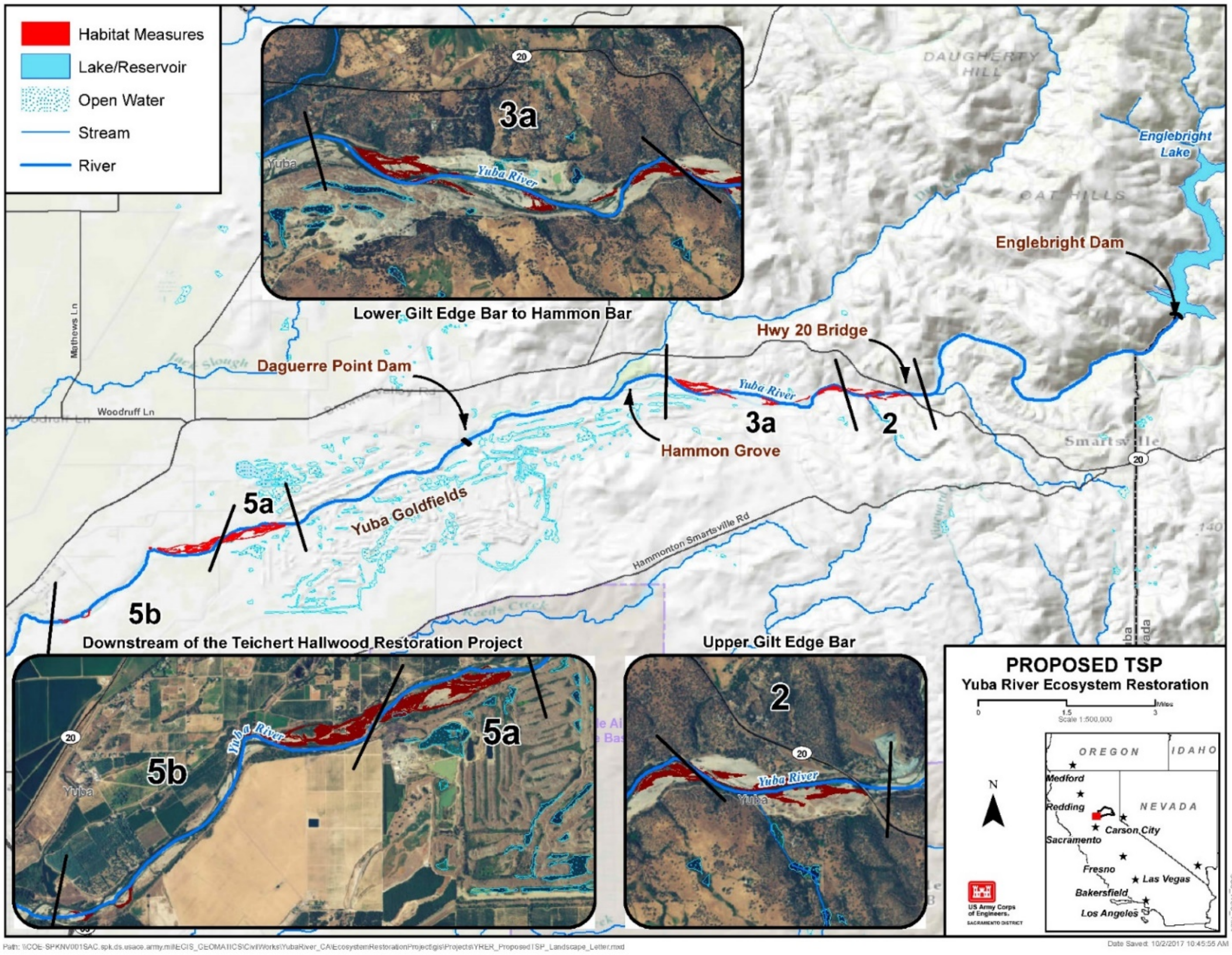

Figure 2. Tentatively Selected Plan.

1.6 General Description of Dredged or Fill Material

The following sections only pertain to project actions that would directly impact waters of the U.S..

1.6.1 General Characteristics of Material

Fill is required below the ordinary high water mark for the purposes of 1) placement of large wood material anchored by cables, boulders, and pins (Engineered Log Jams) 2) deposition of rock/sediment, 3) installation of boulders. Temporary fill below the ordinary high water mark may include the use of construction mats and dewatering equipment. Excavation of sediment (cobbles and soil) within the floodplain would occur for the creation of side channels and lowering the floodplain.

Large Woody Material (LWM)

Where woody material is described as an addition to bankline, assume woody features are 25 feet in length and 2 feet in diameter. The material will be anchored in the bankline at a 45 degree angle downstream and protrude one third of its total length beyond the bankline into the channel. The floodplain application is where woody material is placed on a floodplain or seasonally inundated area, the woody material will be placed parallel with the flow, anchored with cables boulders and pins.

Boulders

Boulders weighing 5 tons and measuring 1 meter in diameter will be used to slow or modify velocities in certain areas. The quantity and placement of boulders incorporated into the restoration actions will be determined during PED pending site specific design, including refined hydraulic modeling.

1.6.2 Quantity of Material

The total amount of fill material placed in the lower Yuba River is not known at this time. The quantities and placement of large woody material, ELJs, and boulders would be determined during site specific design in PED.

1.6.3 Source of Material

The fill material for project would likely come from licensed facilities within 50 miles of the project site that meet the applicable standards and requirements. Cutting for planting would be sourced from local existing vegetation.

1.7 Description of Proposed Discharge Site

1.7.1 Location

The location of the discharge sites would be in designated locations within the lower Yuba River. Specifically Alternative 5, would include sites at Increments 2, 3a, and 5. At Increment 2, just downstream of the Highway 20 bridge at Upper Gilt Edge Bar, riparian planning would occurring along the river banks and Large Woody Material would be inserted along the areas where bank scalloping was done. Further downstream in Increment 3a, Lower Gilt Edge Bar to Hammon Bar, Engineered Log Jams would be placed to stabilize the channel, Large Woody Material would be inserted in a side channel/backwater areas, and riparian planting would occur at many portions throughout. At Increment 5, below the Teichert Hallwood Restoration project, a historical channel alignment on the north side of Bar C would be restored to inundate at 3,000 cfs and function as swale habitat. The side channel and adjacent floodplain would be lowered and graded. Additionally, riparian vegetation would be planted on each side of the restored swale/side channel. ELJs would be placed in a patchwork configuration at the inflow of the swale, at the upstream end of Bar C. In addition, LWM would be placed in the backwater area at the downstream end of Bar C to increase structural and habitat complexity in the area. A historical channel alignment on the south side of the bar would be restored by lowering and grading a side channel within a stand of riparian vegetation. The side channel would extend into an existing backwater habitat located at the downstream edge of the Yuba Goldfields. The floodplain on the north side of the side channel would be lowered and planted with riparian vegetation. Boulder structures would be placed to provide hydraulic stability at the inflow section of the side channel at the upstream end of Bar C. .

Alternative 6 would include all of the above Increments with the addition of Increment 1. Increment 1 would create a new side channel using cobble or armored stone, plant riparian vegetation in side channel locations and adjacent to the lower Yuba River. At all of the Increment locations, materials would be excavated to lower the floodplain, create side channels and backwater areas, and create bank scallops. The excavated material would be hauled off to a commercial disposal site. The specific disposal location has yet to be decided upon, but would be within a 20 mile radius of the project study area.

1.7.2 Size

An aquatic resource delineation has not been conducted, but waters within the study area are assumed to be jurisdictional under Section 404 of the Clean Water Act. Restoration actions would occur along approximately 12.6 miles of the lower Yuba River, but the discharge sites would not exceed 178.6 acres.

1.7.3 Type of Site

The type of disposal site is within the river bed and adjacent to the lower Yuba River.

1.7.4 Type of Habitat

The following habitat types were identified at and adjacent to the study area:

Riverine: The lower Yuba River is located within the study area and would be impacted by the placement of fill into waters of the U.S. The lower Yuba River is a perennial river subject to section 404 of the Clean Water Act, it is not a navigable waterway under Section 10 of the Rivers and Harbors Appropriation Act of 1899. The riverbed is generally composed of gravel/cobble, minimal bedrock, and sediment. Vegetation is largely absent from the riverbed, except on areas where sediment accumulations, depth, and water flow allow for the establishment of plants such as sand/gravel bars or shallow banks.

Barren: This habitat type is defined by the absence of vegetation, any habitat with less than 2% total vegetation cover of herbaceous, desert, or non-wildland species and less than 10% cover by tree or shrub species qualifies. Much of the barren nature of the lower Yuba River is due to anthropogenic mining input.

Valley Foothill Riparian Habitat: The valley foothill riparian habitat is transitional and present between aquatic and upland zones that develops along flood plains of low-gradient rivers and streams. Dominant species present include Cottonwood (Populus spp.), California (western) sycamore (Platanus racemosa), and valley oak (Quercus lobata). Subcanopy trees include white alder (Alnus rhombifolia), box elder (Acer negundo var. californica), and Oregon ash (Fraxinus latifolia). Typical understory shrub layer plants include wild grape (Vitis californica), wild rose (Rosa californica), California blackberry (Rubus ursinus), blue elderberry (Sambucus mexicana), poison oak (Toxicodendron diversilobum), buttonbush (Cephalanthus occidentalis), and willows (Salix spp.).

Other Land Cover types: Irrigated Row and Field Crops; Deciduous Orchards; Un-vegetated, Vacant, or Developed areas; and Barren (mining refuse) occur directly adjacent to, and in some cases partially within, the study area and are associated with human activities: The types of Irrigated Row and Field Crops is unknown, but commonly known types in the region are tomatoes, lettuce, and beets.

1.7.5 Timing and Duration of Discharge

If the project is authorized in 2019, construction activities could start as early as 2022. The following is a schedule showing the approval and construction phases of the project, assuming optimal funding.

- Division Commander's Notice FEB 2019
- Chief of Engineers Report JUL 2019
- Potential Authorization OCT 2019
- USACE and Sponsor sign Design Agreement NOV 2019
- Initiate PED 2019
- Initiate Construction 2022

- Complete Physical Construction 2025
- Complete Plant Establishment Period 2030
- Complete Monitoring 2035

Timing of construction would correspond to low water levels and species migratory patterns, when feasible, to minimize impacts to water quality and species. Physical construction would begin in 2022 and be completed by end of 2025.

1.8 Description of Disposal Method

Construction of the project may be performed using typical construction equipment such as motor graders, backhoes, bulldozers, track and wheel loaders, dump trucks, pavers, rollers, and similar equipment.

2.0 Factual Derterminations

2.1 Physical Substrate Determinations (Sections 230.11(a) and 230.20)

2.1.1 Comparison of Existing Substrate and Fill

The substrate currently within the project area primarily consists of gravel/cobble, minimal bedrock, and sediment. Vegetation is largely absent from the riverbed, except on areas where sediment accumulations, depth, and water flow allow for the establishment of plants such as sand/gravel bars or shallow banks. Sediment size within the project area varies, consisting of silt, sand, gravel, cobble, and boulders. According to the NRCS' Soil Survey Geographic database, Soils present onsite include: Riverwash, dumps, Auburn-Sobrante, Sobrante-Timbuctoo, Redding-Corning, Tujunga, Holillipah, and Shanghai. The large majority of soils are categorized as Riverwash. Dumps, and Tujunga (SoilWeb 2017). No vegetation is expected to be removed from the project site.

The material that will be discharged at the project site consists of organic substrate as in boulders, large woody material, and riparian plantings. No soil material will be discharged at the project site within waters of the U.S., but cobble material may be used in creation of side channels. The cobble for side channel creation would be harvested from the project location. Alternative 5 and Alternative 6 would have similar effects in terms of the type of discharge material.

2.1.2 Changes to Disposal Area Elevation

On average, the elevations within the project area range from 158 to 285 feet above mean sea level. The change in elevation at the disposal sites within the project area due to the discharge of fill material would be minimal. The discharge of large woody material, boulders, and tree cuttings would not significantly change the base elevation. The elevation at other locations, outside of the direct disposal site, are not expected to occur as a result of erosion, slumpage, or other movement of the discharged fill material. It's possible that the riparian plantings and the large wood material may accumulate sediment over time, but this would increase the amount of organic sediment within the river channel and provide suitable material for riparian grown, which is currently absent within the river system. This sort of sediment accumulation is difficult to quantify, but is expected to be small and within the natural amount for the river system. While not a discharge of fill material, as the fill will be hauled off site, the greater elevation change would occur from excavation of riverbed material.

In both Alternative 5 and Alternative 6, the elevation changes would be similar and have the same effects.

2.1.3 Migration of Fill

The discharge of fill material associated with this project is not expected to migrate over time. The large woody material which would be placed below within the floodplain is placed parallel with the flow and anchored with cables, boulders, and pins (known as an Engineered Log Jam). The riparian plantings have the potential to move in high flow events before they're well established. Once established, the plants are expected to stay in place as well as help avoid erosion or scouring. In the event of a high flow situation, there is the possibility that the discharged fill material associated with this project may washed down stream. Due to the small volume and locations of the fill material in this project, the effect they would have on the river and riparian system if migrated downstream would be minimal.

A temporary increase in sedimentation and turbidity could occur within the river during earth moving activities. These indirect effects would be reduced to less than significant with the implementation of BMPs discussed in Water Quality (Chapter 4 of the FR/EA).

The migration of fill material and the effects it would have on the riverine and riparian environments would be similar for both Alternative 5 and Alternative 6

2.1.4 Duration and Extent of Substrate Change

There would be a permanent discharge of fill material into waters of the U.S. in both Alternative 5 and Alternative 6. The fill material would be placed in specific locations, as described in Chapter 3 of the FR/EA, within the river channel and floodplain to emulate a natural system and help restore the degraded quality of the system. While not a discharge of fill material, there would be a large amount of native substrate within the project area removed.

2.1.5 Changes to Environmental Quality and Value

The current riverine and riparian systems within the project area are highly degraded, both Alternative 5 and Alternative 6 would increase the quality and quantity of the environment. Riparian plantings would provide needed woody structure and create species and structural diversity. Insertion of the Engineered Log Jams would be to replicate the complexity of the natural system and gather spawning gravels and provide suitable habit for invertebrates and fish. Both the riparian plantings and Engineered Log Jams would reduce bank erosion while at the same time add stream habitat. In addition, they would also help control the morphology and grade of the river system. An overall increase in quality and value would occur in both Alternative 5 and Alternative 6.

Additional information on vegetation and wildlife, fisheries resources, special status species and impacts to those resources can be found in Chapter 4 of the FR/EA.

2.1.6 Actions to Minimize Impacts

Construction activities would have short-term and minor impacts. In-water project work would occur during low flow period and standard erosion prevention practices would be employed. With the implementation of BMPs and avoidance, minimization, and mitigation measures discussed in Chapter 4 of the FR/EA the impacts to erosion and transport of soils and substrate would be minimized.

2.2 Water Circulation, Fluctuation, and Salinity Determinations

2.2.1 Alteration of Current Patterns and Water Circulation

Alternative 5 and Alternative 6 would both alter the current flow of the river as well, as alter the floodplain. Boulders and ELJs would be placed in conjunction with created aquatic habitat features (i.e. secondary channels) and would serve as hydraulic control features to maintain hydraulic conditions that support the stability and sustainability of these features. Boulders, large woody material, and ELJs may also be placed within a feature to further modify flows. The final quantity and placement of these features would be determined during site specific design in PED

Furthermore, the creation of side channels and lowering the flood plain would also alter the pattern of changing the direction water to go into the historic floodplain. This may affect the velocity of water in certain Increments, would help restore a more natural flow and create habitat diversity. These changes are not expected to negatively alter up or downstream functions. Alternative 5 and Alternative 6 would have similar impacts, but Alternative 6 would have a larger impact on the alternation of current patterns and circulation. Alternative 6 includes Increment 1 which creates a new side channel and lowers the flood plain in addition to the Increments of Alternative 5.

2.2.2 Interference with Water Level Fluctuation

The Yuba River system is regulated by upstream dams which allow a specific amount of water to be released. Major dams in the Yuba River watershed completed in dates from 1913 to 1969 include Spaulding, Bowman, Fordyce, Englebright, Jackson Meadows, and New Bullards Bar. Furthermore the lower Yuba River is currently operating under the Lower Yuba River Accord flow regime, which is a joint project between the Yuba County Water Agency and the United States Department of the Interior Bureau of Reclamation to manage the interests of nearly 17 stakeholders in the area to balance interests of irrigation, conservation, water supply, and fisheries concerns. This plan establishes a flow requirement to meet all of the above needs. Alternative 5 and Alternative 6 would not change the water level fluctuation patterns.

2.2.3 Salinity Gradients Alteration

Salinity gradients would not be affected.

2.2.4 Effects on Water Quality

Multiple factors affect the water quality of the Lower Yuba River including: hydroelectric power generation, dams and reservoirs, mining activities, urbanization, and timber harvesting. At least 6 dams are located within the Yuba River watershed. The physical, thermal, and chemical changes that occur from water being retained behind dams can greatly affect the downstream quality and temperature of the river.

The lower Yuba River experiences temperature fluctuation from inflows of Deer Creek (RM 22.7), irrigation diversions at Daguerre Point Dam (RM 11.6), and operational releases from Englebright Dam (RM 24). Furthermore, the general width to flow ratio in conjunction with low riparian cover provide opportunity for solar heating of the water. The water within the lower Yuba River can increase up to 7°C from the release at Englebright Dam to the City of Marysville (LYRA 2010), but this is seasonally dependent and influenced by amount of water released from Englebright Dam, solar input, and air temperature. Data taken near Marysville, showed that dissolved oxygen concentrations, total dissolved solids, pH, alkalinity, and turbidity are well within acceptable or preferred ranges for salmonids and other key freshwater organisms (USACE 2012). In 2007, instream flow requirements were memorialized by the Yuba Accord (YCWA 2007) to maintain suitable habitat in the lower Yuba River for fish and wildlife.

Mercury contamination from hydraulic mining in the watershed poses a risk to environmental and human health. Mercury was used in hydraulic gold mining to increase the removal of gold from hard rock, but mercury particles would wash through the sluice before they could settle and be confined.

The accumulated mercury in river sediments pose a risk to human health through consumption of contaminated fish, drinking potentially unsafe water, and improper handling of sediments (USGS, 2005). From an environmental standpoint, mercury methylation and biomagnificaiton are a problem, especially when the biomagnificaiton occurs in great geographic distribution. Many environmental factors such as temperature, dissolved organic carbon levels, salinity, oxidation-reduction conditions, acidity (pH), and concentration of sulfur in the water and sediments influence the rates of mercury methylation as well as demethylation (USGS, 2005).   In a statewide survey conducted by the SWRCB's Surface Water Ambient Monitoring Program, the fish tested for mercury in the tributaries of the Yuba River were the highest in the state (Yuba County IRWMP, 2015).

Water Chemistry

The proposed project has the potential to increase turbidity during in-water work. The use of construction equipment such as motor graders, backhoes, bulldozers, track and wheel loaders, dump trucks, pavers, rollers, and similar equipment would likely disturb sediment within the river channel and back areas. These activities also have the potential to mobilize mercury, but these affects are addressed in the Effects on Water Quality section above. Approved BMPs and water quality monitoring would be conducted in compliance with the Section 401 Water Quality Certification. Stormwater runoff has the potential to impact turbidity and pH of the reservoir. Stormwater discharges would be permitted under the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activities. All storm water discharges and activities would be monitored under the project Storm Water Pollution Prevention Plan (SWPPP). With appropriate BMPs and an approved SWPPP, impacts to turbidity and pH from stormwater runoff is anticipated to be minimal.

Appropriate measures implemented during the restoration acvitivities such as BMPs and a Spill Prevention, Control and Countermeasures Plan (SPCCP), would reduce temporary water chemistry impacts to less than significant.

Salinity

The project would not change salinity levels.

Clarity

Total suspended solids may temporarily impact the clarity of water column during construction. This is expected to be contained within the immediate project area. However, the reduction of clarity caused by construction activities would be short in duration and would return to pre-construction levels upon project completion.

Color

Dredging and placement of fill materials would temporarily induce a color change due to an increase in turbidity. However, conditions would return to pre-construction levels upon completion of the project.

Odor

The project would not affect odor.

Taste

The project would not affect taste.

Dissolved Gas Levels

Dissolved gas levels within the project vicinity would be temporarily affected during the project. Significant negative effects would be avoided through the implementation of an approved SWPPP.

Temperature

Temperature would be affected temporarily and permanently. Construction activities have the potential to increase localized turbidity which could affect the amount of light that can enter the water therefore affecting temperature. With Best Management Practices and mitigation measures the effects to temperature during construction would be minimized. Long term beneficial effects to temperature are expected to occur once the project is established. The riparian plantings would provide shade to help moderate stream temperatures and light penetration; and providing root structure and woody material that would help stabilize stream banks, moderate stream velocities, reduce channelization, and reduce erosion and suspended sediments. Excavating side channels and lowering the flood plain to emulate a natural riverine system would provide more consistent temperatures.

Nutrients

Project activities would likely cause the release of sediments and affect the turbidity within the immediate project area. Turbidity would be controlled inside and outside of the working area by using a combination of BMPS. High levels of Mercury and other heavy metals are embedded within the lower Yuba River and may be released from earth moving construction activities associated with the project. Implementation of an approved SWPPP would also prevent and mitigate the temporary and permanent release of excess nutrients.

Eutrophication

With the implementation of BMPs and an approved SWPPP, the project is not intended to contribute excess nutrients into the lower Yuba River or promote excess plant growth.

2.2.5 Changes to Environmental Quality and Value

Implementation of the ecosystem restoration project would not result in long term adverse changes to the current quality or aquatic resource functions and values. Long term changes to the environmental quality and value would increase from the project. Under Alternative 5, 173.5 acres of riverine, riparian, and related habitats would be restored and under Alternative 6 192.8 acres of riverine, riparian, and related habitats would be restored. The impacts under Alternative 6 would be slightly greater than Alternative 5 due to an added increment feature.

Conducting the proposed project has the potential to temporarily adversely impact aquatic resource functions and values. As seen in section B(4) of this document, water quality could be impacted through sedimentation, turbidity, and temperature. The project may also temporarily impact dissolved oxygen levels and nutrient cycling. Integrating BMPs, mitigation and monitoring, and required measures from the SWPPP for both Alternative 5 and Alternative 6 would reduce project impacts to less than significant.

2.2.6 Actions to Minimize Impacts

To minimize impacts that may occur from project construction, standard BMPs, avoidance, minimization, and mitigation measures would be implemented. If possible, the project would be conducted when water levels are at their lowest and erosion prevention measures would be employed to prevent run off.

2.3 Suspended Particulates/Turbidity Determinations

2.3.1 Alteration of Suspended Particulate Type and Concentration

The materials that would be discharged in Alternative 5 and Alternative 6 likely would not alternate suspended particles type. The excavation of river material associated with the project may cause a temporary concentration of sediment in the project area. By implementing avoidance and minimization measures, discussed in Chapter 4of the FR/EA, impacts could be reduced to less than significant.

2.3.2 Particulate Plumes Associated with Discharge

Excavation for creation of side channels and other in water work have the potential to agitate river sediment creating turbidity and sediment plumes within the construction area and downstream. The plumes would be temporary and dissipate after in water construction work is complete. By implementing avoidance and minimization measures, discussed in Chapter 4 of the FR/EA, impacts could be reduced to less than significant.

2.3.3 Changes to Environmental Quality and Value

In Alternative 5 and Alternative 6, suspended particles and plumes associated with discharge would be temporary and subside after the project construction is over. There is also the potential for mercury and other heavy metals to be concentrated and present in the water due to construction activities.

2.3.4 Actions to Minimize Impacts

In order to minimize the impacts that suspended particles and plumes may have, in water work would be conducted in low water level periods if possible. Certification from the Central Valley RWQCB would be obtained prior to in water work. BMPs to avoid, minimize, and mitigate adverse impacts would be implemented and impacts would be less than significant.

2.4 Contaminant Determinations

Construction related activities in both Alternative 5 and Alternative 6 involve the use of hazardous materials such as fuels and lubricants to operate construction equipment. The fill material that will be discharged onsite would be clean organic matter that is free from contaminants. The soil that is excavated on site is likely contaminated with mercury and other heavy metals; this material will be hauled off site and disposed in a commercial upland disposal site. Earth moving activities could result in the release of mercury that already exist in the soil into the environment. This has the potential to affect the direct and indirect project area. In order to ensure that the effects of contaminants on the environment are less than significant for both alternatives, BMPs listed in the Water Quality Section 4.2.7 (Chapter 4) of the FR/EA will be implemented.

2.5 Aquatic Ecosystem and Organism Determinations

2.5.1 Effects on Plankton

Plankton are the floating organisms that occupy the pelagic zone of oceans, seas, or fresh bodies of water. Construction impacts would be temporary and localized. With the implementation of BMPs and an approved SWPPP, the effects to plankton would not be significant.

2.5.2 Effects on Benthos

Benthic organisms are located in the ecological zone that is the lowest level of a water body such as the ocean, river, or lake. This includes the sediment surface and sub-surface layers. This layer typically hosts invertebrates, but it is also important to fish species and their reproduction. The discharge of fill material is not expected to affect the native benthic species due to the location of the disposal points and general depth of the lower Yuba River. The lowering and excavating of the river bed and floodplain have the potential to remove benthic species within the river channel. Alternative 5 and Alternative 6 would also temporarily affect the benthic zone though turbidity and sedimentation. With the implementation of BMPs and an approved SWPPP, the effects to benthic organisms would not be significant.

2.5.3 Effects on Nekton

Nekton consists of actively swimming aquatic organisms and can be further broken down into three categories: invertebrates, mollusks, and crustaceans. Historic and current conditions are host to native and non-native fish, some anadromous species and some resident species. Anadromous fish species in the Lower Yuba River include: Central Valley fall-run, Central Valley late fall–run, and Central Valley spring-run Chinook salmon (*Onchorhynchus tshawytscha*) and Central Valley steelhead (*O. mykiss*), native green sturgeon (*Acipenser medirostris*) and Pacific lamprey (*Lampetra tridentatus*), and nonnative striped bass (*Morone saxatilis*) and American shad (*Alosa sapidissima*). The Lower Yuba River is also home to many non-anadromous native fish species including the resident rainbow trout (*O. mykiss*), Sacramento sucker (*Catostomus occidentalis*), hardhead (*Mylopharodon conocephalus*), Sacramento pikeminnow (*Ptychocheilus grandis*), western roach (*Lavinia symmetricus*), prickly sculpin (*Cottus asper*), riffle sculpin (*Cottus gulosus*), speckled dace (*Rhinichthys osculus*), and tule perch (*Hysterocarpus traski*). Nonnative fish species include smallmouth bass (*Micropterus dolomieui*), bluegill (*Lepomis macrchirus*), green sunfish (*L. cyanellus*), redear sunfish (*L. microlophus*), and mosquitofish (*Gambusia affinis*).

Both Alternative 5 and Alternative 6 would have direct and indirect effects to the nekton community. Direct effects may include injury or mortality due to movement of large equipment, placement/movement of fill, or construction noise. Indirect effects may include impacts to habitat conditions during construction such as sedimentation, turbidity, or slight temperature change, but an overall increase in habitat quality is expected to occur from project implementation.

Nekton organisms may temporarily be displaced during construction activities with both alternatives. Impacts to nekton in Alternative 5 are expected to be less than significant with the implementation of BMPs. Alternative 6 would have slightly more restoration activities than Alternative 5, such as more riparian planting and creation of side channels. The additional restoration work in Alternative 6, would result in a slight increase in potential short term impacts compared to Alternative 5; however, with implementation of BMPs and in anticipation of increased long term benefits, Alternative 6 would be expected to result in less than significant impacts to vegetation and wildlife resources.

2.5.4 Effects on Aquatic Food Web

Implementing Alternative 5 would have direct and indirect effects on the aquatic food web. The proposed in channel work, such as lowering and excavating the floodplain to facilitate more frequent inundation or for the placement of Engineered Log Jams, will temporarily disturb soil and sediments therefore causing an increase in turbidity and sedimentation which can reduce light penetration and disrupt photosynthesis. Furthermore, these effects could potentially interfere with feeding, social organization, spawning, rearing, and juvenile survival in fish species and other nekton species; however, these effects would be short term and localized to the project area. Mitigation measures will be implemented to minimize effects of sedimentation and turbidity to special status species and habitat.

Construction equipment has the potential to leak toxic substances such as gasoline and diesel, lubricants, and other petroleum-based projects. As a result of spills or leaks in storage containers, the substances could enter waterways within and adjacent to the project site, causing mortality or physiological impairment or disrupt other behavioral patterns of all types of species.

Alternative 6 includes all elements of Alternative 5 plus the addition of Increment 1. With the addition of Increment 1, additional aquatic habitats will be created through the excavation of a side channel and back water area in Timbuctoo Bend upstream of Highway 20. Alternative 6 would have similar construction related affects to Alternative 5, with an incrementally higher magnitude from the additional project features. As with Alternative 5, these effects would be short term in nature and with implementation of BMPs and mitigation measures, less than significant.

Implementation of BMP's and other mitigation measures (Chapter 4 of FR/EA) would result in minimal impacts on the aquatic food web outside and within the immediate work area.

2.5.5 Effects on Special Aquatic Sites

Sanctuaries and Refuges

No sanctuaries and refuges are within the project area.

Wetlands

No wetlands would be affected.

Mud Flats

No mud flats are within the project area.

Vegetated Shallows

No vegetated shallows are within the project area.

Coral Reefs

No coral reefs are within the project area.

Riffle and Pool Complexes

The lower Yuba River has a fairly low gradient, which does not lend itself to have riffle and pool complexes, but in high flow with the cobble sediment certain portions of the lower Yuba River may contain riffle and pool complexes. The coarse substrate of the lower Yuba River can result in rough turbulent flow and high dissolved oxygen levels. Pools typically occur downstream of the riffle complexes and have slower stream velocities and finer substrate. Alternative 5 and Alternative 6 would not result in the discharge of fill material into riffle and pool complexes. Gradual sedimentation from the discharge of fill material is not expected to affect the riffle and pool complexes any more than natural stream movement might.

2.5.6 Threatened and Endangered Species

Implementation of Alternative 5 and Alternative 6 have the potential to impact 6 species that are listed as Threatened or Endangered under the Federal Endangered Species Act (16 U.S.C. 1531-1544). Detailed accounts of special status species can be found in Chapter 4 of the FR/EA. There is a possibility that the following species could be located within the project area: California Red-legged Frog (*Rana draytonii),* Western Yellow-billed Cuckoo (*Coccyzus americanus),* and Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*). If these species are located within the project area, they have the potential to be indirectly impacted. The following species are known to occur within the project area and would likely be directly impacted: Southern DPS Green Sturgeon (*Acipenser medirostris),* Central Valley Spring-run Chinook salmon (*Oncorhynchus tshawytscha),* and California Central Valley Steelhead DPS (*Oncorhynchus mykiss).*

The presence of VELB within the project area is unknown, but if the species is located within the Action Area, there is the potential to cause temporary disturbance which may adversely affect the VELB. If possible a 100 foot buffers would be used, which is considered complete avoidance (USFWS 1999). With the proposed avoidance and mitigation measures implemented during construction, the impact to VELB would be insignificant.

The nearest known occurrence of the California Red Legged Frog is approximately 15.45 miles away and was recorded in 2013. The recorded location is not hydrologically connected to the project area. Furthermore, there is low quality habitat with minimal riparian cover within the project area and there are known predators (bullfrogs and predatory fish) on the lower Yuba River. Although a very small chance, if the species is present during construction, there is the possibility that they would be crushed from equipment or displaced from noise and movement. Pre-project surveys would be conducted by a qualified biologist. The effects of fill on the California Red Legged frog, if present, would be insignificant with the implementation of BMPs.

Based on the necessary habitat requirements for the western Yellow Billed Cuckoo and nearest known recorded occurrence of the species, there is a low possibility for the species within the project area. Furthermore, much of the riparian habitat within and along the lower Yuba River is patchy and not large enough to be considered suitable habitat. Pre-project surveys would be conducted by a qualified biologist. The effects of fill on the Yellow Billed Cuckoo, if present, would be insignificant with the implementation of BMPs.

Both Alternative 5 and Alternative 6 would directly impact the Southern DPS Green Sturgeon (Acipenser medirostris), Central Valley Spring-run Chinook salmon (Oncorhynchus tshawytscha), and California Central Valley Steelhead DPS (Oncorhynchus mykiss). Under Alternative 5, the proposed in channel work, such as lowering and excavating the floodplain to facilitate more frequent inundation or for the placement of Engineered Log Jams, will temporarily disturb soil and sediments therefore causing an increase in turbidity and sedimentation. These effects could potentially interfere with feeding, social organization, spawning, rearing, and juvenile survival in fish species; however, these effects would be expected to be short term and localized to the project area. Mitigation measures will be implemented to minimize effects of sedimentation and turbidity to special status species and habitat. As a result of spills or leaks in storage containers or from project equipment, substances could enter waterways within and adjacent to the project site, causing mortality or physiological impairment of fish or disrupt other behavioral patterns. Alternative 6 would have similar construction related affects to Alternative 5, with an incrementally higher magnitude from the additional project features. As with Alternative 5, these effects would be short term in nature and with implementation of BMPs and mitigation measures, less than significant. Improvements to aquatic and riparian habitat would result in long term benefits for special status species.

2.5.7 Other Wildlife

Project implementation has the potential to impact non-special status species within the project area. Species that may occur in the area include: Species of birds may include the Northern harrier (*Circus cyaneus*), Swainson's hawk (*Buteo swainsoni*), Tricolored blackbird (*Agelaius tricolor*), Loggerhead shrike (*Lanius ludovicianus*), Song sparrow, (*Ammodramus sacannarum*). Reptile and amphibians may include: pond turtle (*Actinemys marmorta*), green racer (Coluber constrictor), and Gilbert's skink (Eumeces gilbertii). Bats such as the Western red bat (*Lasiurus blossevillii*) or Yuma myotis (Myotis yumanensis), may also utilize the riparian area. Other common mammal species known to occur in the area include: mule deer, cougar (*Felis concolor*), and opossum (*Didelphus virginiana*). Aquatic species present in the project area are: non-native bullfrogs (*Lithobates catesbeianus*) and non-native crayfish (*Procambarus clarkii*; *Pacifastacus leniusculus*), Pacific lamprey (*Lampetra tridentatus*), and nonnative striped bass (*Morone saxatilis*) and American shad (*Alosa sapidissima*), resident rainbow trout (*O. mykiss*), Sacramento sucker (*Catostomus occidentalis*), hardhead (*Mylopharodon conocephalus*), Sacramento pikeminnow (*Ptychocheilus grandis*), western roach (*Lavinia symmetricus*), prickly sculpin (*Cottus asper*), riffle sculpin (*Cottus gulosus*), speckled dace (*Rhinichthys osculus*), and tule perch (*Hysterocarpus traski*), smallmouth bass (*Micropterus dolomieui*), bluegill (*Lepomis macrchirus*), green sunfish (*L. cyanellus*), redear sunfish (*L. microlophus*), and mosquitofish (*Gambusia affinis*).

Under both alternatives wildlife species could be directly or indirectly affected. Direct effects may include injury or mortality due to movement of large equipment, placement/movement of fill, or construction noise. Indirect effects may include impacts to habitat conditions during construction, but an overall increase in habitat quality is expected to increase from project implementation. Under Alternative 6, the additional restoration work of Increment 1 would result in a slight increase in potential short term impacts compared to Alternative 5; however, with implementation of BMPs and in anticipation of increased long term benefits, Alternative 6 would be expected to result in less than significant impacts to vegetation and wildlife resources.

To ensure that there would be no effect to migratory birds, preconstruction surveys would be conducted, if needed, in and around the project area. If any migratory birds are found, a protective buffer would be delineated, and USFWS and CDFG would be consulted for further actions. Recommendations proposed by the USFWS in their Fish and Wildlife Coordination Act Report.

2.5.8 Actions to Minimize Impacts

To minimize impacts to the aquatic ecosystem and organisms, mitigation measures have been developed and can be found in Chapter 4 of the FR/EA. With the implementation of a SWPPP and special conditions from federal consultations, the impact to special status species and wildlife will be minimized to a less than significant level.

2.6 Proposed Disposal Site Determinations

2.6.1 Mixing Zone Size Determination

Not applicable

2.6.2 Determination of Compliance with Applicable Water Quality Standards

Water quality within the project area and downstream may be affected as a result of project implementation. Construction activities, such as grading, excavating, structure placement, and rock placement have the potential to degrade water quality through material release of sediment and contaminants. The discharge of fill material into waters of the U.S. would not violate state or Federal water quality standards or primary drinking water standards of the Safe Drinking Water Act (42 USC 300f – 300j). Certifications would be obtained from the Central Valley RWQCB prior to construction to comply with the California Water Code. Project design, certification from the RWQCB, and project

BMPs would ensure that fill material would not have an adverse impact on water quality and would adhere to applicable water quality control standards.

2.6.3 Potential Effects on Human Use Characteristics

Municipal and Private Water Supplies

Currently Yuba County Water Agency obtains the water service agreements to provide its member units surface water from the lower Yuba River. Ground water, which is deemed good quality, within the Yuba basin is typically used for domestic and agricultural uses. The project will not violate an Environmental Protection Agency or State water quality standards or violate the primary drinking water standards of the Safe Drinking Water Act (42 USC 300f – 300j).

Recreation and Commercial Fisheries

The lower Yuba River offers excellent American shad, Chinook salmon, and steelhead, smallmouth bass, and striped bass fishing. While recreation opportunities in the lower Yuba River are limited by poor access, informal public river access in the 24-mile long lower Yuba River is available at Parks Bar approximately 5 miles northwest of Smartsville and the Hallwood Avenue Access approximately five miles northeast of Marysville. Formal recreation areas along the Yuba River that are operated by Yuba County include Sycamore Ranch and Hammon Grove Parks near the Dry Creek and lower Yuba River confluence. These parks are located just downstream of the proposed Increment 3a restoration area.

Project activities would temporarily and indirectly disrupt informal recreational fishing activities. Access points and parts of the river would be temporarily disturbed during construction. Construction activities, such as the placement of temporary bridges and construction equipment would temporarily impair the visual aesthetics of informal fishing. It would also temporarily block access from river points used for informal fishing access. In both Alternative 5 and Alternative 6, since these are informal recreation uses in the area, and since there would still be land permanently available for these activities, this impact would be considered less than significant. No formal commercial fishing activities would be affected by project implementation.

Water-related recreation

In addition to fishing activities, the lower Yuba River offers boating, recreational exercise, and wildlife viewing. Other activities may include hunting, swimming, and gold panning. Similar to fishing, hiking and boating opportunities in the lower Yuba River are limited by poor access. Where access is available, fishing, picnicking, rafting, kayaking, tubing, and swimming are the dominant recreational uses. There are proposed staging areas located in the vicinity of both the Hallwood and Parks Bar river access points. The proposed staging areas would not restrict access at these locations, but they would cause the area to have a degraded recreation experience due to the presence of heavy construction equipment, increased dust, and noise. These impacts would be significant, but with implementation of the proposed mitigation measures they would be reduced to less than significant.

Aesthetics

Temporary impacts to the aesthetics would likely occur from project implementation. Heavy construction equipment, increased dust, and noise would be present that could disrupt natural visual conditions. While no vegetation is expected to be removed during the project, there is the potential that it would be necessary to remove vegetation which could also disturb the existing visual conditions. If necessary vegetation would be replanted in-kind and no temporal loss of vegetation is expected. Long term aesthetics would benefit from the project design, as there would be more riparian plantings and restoration modeled after natural riverine conditions. Furthermore, an increase in the quality and quantity of habitat would promote the use of the land to more wildlife.

Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

Formal recreational parks owned and operated by Yuba County are situated along the lower Yuba River. These include Sycamore Ranch and Hammon Grove Parks near the Dry Creek and lower Yuba River confluence. Operation, use, and quality of the parks within and adjacent to the project areas would not be significantly affected.

2.7 Determination of Cumulative Effects on the Aquatic Ecosystem

Construction activities have the potential to temporarily degrade water quality through the direct release of soil and construction materials into water bodies or the indirect release of contaminants into water bodies through excavation activities. Projects being conducted concurrently with the proposed YRERS may including Hallwood Side Channel and Floodplain Restoration Project, the Yuba River Canyon Salmon Habitat Restoration Project, ongoing voluntary conservation measures related to DaGuerre Point Dam and continuing operations and maintenance, as well as continuous sand and gravel mining in the lower Yuba River area. Adding in the impacts of the YRERS to other past, present, and reasonably foreseeable future actions could experience a cumulative effect on the environment.

All projects within the lower Yuba River would be required to coordinate with the Central Valley RWQCB to obtain certification. Degradation of water quality from the project would be short term and limited to the construction period. The proposed restoration activities associated with the study would result in less-than-significant effects to water quality and would not contribute to cumulative long-term adverse effects.

2.8 Determination of Secondary Effects on the Aquatic Ecosystem

No secondary effects to the aquatic ecosystem are anticipated to occur as a result of the discharge of fill material associated with Alternative 5 or Alternative 6.

3.0 Findings of Compliance or Non-Compliance with the Restrictions on Discharge

3.1 Adaptation of the Section 404(b)(1) Guidelines to this Evaluation

No significant adaptations of the guidelines were made relative to this evaluation.

3.2 Evaluation of Availability of Practicable Alternatives to the Proposed Dischage Site Which Would Have Less Impact on the Aquatic Ecosystem

All alternative information is discussed in Chapter 3 of the FR/EA. While Alternative 6 would restore more habitat (197.8 acres) than Alternative 5 (178.6 acres), it is more than three times the cost per AAHU of other increments. Alternative 5 maximizes benefits relative to costs and is therefore the NER Plan and the Tentatively Selected Plan. Alternative 5, the TSP, restores significant ecosystem function, structure, and dynamic processes on 178.6 acres of riverine, riparian, and related habitats in the highly degraded Yuba River System.

3.3 Compliance with Applicable State Water Quality Standards

Construction and subsequent removal of the project related discharge would not cause or contribute to violation of any applicable State water quality standards. The discharge operations would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

3.4 Compliance with Endangered Species Act

Placement of fill materials in the project area(s) will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973. Consultations would occur with the National Marine Fisheries Service and the U.S. Fish and Wildlife service under Section 7 of the Endangered Species Act.

3.5 Evaluation of Extent of Degradation of the Waters of the United States

Long-term significant effects on the aquatic ecosystem diversity, productivity, and stability would not occur, nor would long-term effects to recreational, aesthetic, and economic values of the affected WOUS occur as a result of the discharge of fill material.

3.6 Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Sanctuaries Designated by the Marine Protection, Research, & Sanctuaries Act.

Not applicable.

3.7 Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem

With the implementation of BMPs; avoidance, minimization and mitigation measures; and input from other federal agencies the project would not result in significant adverse effects on the environment.

Environmental Appendix D
Attachment 4

Draft Fish and Wildlife Coordination Act Planning Report
Yuba River Ecosystem Restoration Feasibility Study

November 2017

U.S. Army Corps of Engineers

Sacramento District

UNITED STATES DEPARTMENT OF THE INTERIOR FISH

AND WILDLIFE SERVICE

DRAFT FISH AND WILDLIFE COORDINATION ACT REPORT FOR THE

YUBA RIVER ECOSYSTEM RESTORATION PROJECT YUBA COUNTY

PREPARED FOR:
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

PREPARED BY:
U.S. FISH AND WILDLIFE SERVICE
SACRAMENTO FIELD OFFICE
SACRAMENTO, CALIFORNIA

DECEMBER 2017

INTRODUCTION

The U.S. Fish and Wildlife Service (Service) is preparing this draft Fish and Wildlife Coordination Act (FWCA) report for the U.S. Army Corps of Engineers' (Corps) Yuba River Ecosystem Restoration Project, Yuba County, California. This report is prepared under the authority of, and in accordance with the FWCA, as amended. Funding to initiate this study was provided by the Corps. The Corps is the federal lead agency and the Yuba County Water Agency (YCWA) is the local sponsor.

The information presented is based primarily upon project planning information made available by the Corps and various reports pertinent to the project area. This report presents the current views of the Service on this project. Our analysis is based on engineering and other project information provided by the Corps. Our appraisal of resources is based on literature reviews; personal communications with other recognized experts; best professional judgment of Service biologists; and a projection of future conditions using current land-use information. Our analyses will not remain valid if the project, the resource base, or anticipated future conditions change significantly.

Hydraulic mining that occurred in the mid to late 1800s has shaped the Yuba River watershed resulting in large amounts of sediment being transported downstream and causing aggradation of the Yuba River channel. Gravel berms were created in the lower Yuba River to promote scouring and create a stable river channel and two debris dams were constructed to prevent further movement of fine sediments from flowing into the Feather and Sacramento rivers. The influx of sediment into the Yuba River watershed caused loss of riparian habitat and fish rearing habitat and the placement of dams blocked fish migration.

AREA DESCRIPTION

The Yuba River watershed encompasses 1,340 square miles on the western slopes of the Sierra Nevada Mountain Range. The river flows east to west through forest, foothill chaparral, and agricultural lands to the confluence of the Feather River. The watershed is located in portions of Sierra, Placer, Yuba, and Nevada counties. There are a total of 32 dams and 11 powerhouses in the watershed. For most of its course, levees are absent from the river, except for near the confluence with the Feather River. At that point, the Yuba River is confined by setback levees for 6 miles.

The Yuba River Ecosystem Restoration Project is focusing on the lower Yuba River downstream of Englebright Dam to the confluence of the Feather River. The Corps has divided this length of river into eight reaches with a portion of the Yuba Goldfields, an area of active gravel mining, removed from the project because there is a separate restoration action being planned for that reach through the Department of the Interior's Anadromous Fish Restoration Program (AFRP).

PROJECT DESCRIPTION

A no action alternative and two restoration alternatives are being evaluated. A description of each alternative is provided below.

No Action

Under the No Action Alternative there would be no restoration activities along the Yuba River. Existing problems with fish rearing and habitat would not be resolved and would likely continue on and likely worsen with climate change.

Alternative 5

Alternative 5 is made up of four reaches. They are described below according to reach. Overall, 91.9 acres of riparian habitat would be restored and 104.7 acres of fish habitat would be created through the construction of side channels, lowering of floodplains, creation of backwater habitat, bank scalloping, and gravel placement.

Reach 2 – Just downstream of the Highway 20 Bridge at Upper Gilt Edge Bar, the floodplain would be lowered to facilitate inundation at 3,000 cubic feet per second (cfs) and riparian vegetation would be planted along the channel edge.

On the southern bank of Upper Guilt Edge Bar, where the bank is 8 – 15 feet high, and the edge of the channel is relatively homogeneous with little habitat complexity, small scallops would be excavated into the tall and steep banks to increase local topographic diversity and wetted edge. These scallops are designed to create an inundated alcove at all discharges with the steep slopes surrounding the alcoves feathered to at least a 10:1 slope, providing additional shallow inundated areas with desirable depth/velocity combinations. Initially, these scallops would provide year round rearing habitat to juvenile salmonids. Over time, it is expected that fine sediment may deposit in the scallops creating nursery sites where natural woody vegetation recruitment could occur. The scallops would further facilitate natural recruitment of riparian vegetation, due to shallow access to the water table, and the fine texture of deposited sediments.

Large woody material (LWM) would be placed within and protruding from the scallops. An existing backwater area would be restored allowing for inundation in a typical 1 – 2 year recurrence interval flood. Riparian vegetation would be planted to increase the structural diversity and extent of existing riparian vegetation. Additional fine material would be introduced to the upper 3 feet of the soil column in excavated areas to increase soil absorption and the amount of soil moisture available to riparian vegetation. LWM would be placed within the backwater to provide aquatic structure.

An unnamed bar on the north side of the river near River Mile (RM) 17, riparian vegetation would be planted. The site would be restored by lowering areas to increase lateral floodplain connectivity and provide additional opportunity to plant riparian vegetation.

Reach 3a – At Lower Gilt Edge Bar, an existing swale feature (at the upstream end of Lower Guilt Edge Bar) would be lowered and connected to the channel to become inundated at 3,000 cfs. A patchwork floodplain network of LWM surrounding the restored groundwater-fed swale would be constructed to encourage fine sediment deposition and riparian recruitment, as well as provide edgewater refugia at flows above baseflow.

Downstream of Lower Gilt Edge Bar, on the alluvial bar on the north side of the river, riparian vegetation would be planted.

First Island has large expanses of floodplain and high floodplain, and a side channel on river left which provides spawning and rearing habitat. This area may provide immediate benefit to emerging salmonid fry if allowed access to larger expanses of shallow habitat with riparian cover. To encourage sediment deposition and riparian vegetation recruitment, engineered log jams (ELJs) would be installed in a patchwork configuration, particularly along the apex of First Island just above bankfull elevation.

Rock and sediment would be deposited along the left bank of Silica Bar, and ELJs would be placed to aid constriction at this location. LWM would be placed along the margins of the downstream terminus of the existing side channels/backwater that is surrounded by an existing stand of diverse, mature, native riparian vegetation, in areas that would not disrupt existing riparian vegetation along the banks of the side channel/backwater area. Floodplain areas would be lowered to facilitate inundation and riparian vegetation would be planted.

On the river downstream of First Island, floodplain surfaces would be lowered and riparian vegetation would be planted to facilitate more frequent inundation between 2,000 and 5,000 cfs. Lowering would avoid prolonged inundation and potential to induce mortality of riparian vegetation cuttings. Rock and sediment would be deposited along the left bank of Silica Bar, coupled with placement of ELJs to aid river constriction at this location.

A side channel would be created that activates above 3,000 cfs and connects to the low lying area downstream, providing beneficial off-channel habitat with established riparian vegetation. This would create an anabranching side channel (stable multiple-thread channels) in an existing swale within a stand of relatively dense vegetation that includes willows and cottonwoods.

Actions in this reach will increase habitat connectivity between two other separate restoration projects on the Yuba River and work along Reach 2.

Reach 5a – Immediately downstream of the (AFRP) Teichert Hallwood Restoration Project, a historical channel alignment on the north side of Bar C would be restored to inundate at 3,000 cfs and function as swale habitat. The side channel and adjacent floodplain would be lowered and graded. Additionally, riparian vegetation would be planted on each side of the restored swale/side channel. ELJs would be placed in a patchwork configuration near the inflow of the swale at the upstream end of Bar C. In addition, LWM would be placed in the backwater area at the downstream end of Bar C to increase structural and habitat complexity in the area.

A historical channel alignment on the south side of the bar would be restored by lowering and grading a side channel within a stand of riparian vegetation. The side channel would extend into an existing backwater habitat located at the downstream edge of the Yuba Goldfields. The floodplain on the north side of the side channel would be lowered and planted with riparian vegetation. Boulder structures would be placed to provide hydraulic stability at the inflow section of the side channel at the upstream end of Bar C.

Reach 5b – A side channel would be constructed at Narrow Bar that would connect to an existing swale at the downstream end of the bar. Existing riparian vegetation would border the created side channel. Another side channel would be created, splitting off from the other side channel through the middle of the bar in the southwest direction. Boulders would be placed to maintain stable hydraulic conditions at the inflow. There is a large expanse of shallow depth to groundwater on Narrow Bar, with some areas of high floodplain. The high floodplain areas would be graded and planted with riparian vegetation. Additionally, floodplain along the main channel would be graded to increase inundation duration and frequency at 2,000 cfs. ELJs would be placed in a patchwork configuration to facilitate riparian recruitment and to restore swale habitat. At the terminus of the anabranching side channel, a backwater area would be created. A backwater area would be created on the right bank at RM 6.5 to provide shallow water refugia for salmonids.

Riparian vegetation would be planted in the downstream portion of Bar E surrounding a historical channel alignment to restore species and structural diversity. LWM would be placed in the swale/backwater downstream from the existing diversion channel.

Riparian vegetation would be planted along the upstream portion of Island B to create species and structural diversity. ELJs would be placed in a patchwork configuration to encourage native plant recruitment and improve survivability of plantings. Table 1 includes the acres of habitat created per reach.

Alternative 6

Alternative 6 includes measures in the four reaches described in Alternative 5 and reach 1. Therefore, we will only describe reach 1 here and the reader can refer to Alternative 5 for the remaining alternative description. Work in reach 1 would include the creation of a side channel in the Timbuctoo Bend area. The side channel would be constructed with native cobble or armored

Table 1. Alternative 5 Restoration Acreages

Reach	Feature Type	Acres
2	Floodplain Lowering	14.0
	Riparian Planting	8.7
	Bank Scalloping	0.3
	Backwater Area	0.3
3a	Floodplain Lowering	13.0
	Riparian Planting	28.7
	Side Channel	11.3
	Gravel Placement	3.5
5a	Floodplain Lowering	13.0
	Riparian Planting	21.3
	Side Channel	15.1
5b	Side Channel	11.1
	Floodplain Lowering	7.7
	Riparian Planting	33.2
	Backwater Area	2.9
	Floodplain Terracing	12.5

stone. Along the southern bank of the side channel, the floodplain would be lowered and planted with riparian vegetation extending across the existing bar to the lower Yuba River. This action would reconnect the river to its floodplain and increase aquatic and riparian habitat. East of Parks Bar, near Big Ravine, the near-shore area and adjacent floodplain on the south bank of the Lower Yuba River would be lowered and planted with riparian vegetation adjacent to the Yuba River. Near the confluence of Big Ravine Creek, a large backwater area would be created for use by waterfowl, amphibians, and other wildlife species. Table 2 includes the acres of habitat created per reach.

EXISTING BIOLOGICAL RESOURCES

Vegetation

Historically, the lower Yuba River had dense wide swaths of riparian vegetation with multiple layers of vegetation varying in height due to the age of the stand. Mining activities in the 1800s drastically changed the Yuba River channel and negatively affect the adjacent riparian habitat. In the *Riparian Vegetation Analysis* (Watershed Science 2012) an analysis of LiDAR data determined that 264.3 acres of riparian vegetation exists in the study area of the project. This habitat is patchy along the roughly 14 miles of river. Riparian species that can be found along the lower Yuba River include elderberry shrubs, willow species, white alder, Oregon ash, California black walnut, western sycamore, button bush, and Fremont cottonwood. Smaller willow species combined with Fremont cottonwood are the most common species in the floodplain. Agriculture and urban cover-types make up the majority of the area with patches of annual grassland, areas of rock or gravel, and small amounts of oak woodland.

Table 2. Alternative 6 Restoration Acreages

Reach	Feature Type	Acres
1	Riparian Planting	7.4
	Side Channel	5.8
	Backwater Area	6.1
2	Floodplain Lowering	14.0
	Riparian Planting	8.7
	Bank Scalloping	0.3
	Backwater Area	0.3
3a	Floodplain Lowering	13.0
	Riparian Planting	28.7
	Side Channel	11.3
	Gravel Placement	3.5
5a	Floodplain Lowering	13.0
	Riparian Planting	21.3
	Side Channel	15.1
5b	Side Channel	11.1
	Floodplain Lowering	7.7
	Riparian Planting	33.2
	Backwater Area	2.9
	Floodplain Terracing	12.5

<u>Wildlife</u>

Riparian habitat is especially valuable for wildlife. Riparian trees provide nesting habitat for many birds, notably cavity-nesting species and a large assemblage of raptors, including the State-listed Swainson's hawk. Birds which glean insects off of bark, leaves, and leaf tangles such as bushtits, woodpeckers, and nuthatches, also use riparian habitats. Typical mammal species that can be found in riparian areas include deer, raccoons, beavers, coyotes, and red foxes. The multilayered vegetation provides an abundance of insects that feed on fresh foliage and stems during the growing season and serve as prey for birds, mammals, and reptiles.

Grassland areas provide habitat for granivorous birds such as western meadowlarks, California quail, sparrows, and finches, for mammals such as voles, mice, and pocket gophers and reptiles such as western fence lizards, gopher snakes and western rattlesnakes. The reptile species in particular can also be found using the open rock areas for thermoregulation or cover.

<u>Fisheries</u>

Forty-five fish species reside within the lower Yuba River. Federally listed species will be described in the following section. Twenty-three of the species are not native to California and include species such as inland silversides, various sunfish species, various bass species, minnows, shad, and catfish.

Native species include Sacramento sucker, sculpin, Sacramento splittail, and lampreys. Only 18 of the 45 species have been observed upstream of Daguerre Point Dam.

Endangered Species

A query of the Service's Information for Planning and Consultation resulted in the following nine Service federally listed species: the endangered conservancy fairy shrimp, vernal pool tadpole shrimp, Hartweg's golden sunburst; and the threatened valley elderberry longhorn beetle, vernal pool fairy shrimp, delta smelt, California red-legged frog, giant garter snake, and yellow-billed cuckoo.

A review of the California Department of Fish and Wildlife's (CDFW) California Natural Diversity Database (CNDDB) found the following state listed species have occurrences within a half mile of the lower Yuba River: Harwtig's golden sunburst, spring run chinook salmon, tricolored blackbird, yellow-billed cuckoo, and Swainson's hawk.

California's State Wildlife Action Plan (SWAP) is a plan developed to guide the state in its long-term goals of conserving the state's fish and wildlife and their natural habitats. It includes Species of Greatest Conservation Need (SGCN) which consists of species determined to be rare, imperiled, and/or in need of conservation. For purposes of this project, the Central Valley spring-run chinook salmon and Central Valley fall/late fall-run chinook salmon are SGCN species. Additionally, one of the six cores principles for anadromous fish in the SWAP is habitat restoration.

Federally listed species under the jurisdiction of the National Marine Fisheries Service (NMFS) that occur in the lower Yuba River include green sturgeon, Central Valley steelhead, and Central Valley spring-run chinook salmon. The Corps has been coordinating with NMFS on the restoration project.

FUTURE CONDITIONS WITHOUT THE PROJECT

Vegetation

Land use in the study area is expected to maintain the current mix. Habitat along the lower Yuba River is likely to continue to degrade in the project footprint. However, though restoration projects are slated to be constructed outside of the project footprint and those would continue as planned. Climate change and hydrologic models are estimating that with increasing temperatures the northern and central Sierra mountain range will have increasing snow level elevations resulting in more rain falling and flowing into the east side tributaries such as the Yuba River (DWR 2017). When looking at flood magnitudes for various flood flows, all flows increased with climate change factored in versus existing climate conditions. Projections for the Yuba River estimate the largest increase in flows in the 10-year flood magnitude. Climate change would likely cause an increase in the flows coming down the Yuba River during the winter months and a lessening of flows in the spring as a result of less water being stored in snow pack. However, warmer temperatures would also affect how frequently the Yuba River would have wet years. Climate change modeling of effects on vegetation indicate a loss of riparian habitat along the Yuba River under all potential climate scenarios (Thorne *et al.* 2016). Therefore, climate change is likely to decrease the amount of riparian vegetation along the lower Yuba River in the future.

Wildlife

Since little is expected to change in the project footprint to habitat, little change is expected to occur for wildlife species. Restoration outside of the project footprint is expected to focus on fish, but could still benefit wildlife species if native riparian vegetation is planted. This may cause expansion of wildlife species into the project area though given the lack of habitat, it is unlikely to support a robust population of wildlife. Long-term, climate change would likely to shift habitat types from riparian to more general grassland/upland species and therefore shift the species from riparian wildlife to more general grassland or upland wildlife species.

Fisheries

Aquatic resources would not benefit within the project footprint without the project. Aquatic restoration done adjacent to the project would benefit and fishes, but existing habitat conditions would not be improved.

FUTURE CONDITIONS WITH THE PROJECT

Alternative 5

Vegetation

Lowering of floodplain and creating side channels and backwater would remove vegetation from the project footprint. For this alternative an estimated 13.4 acres of riparian vegetation would be removed and 136 acres would be planted. There would be a temporal loss between removal of existing vegetation and the time it will take for the newly planted woody vegetation to grow. The Corps would attempt to minimize vegetation lost when the project moves into the preconstruction engineering and design (PED) making the loss of 13.4 acres a worst case scenario.

As with most regulated rivers in the Sacramento Valley, there are fewer riparian pioneer communities due to lower rates of seedling establishment. Lowering floodplain habitat and planting woody vegetation will begin to establish early successional riparian habitat along the lower Yuba River, a habitat stage that is not abundant in the Sacramento Valley.

Wildlife

Wildlife species in the lower Yuba River would be disturbed from construction activities and killed or displaced due to the loss of habitat. If woody vegetation is removed during the winter months, then effects to bird species would be lessened as migratory birds would find other habitat for nesting and foraging during construction. Birds would also need to find other habitat for foraging. Given that the 13.4 acres are spread out over 4 reaches, the individual habitat patches lost would be small which lessens effects to wildlife species.

In the long-term there will be benefits to wildlife species that use the lower Yuba River. About 10 times the amount of habitat that is lost will be restored through the project. This will allow various wildlife species to expand into the new riparian habitat. As the vegetation matures bird, mammal, and reptile species would be able to use the riparian for breeding, feeding, and sheltering.

Fisheries

Construction activities would have small temporary affects to fisheries. The Corps and their contractors would work in the dry as much as possible. Invariably there would be some work which would affect fish species through increasing turbidity, temporary loss of benthic macroinvertebrates, disturbance from construction equipment including noise and potential spills of toxic substances, and changes to dissolved oxygen. However, these effects are expected to be short-term, minimal, and are expected to result in improved habitat for fish.

Over the long-term, there will be many beneficial effects to fisheries and riverine habitat. The project would create 38.8 acres of side channels and backwater and 47.6 acres of lowered floodplain for a total of 86.4 acres of newly created aquatic habitat. Large woody material and EJBs creates hydraulic diversity as well as providing structural cover for fish species. All of the aquatic features would provide additional diverse rearing habitat for many fish species, but particularly salmonids, which will be available at varying river stages.

Alternative 6

Vegetation

Alternative 6 is the same as Alternative 5 but with an additional reach of restoration. Lowering of floodplain and creating side channels and backwater would remove vegetation from the project footprint. For this alternative an estimated 14.8 acres of riparian vegetation would be removed and 143 acres would be planted. There would be a temporal loss between removal of existing vegetation and the time it takes for the newly planted woody vegetation to grow. The Corps would attempt to minimize vegetation lost when the project moves into PED making the loss of 14.8 acres a worst case scenario.

Again most regulated rivers in the Sacramento Valley, have fewer riparian pioneer communities due to lower rates of seedling establishment. Lowering floodplain habitat and planting woody vegetation will begin to establish early successional riparian habitat along the lower Yuba River, a habitat stage that is not abundant in the Sacramento Valley.

Wildlife

Wildlife species in the lower Yuba River would be disturbed from construction activities and killed or displaced due to the loss of habitat. If woody vegetation is removed during the winter months, then effects to bird species would be lessened as migratory birds would find other habitat for nesting and foraging during construction. Birds would also need to find other habitat for foraging. Given that the 14.8 acres are spread out over 5 reaches, the individual habitat patches lost would be small which lessens effects to wildlife species.

In the long-term there would be benefits to wildlife species that use the lower Yuba River. About 10 times the amount of habitat that is lost will be restored through the project. This would allow various wildlife species to expand into the new riparian habitat. As the vegetation matures bird, mammal, and reptile species will be able to use the riparian for breeding, feeding, and sheltering.

Fisheries

Construction activities would have small temporary affects to fisheries. The Corps and their contractors would work in the dry as much as possible. Invariably there would be some work which would affect fish species through increasing turbidity, temporary loss of benthic macroinvertebrates, disturbance from construction equipment including noise and potential spills of toxic substances, and changes to dissolved oxygen. However, these effects should be short-term, minimal, and are expected to return back to baseline and even better.

Over the long-term, there would be many beneficial effects to fisheries and riverine habitat. The project would create 50.6 acres of side channels and backwater and 47.6 acres of lowered floodplain for a total of 98.2 acres of newly created aquatic habitat. Large woody material and EJBs would create hydraulic diversity as well as providing structural cover for fish species. All of the aquatic features would provide additional diverse rearing habitat for many fish species, but particularly salmonids, which would be available at varying river stages.

DISCUSSION

The Service recommends the Corps move forward with the proposed Yuba River Ecosystem Restoration Project. Either alternative would create much needed fish habitat along the Lower Yuba River, with Alternative 6 creating more habitat due to the inclusion of an additional reach for restoration. Planting of riparian vegetation will increase habitat for many riparian wildlife species.

The Corps uses ecological benefits and the Cost Effectiveness and Incremental Cost Analysis to inform environmental investment decision making in the Corps planning process. Any model that is certified by the Corps and ideally measures quality and quantity of ecosystem benefits (such as the Habitat Evaluation Procedures (HEP)) is used to evaluate alternatives. HEP was used for this project. Typically, the Service has been responsible for leading a multi-agency team through the selection of HEP models, coordinating the data collection, and running the HEP model to create outputs with input from the HEP team. The Sacramento District chose for this project to run the HEP with very little opportunity for the Service to participate in the process. The Corps has transmitted the HEP report to the Service and provided a briefing on their data collection and running of the selected HEP models. However, because of our lack of opportunity to participate in the HEP process we are not including the Corps' HEP data in our FWCA report. The Service should be integrally involved in the HEP process even in ecosystem restoration projects.

RECOMMENDATIONS

When the planning process moves into PED, the Service should be involved in the process and an updated FWCA report should be prepared to provide project level recommendations for the benefit of fish, wildlife, and their habitat. The Service recommends the following for based on the current broad alternative descriptions:

1. Avoid impacts to woody vegetation to the maximum extent possible by removing the least amount of vegetation and choosing to trim trees and shrubs to allow access for equipment and construction in the footprint.
2. Incorporate climate-smart principles into the planning process of this project. Point Blue has developed a set of five guiding principles which can be found at

http://www.pointblue.org/our-science-and-services/conservation-science/habitat-restoration/climate-smart-restoration-principles. Currently the Corps has a rather small planting palette for the proposed project. We recommend that you expand the number of species to maximize the number of months that food resources are available to wildlife species. We also recommend planting a wide range of plant species to that could be successful in a range of future climate scenarios.

3. When scheduling construction, ensure that the Migratory Bird Treaty Act is complied with. In particular, any vegetation removal should be done during the non-nesting season. Work occurring during the nesting season that could adversely affect avoided vegetation should have a pre-construction nesting bird survey to identify any nesting migratory birds. Appropriate buffers should be designed and maintained in the event nesting migratory birds are found.
4. Work with the Service, NMFS, and CDFW to develop planting and monitoring plans.
5. Include within the planting contract a provision for the contractor to plant understory species after some of the woody canopy has established. Studies have shown that planting late successional understory species after woody canopy has become established increases success of understory plants. This will provide a more diverse and climate resilient habitat for wildlife species over the project life (Johnston 2009).
6. Incorporate native pollinator habitat within the planting plan. Pollinator habitat has decreased resulting in a loss of pollinators. In addition to benefiting the habitat complexity there are benefits to creating pollinator habitat near agricultural areas.
7. The Service should be included in the development of a long-term operation and maintenance plan for the created habitat.

LITERATURE CITED

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Environmental Appendix D
Attachment 5

Clean Water Act Section 401 Water Quality Certification
Yuba River Ecosystem Restoration Feasibility Study

November 2017

U.S. Army Corps of Engineers

Sacramento District

[Coordination with Central Valley Regional Water Quality Control Board will be conducted in compliance with Section 401 of the Clean Water Act prior to completion of the Final FR/EA.]

Environmental Appendix D
Attachment 6

Feasibility-Level Monitoring and Adaptive Management Plan

Yuba River Ecosystem Restoration Feasibility Study

November 2017

U.S. Army Corps of Engineers

Sacramento District

Table of Contents

1.0 Introduction

This document outlines the feasibility level monitoring and adaptive management (M&AM) plan for the Yuba River Ecosystem Restoration Feasibility Study (YRERFS) in Yuba County, California. The Project Delivery Team (PDT) of Sacramento District (SPK), in ongoing cooperation with the non-Federal study sponsor, the Yuba County Water Agency (YCWA), have developed this plan to describe monitoring and adaptive management activities proposed for the YRERFS, assign costs, and estimate duration. This plan will be further developed with the project sponsor and any partners and in the Preconstruction, Engineering, and Design (PED) phase.

1.1 Authorization for Adaptive Management in the YRERFS

Section 1161 of WRDA 2016 amends Section 2039 of WRDA 2007 to specify information required to be included in monitoring plans for ecosystem restoration projects, and to direct when non-federal operation and maintenance responsibilities of these projects may cease.

The implementation guidance for Section 1161, in the form of a CECW-P Memo dated October 19, 2017, also requires that an adaptive management plan be developed for all ecosystem restoration projects.

Monitoring and adaptive management addresses sources of uncertainty, steers project implementation and maintenance to maximize results, and documents project effects for communication to participants, stakeholders, HQ, and Congress.

1.2 Procedure for Drafting a Monitoring and Adaptive Management Plan for the YRERFS

The U.S. Army Corps of Engineers, specifically Sacramento District is collaborating with the project sponsor to establish a framework for monitoring and adaptive management (M&AM). The YRERFS adaptive management framework includes both a set-up phase (Figure 1) and an implementation phase (Figure 2).

1.3 Adaptive Management Team Structure

As part of the communication structure for implementation of adaptive management, an Adaptive Management Planning Team will be established. This team will be led by a Senior Planner from the USACE and a counterpart from the project sponsor's office or its appointment. Other resources and expertise will be brought in as needed, and may include representatives from USACE, CDFW, USFWS, or NMFS. This team is responsible for ensuring that monitoring data and assessments are properly used in the adaptive management decision-making process. If this team determines that adaptive management actions are needed, the team will coordinate a path forward with project planners and project managers. The Adaptive Management Planning Team is also responsible for project documentation, reporting, and external communication.

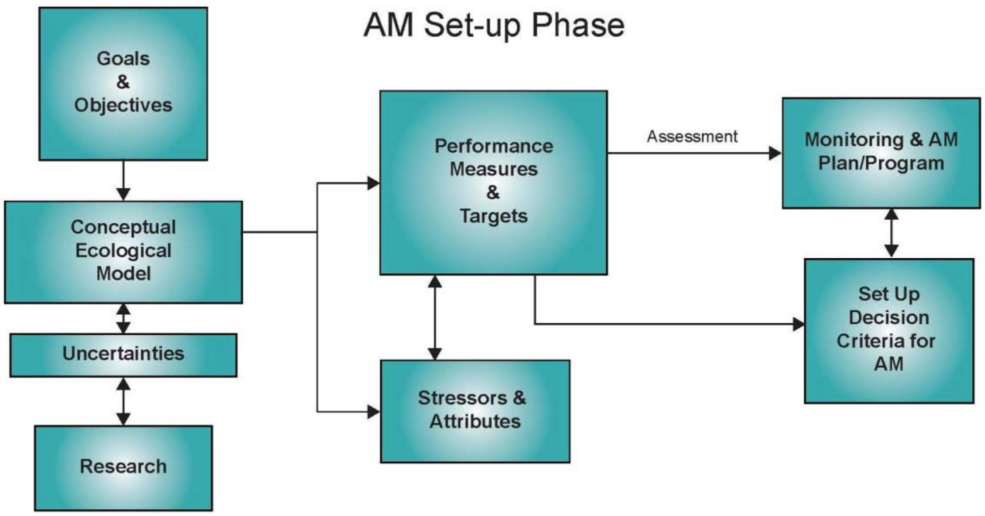

Figure 1. Set-up phase of the adaptive management framework.

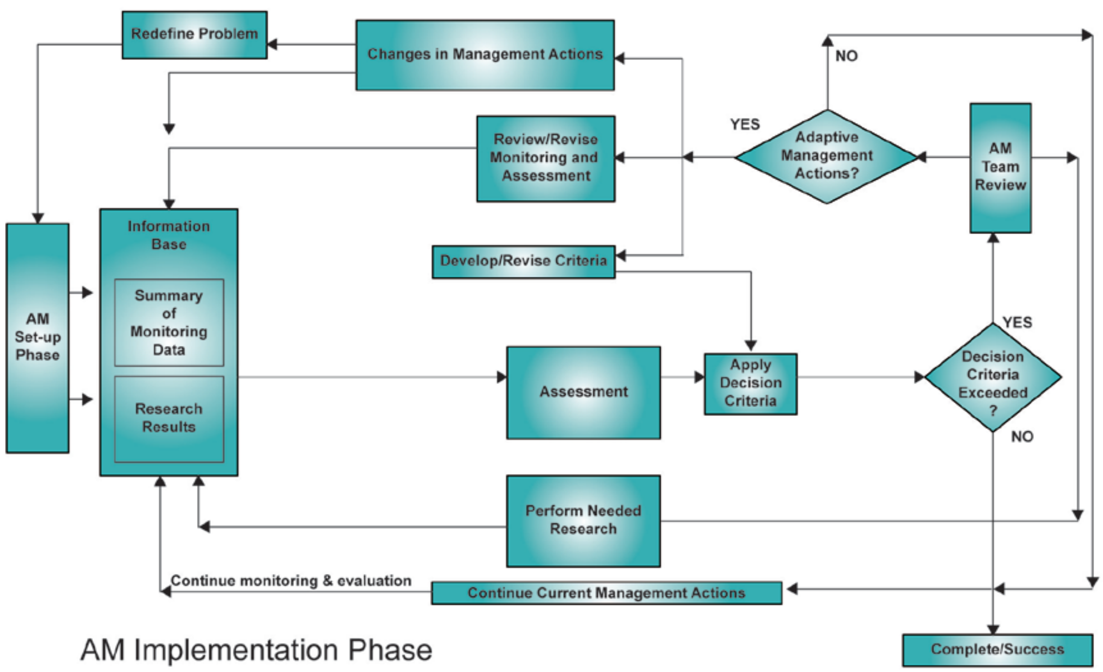

Figure 2. Implementation phase of the adaptive management framework.

2.0 Basis for Monitoring and Adaptive Management

The primary incentive for implementing an adaptive management program is to increase the likelihood of achieving desired project outcomes given the identified uncertainties. All projects face uncertainties with the principal sources of uncertainty including (1) incomplete description and understanding of relevant ecosystem structure and function, (2) imprecise relationships between project management actions and corresponding outcomes, (3) engineering challenges in implementing project alternatives, (4) ambiguous management and decision-making processes, and (5) unpredictable independent variables, such as discharge and climate extremes.

Given these uncertainties, adaptive management provides an organized, coherent, and documented process that suggests and triggers management actions in relation to measured project performance compared to desired project outcomes. The Adaptive Management Plan for this project reflects a level of detail consistent with the project Feasibility Study. The primary intent is to develop monitoring and adaptive management actions appropriate for and specific to the project's restoration goals and objectives. The specified management actions allow estimation of the M&AM program costs and duration for the project.

The following section (1) identifies the restoration goals and objectives identified for the YRERFS, (2) outlines management actions that can be undertaken to achieve the project goals and objectives, (3) presents a conceptual ecological model that relates management actions to desired project outcomes, and (4) lists sources of uncertainty that would recommend the use of adaptive management for this project. Subsequent sections describe monitoring, assessment, decision-making, and data management in support of adaptive management.

The level of detail in this plan is based on currently available data and information developed during plan formulation as part of the feasibility study. Uncertainties remain concerning the exact project features, monitoring elements, and adaptive management opportunities. Components of the monitoring and adaptive management plan, including costs, were also estimated using currently available information. Uncertainties will be addressed in the preconstruction, engineering, and design phase, and a detailed monitoring and adaptive management plan, including a detailed cost breakdown, will be drafted as a component of the design document.

2.1 Project Goals and Objectives

Sacramento District and study non-Federal sponsor, YCWA developed restoration goals and objectives to be addressed by YRERFS ecosystem restoration actions. The restoration objectives are to:

- Improve the quantity, quality, complexity of aquatic habitats
- Improve the quantity, quality, complexity, and connectivity of riparian habitats
- Restore longitudinal river connectivity
- Restore lateral connectivity of the river to its floodplain

2.2 Management and Restoration Actions

The PDT performed a plan formulation process to identify potential management measures and restoration actions that address the project objectives. Many alternatives were considered, evaluated, and screened in producing a final array of alternatives. The PDT subsequently identified a tentatively selected plan (TSP). The intent of the TSP is to optimize to maximize restoration outputs while acknowledging sources of risk and uncertainty.

2.3 Conceptual Ecological Model (CEM) for Monitoring and Adaptive Management

As part of the planning process, members of SPK's PDT and YCWA worked together to develop a conceptual ecological model to represent current understanding of ecosystem structure and function in the project area. The CEM was used in this M&AM to support the identification of performance measures and help select parameters for monitoring (Figure 3). The model illustrates the effects of important natural and anthropogenic activities that result in different ecological stressors on the system. The model has helped to identify hypothesized effects of restoration actions on selected performance measures defined for broader physical, chemical, and biological attributes of the system.

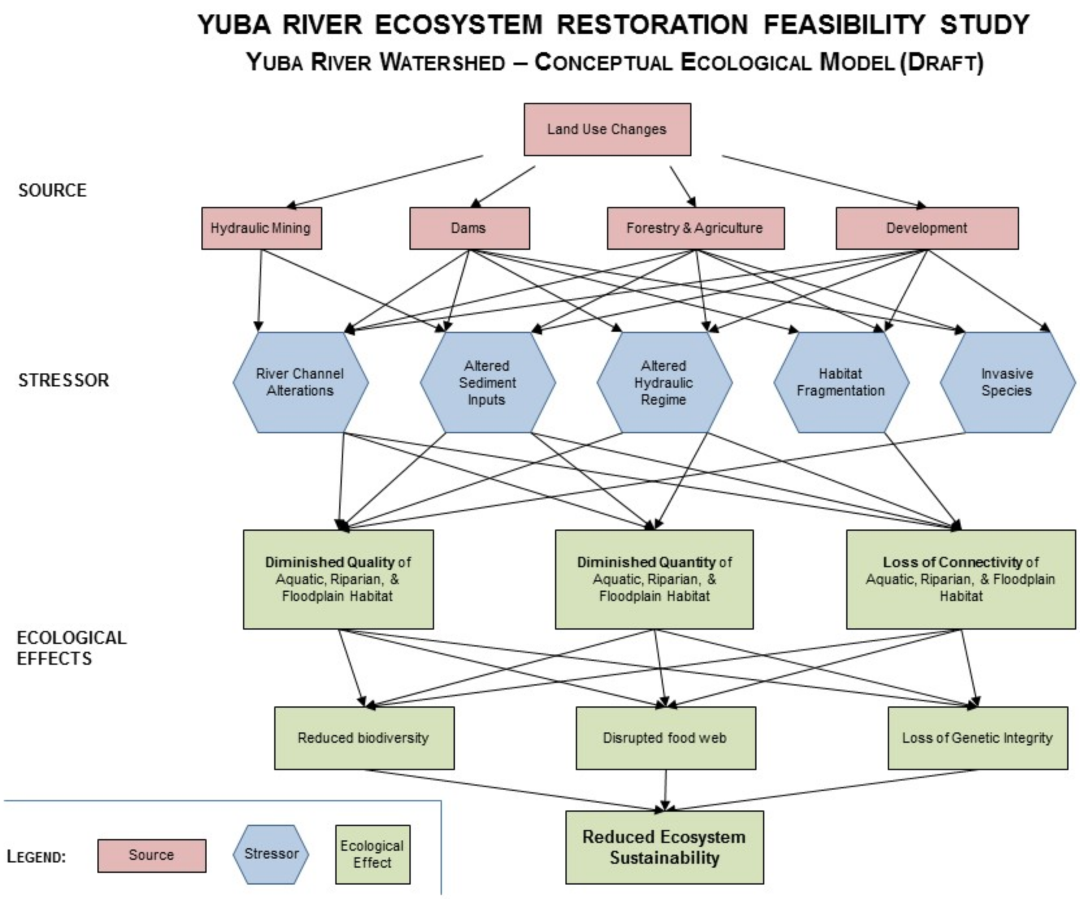

Figure 3. YRERFS Conceptual Ecological Model

2.4 Sources of Uncertainty

Adaptive management provides a coherent process for making decisions in the face of uncertainty. Scientific uncertainties and technological challenges are inherent with any large-scale ecosystem restoration project. Below is a list of uncertainties associated with restoration of the YRERFS.

- Unpredictable climatic conditions and flow extremes
- Ability of ecological and hydrologic models to predict project impacts/benefits

- High level of habitat degradation may render traditional restoration methods ineffective
- Limited ability to predict invasive species impacts
- Reliance on existing information to establish baseline environmental conditions, dynamic river conditions may result in significant differences in existing conditions (on a site specific level) during later phases of project implementation
- Limited ability to predict changes to critical physical habitat variables (i.e., flow and temperature)

3.0 Monitoring and Adaptive Management Plan

This section will described the monitoring, assessment, and decision making processes that form the basis of adaptive management. This section will establish conceptual habitat restoration proposals, performance standards, and outline adaptive management measures and costs. Conceptual habitat restoration proposals are based on the project goals and objectives described above. Performance criteria includes specific feature(s) to be monitored to determine project performance. Performance standards are established below for each habitat type, and monitoring would be conducted with the intent of meeting those standards. Adaptive management measures are actions identified to address potential mechanisms for failure of project features meeting performance criteria. Triggers for implementation adaptive management and specific adaptive management measures and are established below for each habitat type.

Monitoring must be closely integrated with all other adaptive management components because it is the key to the evaluation, validation, and learning components of adaptive management. Over the 3 to 5 year site establishment period, improvements in field and analytic techniques may lead to changes in the monitoring methodology. Furthermore, unrealistic expectations or inaccurate assumptions can lead to the establishment of inappropriate monitoring objectives. It is possible that a decision to modify success criteria might be reached based on results after several years of monitoring. While the aquatic habitat and riparian habitat monitoring strategies described below build on past experiences, it is likely that other opportunities for improvement will be identified in the future that should be incorporated into the M&AM Plan. In the future, there may be a determination that specific performance standards have been met and that associated monitoring tasks could cease. Similarly, it could be determined that a monitoring task was not returning useful information, and therefore not worth the expense of continuation.

When possible, specific monitoring and large scale information needs should be integrated with existing monitoring efforts that are underway in the Yuba River watershed. During the PED phase the PDT will explore opportunities to collaborate with existing monitoring networks to achieve the monitoring objectives associated with this project. Any changes to an adaptive management plan would be coordinated with HQUSACE Chief of Planning and Policy.

Monitoring for ecological success and adaptive management for the project will be initiated upon completion of individual elements or as baseline data are needed and continue until ecological success is achieved, as defined by the project-specific objectives. This monitoring plan includes the minimum monitoring actions to evaluate success and to determine adaptive management needs. Although the law allows for up to ten years of cost-shared implementation of the monitoring plan, ten years of monitoring may not be required. Once ecological success has been achieved, which may occur in less than ten years post-construction, no further monitoring will be performed. If success cannot be determined within that ten-year period of monitoring, any additional monitoring will be a non-Federal responsibility. This plan estimated monitoring costs for a period of ten years because that is the maximum allowed federal contribution to monitoring. Following successful establishment of project features, the project would be managed following guidelines outlined in the Operations Maintenance, repair, replacement, and rehabilitation (OMRR&R) plan.

The following discussion outlines key components of a monitoring plan that will support the YRERFS Adaptive Management Program. The plan identifies performance measures along with desired outcomes and monitoring designs in relation to specific project goals and objectives. Although the study initially included major longitudinal connectivity objectives (i.e. fish passage), proposed measures relating to fish passage were screened from inclusion in the final array of alternatives and therefore no monitoring objectives were developed for those type of connectivity actions. Additional monitoring would be identified as supporting information needs that will help further document project effects. It is important to note that there is a high degree in overlap between anticipated benefits of proposed actions; for the purpose of this M&AM plan, project success will be evaluated based on two habitat types, aquatic habitat and riparian habitat.

3.1 Aquatic Habitat

3.1.1 Objectives and Implementation Strategy

The primary objectives for restoration of aquatic habitat are to restore the quantity, quality, complexity, and connectivity of these habitats. Although aquatic habitats support a wide range of terrestrial and aquatic wildlife and vegetation, the proposed restoration measures are generally modeled to benefit rearing (fry and juvenile) salmonids. Proposed measures focus on rearing salmonids because they are a keystone species and improvement to these species' habitat are expected to benefit the ecosystem as a whole. Rearing habitat, in general, encompasses a wide variety of microhabitats and physical disturbance of the river has reduced the quantity and diversity of those habitats. The proposed actions for the improvement to aquatic habitat include the creation of additional diverse aquatic habitat types such as secondary channels, backwaters, floodplain lowering, and shoreline sculpting as well as installation of complex riparian features. These habitat improvements would be accomplished through excavation of sediment and addition of riparian features (vegetation and structural complexity). Creation of these features is expected to benefit the ecosystem through the creation of additional microhabitat types that support a more diverse range of species and life histories.

3.1.2 Success Criteria

Successful establishment of aquatic habitat would be evaluated through restoration of physical habitat, including depth, velocity, and area. The performance standards used to determine success of habitat restoration are described in Table 1 below. Indicators of biological function will be incorporated into the monitoring, however, specific quantitative criteria for biological success would not be considered.

3.1.2.1 Physical indicators of success

Depth and velocity are critical components of aquatic habitat and support a variety of biological and abiotic functions. Depth and velocity serve as important indicators of shallow water refuge for juveniles as well as food and resting areas. By using rearing salmonid habitat requirements as a basis for restoring aquatic habitat, this study is assumes that conditions suitable for juvenile salmonids would provide a benefits to the broader ecosystem. It is also important toacknowledge that a broader range of depths and velocities, considered unsuitable for juvenile salmonids would likely provide value to the ecosystem (other life stages and species);however, the proposed measures are intended to create aquatic habitat with depths and velocities suitable for rearing salmonids and therefore, the success criteria will be based on meeting those design criteria (Engineering Appendix B to the Integrated Feasibility Report/ Environmental Assessment - Design Criteria Attachment). In establishing indicators of success, a distinction was made between project features that were permanently inundated and features that were temporarily inundated.

For permanently inundated features (i.e., secondary channels, backwaters, and shoreline sculpting)the design goal was to create additional perennial aquatic habitat. The suitable range of depths and velocities are based on providing aquatic habitat during the critical summer rearing period (June – September) for steelhead and spring-run chinook. The design goal for depth for these features is to establish 0.5 ft of inundation at base flow discharge (730 cfs above Daguerre Point Dam, 530 cfs below Daguerre Point Dam). A design depth 0.5 ft would provide about 0.5 suitability habitat value for juveniles and optimal suitability (1.0) for fry at base flow. Water depth and velocity suitability ranges were obtained from YRDP Relicensing Participants HSCs (YCWA 2013). To remain consistent with the design criteria the range of suitable depths will be based on a lower limit suitability threshold of 0.5. For the purpose of this M&MP the minimum and maximum depths will be selected for steelhead and chinook rearing lifestages. Given these considerations, the aquatic habitat restoration would be considered successful if the average depth of the created aquatic feature is between 0.3 ft (lower limit based on steelhead fry) to 4.8 (upper limit based on steelhead juvenile).

The same assumptions for determining a range of suitable depths was applied to determining the range of suitable velocities. The upper and lower limits of velocity were based on the greatest range of tolerance for velocities that provide a minimum of 0.5 habitat suitability value. Given these considerations, the aquatic habitat restoration would be considered successful if the average velocity of the created aquatic feature is between 0 ft/sec (lower limit based on all rearing lifestages for steelhead and chinook) to 1.95 ft/sec (upper limit based on steelhead and chinook juvenile). Depths and velocities in restored aquatic features are dependent on discharge and the above success criteria should be evaluated under base flow conditions.

Area is another important physical indicator of successful site establishment in that it provides a simple measure of quantitative performance. Area will be measured as the two-dimensional wetted area of a feature at base flow. No broadly applied minimum area would be established for determining successful establishment of habitat features because each habitat feature would be created on a site specific basis and would vary in the initial design and construction of wetted area. Successful establishment of area would be based on maintaining a percentage of initial design. For the purpose of this M&AM plan, permanently inundated features would be considered successfully established if the features maintain a minimum of 80% of the wetted area at baseflow of the initial designed and constructed area. The success criteria for area is not directly linked to specific biological functions, rather it represents a target for design and construction. Successful establishment of wetted area, coupled with depth and velocity, would ensure that a feature was providing suitable quantity and quality of habitat.

For temporarily inundated features (i.e., lowered floodplains), the design goal was to create additional seasonally inundated salmonid rearing habitat during the spring rearing and growth period. Lowering the floodplain would increase inundation frequency and duration and support establishment of vegetation, increased production of benthic macroinvertebrates, and increase access to off channel rearing habitat. An inundation duration of 21 days would support these functions. The suitable range of depths and velocities would be the same as those set for perennially inundated aquatic habitat features, however, due to the sloped nature of the floodplain, the target depths and velocities would only be expected to occur near the shoreline. The target depths and velocities would be evaluated between 2000 cfs (design flow for at which lowered floodplains begin to be inundated) and 5000 cfs (approximate bankfull flow).

As with permanently inundated features, establishment of temporarily inundated features would be considered successful if 80% of the initially designed and constructed wetted area is maintained. One key difference is that temporarily inundated features are designed to provide habitat between 2000 and 5000 cfs. During final design and construction of temporarily inundated features, the anticipated inundation area under a range of flows should be established for use during monitoring and adaptive management.

An important component of demonstrating successful establishment of project features is durability. While the project aims to establish features in perpetuity, it is beyond the scope of a M&AM Plan to monitor project performance for an extended period of time. Long term durability is ensured through development and adherence to an OMRR&R Plan. For the purpose of this M&AM Plan, temporal success criteria were established to demonstrate a reasonable level of success. As with the other indicators of success, separate temporal success criteria were established for permanently and temporarily inundated features.

For permanently inundated features, establishment would be considered successful if physical indicators (depth, velocity, and area meet the established success criteria during and at the end of the 5 year monitoring period. Monitoring would occur for a minimum of 5 years which would provide a reasonable opportunity to evaluate the response of constructed features under to the target range of flow conditions (baseflow to bankfull discharge). For the purpose of this analysis, baseflow conditions would be expected to occur each year and bankfull conditions were defined as a discharge of 5,000 cfs which has an 80% Annual Chance of Exceedance (Wyrick and Pasternack 2012). Given these parameters bankfull conditions would be observed 4 times during a 5 year monitoring period.

For temporarily inundated features, establishment would be considered successful if physical indicators (depth, velocity, and area meet the established success criteria during and at the end of the 5 year monitoring period. Monitoring would occur for a minimum of 5 years.

3.1.3 Monitoring Strategy

As described above, the monitoring strategy is focused on successful establishment of critical physical habitat attributes. Monitoring for physical habitat structure would include 1 survey prior to construction to establish existing conditions. Following construction, monitoring would be conducted annually for a minimum of 5 years. If success criteria are not met within 5 years, monitoring would continue every 2 years after (year 6, 8, 10) or until success criteria are met (up to a maximum of 10 total years of monitoring). Monitoring for physical habitat attributes in permanently inundated features would be conducted between June and September each year and in temporarily inundated features February and June each year.

Table 1. Performance standards for physical indicators for aquatic habitat restoration: depth and velocity

Feature	Suitable Depth (ft)	Suitable Velocity (ft/sec)	Wetted Area	Inundation Duration	Evaluation Discharge
Secondary Channel, Backwater, and bank sculpting	0.3 – 4.8	0 – 1.95	80% of total area as designed and constructed	June - September	Baseflow (730 cfs upstream of DPD/ 530 cfs downstream of DPD
Lowered floodplain	0.3 – 4.8	0 – 1.95	80% of total area as designed and constructed	21 days minimum (February – June)	2000 cfs – 5000 cfs

Physical habitat attributes including depth, velocity, and wetted area would be evaluated over the length of the restored areas at transects spaced every 10m. Depth would be sampled with a stadia rod along each transect measured at intervals of 3 ft from the perimeter to the midpoint of the wetted area of the feature. This method would support development of an average depth. Velocity would be sampled with a flow meter at half the depth of the water column at the same sample locations as depth measurements. Area would be recorded by walking the perimeter of the wetted area of the feature using a handheld GPS unit with sub-meter accuracy. Upstream and downstream gage data would be recorded for the dates of the surveys.

In addition to monitoring physical parameters additional data would be collected to provide a better context for implementing adaptive management including: substrate classification, habitat type classification, gradient, photos, in water structural elements, wildlife use, and site disturbance. Observations of wildlife use would include snorkel surveys to provide a qualitative evaluation of fish use of created and restored aquatic habitat.

Monitoring reports documenting the restoration effort would be prepared following the first monitoring period and would continue annually until the site has met the success criteria. The report would summarize and analyze all monitoring activities with overall evaluation of the performance of the success criteria. Additional results, analysis, proposed adaptive management measures, and associated costs would be incorporated into the monitoring report.

3.1.4 Adaptive Management Strategy

If the habitat is not meeting the success criteria established above, then adaptive management would be implemented in order to ensure that the habitat establishment is successful. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

3.1.4.1 Adaptive Management Triggers

Desired Outcome: Maintain depth and velocity within suitable ranges at base flow conditions (June – September) in restored secondary channels, backwaters, and shoreline sculpted areas.

Triggers: if average depth and velocity in these features is not within the suitable range at base flows.

Desired Outcome: Maintain depth and velocity within suitable ranges between 2000 cfs and 5000 cfs (February – June) in restored floodplain areas.

Triggers: if average depth and velocity in these features is not within the suitable ranges between 2000 cfs and 5000 cfs (February – June) in restored floodplain areas.

Desired Outcome: Maintain wetted area within 80% of designed and constructed features. For permanently inundated features, this area would be evaluated under baseflow conditions (June – September). For temporarily inundated features, this area would be evaluated between 2000 cfs and 5000 cfs (February – June).

Triggers: If wetted area is less than 80% of designed and constructed features at target flow conditions.

3.1.4.2 Adaptive Management Measures

If the triggers established above occur, the following measures would be considered in order to adaptively manage the site for success.

- Regrading or reconfiguration of terrain.
- Addition or reconfiguration of hydraulic control elements (i.e., boulders, large woody material, engineered log jams, and bank armoring).

3.2 Riparian Habitat

3.2.1 Objectives and Implementation Strategy

The primary objectives for restoration of riparian habitat are to restore the quantity, quality, complexity, and connectivity of these habitats. Riparian vegetation is an important component of river ecosystems. Improvements to riparian habitat are expected to increase productivity across multiple trophic levels as well as provide physical structure and complexity that would support a variety of terrestrial and aquatic wildlife. The species composition and distribution of riparian vegetation has been altered through various human related impacts, especially legacy and ongoing mining activities. Natural recruitment and survival of riparian vegetation in the lower Yuba River is generally restricted to areas that provide adequate depth to ground water. Riparian vegetation along the lower Yuba River banks generally occur in narrow bands consistent with a narrow range of suitable hydrologic conditions. The strategy for improving the quantity, quality, complexity, and connectivity of riparian habitat is to improve topographical conditions through floodplain lowering to support adequate survival of riparian vegetation and also to plant riparian vegetation in suitable areas. Floodplain lowering would occur in areas between 7 -10 ft above the water table. Riparian planting would occur on lowered floodplains and areas of existing suitable depth to water table and would include Fremont cottonwood (*Populus fremontii*), Gooddings black willow (*Salix gooddingii*), red willow (*S. laevigata*), and arroyo willow (*S. lasiolepis*). As native vegetation matures, it helps to stabilize stream banks and shorelines; provides food, shelter, shade, and access to adjacent habitats; creates pathways for movement by resident and nonresident aquatic, semi-aquatic, and terrestrial organisms; and improves and protects water quality by reducing the amount of sediment and other pollutants such as pesticides, organic materials, and nutrients in surface runoff.

3.2.2 Success Criteria

Monitoring of riparian habitat would focus on: (1) the percent of canopy cover of native plant species; (2) the percent survival of planted vegetation; (3) the percent cover of native plant species; and (4) the percent cover of non-native invasive species that out-compete natives. The performance standards used to determine success of habitat restoration are described in Table 2 below.

Table 2. Riparian Habitat Performance Standards.

Performance Standard	Quantitative Measure
Percent of canopy cover	37.5%
Survival of planted vegetation	50% survival
Percent cover of native plant species	75%
Percent cover of non-native species	Less than 15%

Percent canopy cover and survival of planted vegetation are important critical components of riparian habitat restoration. Successful establishment of these attributes would ensure that the restored riparian habitat develops to a functional condition and provides benefits to the ecosystem. The target canopy cover for riparian planting is 50% of the restored area such that a portion of the area remain exposed for natural plant recruitment. The performance standard for canopy cover was set at 75% of the target planted area, 37.5%. The existing and degraded conditions on the lower Yuba River, including coarse substrates and altered hydrologic regimes/ high floodplains, limit the successful recruitment of native riparian species. To address these challenges, riparian species will be planted via a stinger, which facilitates direct installation of dormant pole cuttings to suitable depths. This planting method has been demonstrated on the lower Yuba River to have an approximate 50% survival (SYRCL 2013); therefore the target survival for riparian plantings is 50%. Riparian plantings would be planted with redundancy and in patches to facilitate achievement of target canopy cover.

Percent cover of native and non-native species are critical components to riparian habitat restoration. Successful establishment of these attributes would ensure that the restored riparian habitat is appropriate for the ecosystem and supports native fauna. Non-native species, especially those species that are invasive have the potential to outcompete native planted vegetation and reduce the overall value of the riparian habitat. The target for native species cover was set at 75% to ensure that although some non-native species may recruit into the restored area, the majority of the restored area would consist of native species. The target maximum for non-native, invasive species was set at 15% to ensure that although some non-native species may recruit into the restored area, the majority of the restored area would consist of native species.

An important component of demonstrating successful establishment of project features is durability. While the project aims to establish features in perpetuity, it is beyond the scope of a M&AM Plan to monitor project performance for an extended period of time. Long term durability is ensured through development and adherence to an OMRR&R Plan. For the purpose of this M&AM Plan, temporal success criteria were established to demonstrate a reasonable level of success. Vegetation indicators will be monitored for a minimum of 3 years to allow for a reasonable period of time to observe the response of project features to a full range of target flow conditions. For riparian habitat features, establishment would be considered successful if vegetative indicators meet the established success criteria for 2 consecutive seasons and at the end of the 3 year monitoring period. It is important to note that the initial construction/ planting of riparian vegetation would include contractual based establishment requirements separate from those described in this M&AM plan. Those separate establishment requirements would be considered a component of construction and M&AM would not begin on those features until those contractual establishment requirements were met.

3.2.3 Monitoring Strategy

The following monitoring procedures will provide the information necessary to evaluate the success of riparian habitat restoration. Monitoring for riparian vegetation attributes would include 1 survey prior to construction to establish existing conditions. Follow construction monitoring would be conducted annually for a minimum of 5 years and every 2 years after (year 6, 8, 10) or until success criteria are met (up to a maximum of 10 total years of monitoring). Sampling will occur during spring months, at the peak of growing season, and will consist of permanent field monitoring plots along one or more transects either perpendicular to the river or parallel to the floodplain slope. Plots will be located randomly within each site, and the distance between plots and along transects will be site specific. Woody species with overhead canopy cover that falls along the vegetation monitoring transect, including those that were planted, have recruited naturally to the site, or were existing at the site prior to planting efforts would be recorded. Monitoring will measure the overall cover of riparian vegetation, survival of planted vegetation, and percent cover of native and non-native plant species. Photograph stations are also important for documenting vegetation conditions. All plots and photograph stations will be documented via Global Positioning System (GPS) coordinates to maintain consistency throughout the monitoring period.

In addition to the data collected to determine success, general observations, such as fitness and health of plantings, native plant species recruitment, and signs of drought stress would be noted during the surveys. Additionally, flood damage, vandalism and intrusion, trampling, and pest problems would be qualitatively identified. A general inventory of all wildlife species observed and detected using the mitigation site would be documented. Nesting sites and other signs of wildlife use of the newly created habitat would be recorded.

Monitoring reports documenting the restoration effort would be prepared following the first monitoring period and would continue annually until the site has met the success criteria. Monitoring reports would include photos, the timing of the completion of the restoration, what materials were used in the restoration, and plantings (if specified). Monitoring reports would also include recommendations for additional adaptive management measures, if necessary.

3.2.4 Adaptive Management Strategy

If the habitat is not meeting the success criteria established above, then adaptive management would be implemented in order to ensure that the habitat establishment is successful. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

3.2.4.1 Adaptive Management Triggers

Desired Outcome: increase percent cover of riparian vegetation.

Triggers: If 37.5% canopy cover of riparian habitat or 50% survival of planted vegetation is not achieved within the monitoring period.

Desired Outcome: maintain majority of native species contribution to canopy cover

Triggers: if percent of native species canopy cover falls below 75% native species or if percent of non-native species cover exceeds 15% within the monitoring period.

3.2.4.2 Adaptive Management Measures

If the triggers established above occur, the following measures would be considered in order to adaptively manage the site for success.

- Replanting may be needed if triggers for vegetative cover, survival, and native species composition are met. Monitoring results should be used to assess the underlying cause of inadequate cover, which may require that additional adaptive management actions be implemented to support successful replanting. Adaptive management actions could include targeted revegetation, such as replanting varieties of species that are exhibiting the greatest growth and survival, or planting at elevations that are exhibiting the greatest growth and survival.
- Nonnative species management such as plant removal may be needed if monitoring results show that the triggers for nonnative species present are met, or if nonnative species are impacting the survival of native species.
- Plant protection may be needed if triggers for vegetative cover and/or survival are being met. If monitoring results show that plantings are failing due to predation or trampling from human use, then adaptive management actions would include plant cages that could be installed to protect plantings.

4.0 Costs for Implementation of Monitoring and Adaptive Management

The costs associated with implementing these monitoring and adaptive management plans were estimated based on currently available data and information developed during plan formulation as part of the feasibility study. Because uncertainties remain as to the exact project features, monitoring elements, adaptive management opportunities, and the costs thereof, the quantities estimated in Tables 3 and 4 (below) will be need to be refined in PED during the development of the detailed monitoring and adaptive management plans. The current total estimated cost for implementing the monitoring and adaptive management programs is **$3,750,700.**

4.1 Costs for Implementation of Monitoring Program

Costs to be incurred during the PED and construction phases include drafting of the detailed monitoring plan, monitoring site and system establishment, and pre-construction and construction data acquisition to establish baseline conditions. Cost calculations below assume that project features would be successfully established at the end of initial monitoring (5 years for aquatic habitat and 3 years for riparian habitat).

It is intended that monitoring will utilize standardized data collection, management, analysis, and reporting processes. Cost estimates include monitoring equipment, monitoring station establishment, data collection, quality assurance/quality control, data analysis, assessment, and reporting, and for the proposed monitoring elements (Table 3). The current total estimate for implementing the monitoring and assessment program is $**739,200**. Costs would begin at completion of the construction phase.

If success criteria are not met after initial monitoring, the monitoring activities would continue until success criteria are met and would be cost shared for up to ten years following construction. If monitoring is required beyond 10 years, costs would be the sole responsibility of the non-Federal sponsor. Costs associated with the maximum cost-shared amount of monitoring (i.e., up to 10 years) would be $1,238,400. If ecological success criteria are met prior to ten years post-construction, the monitoring program would cease and costs will decrease accordingly.

Table 3. Preliminary monitoring cost estimates for the YRERFS

Monitoring	Assumed Tasks for Monitoring	Frequency	Cost Assumptions	Total Cost
Aquatic Habitat Monitoring – Physical Habitat Attributes	Monitoring includes: depth and velocity in restored aquatic habitat elements.	1 Pre Construction survey; following construction annual surveys for 5 years	$80,000 per survey	$352,800
Riparian Habitat Monitoring	Monitoring includes: transects for total percent cover, survival, and percent cover of natives and non-natives.	1 Pre Construction survey; following construction annual surveys for 3 years	$64,800 per survey	$259,200
			TOTAL MONITORING COST	**$739,200**

4.2 Costs for Implementation of Adaptive Management Program

Costs for the project adaptive management program were based on estimated level of effort. These costs estimates assume that project features would be generally well established and a minimal level of adaptive management would be required to maintain project performance. If the results of the monitoring program support the need for physical modifications to the project, the cost of the changes would be cost shared with the non-Federal sponsor and must be concurred with by the non-Federal sponsor.

It is important to note that actions similar to those included as adaptive management measures are also included in OMRR&R assumptions. Although M&AM and OMRR&R actions may overlap in the type of actions and timing of implementation, M&AM and OMRR&R do not share costs. The costs below represent only actions implemented under the M&AM plan. In general this M&AM plan assumes that adaptive management efforts would be minimal (as represented by a 5% replacement of initial quantities) while OMRR&R assumes a higher level of effort to address a larger scope of uncertainty. The current total estimate for implementing the adaptive management program is **$3,011,500 (Table 4)**. Unless otherwise noted, costs will begin at the onset of the PED phase and will be budgeted as construction costs.

Table 4. Preliminary adaptive management measures cost estimates for the YRERFS

Adaptive Management Measures	Assumed Tasks for Adaptive Management	Cost Assumptions	Total Cost for 10 Years
Re-planting	Assume that assume 5% of vegetation may require replanting.	Assume replanting via stinger method at cost of $41,000 per acre. Costs referenced to similar action completed at Hammon Bar (SYRCL 2013)	$287,000
Plant Protection	Assume 5% of acreage will require plant cages (~10,500 plantings).	Assume $10/plant cage, at 1500 plants per acre + plus $7,500/acre for installation. Costs referenced from existing restoration contracts.	$157,500
Non-native species management	Assume implementation of non-native species management. (i.e. physical removal of non-native species) across 5% of total plated area (7 acres)	Assume $6,000 per acre. Costs referenced from existing restoration contracts.	$42,000
Aquatic feature regrading and realignment	Regrading of aquatic features (slope and feature alignment). Assume reworking of 5% of total initial excavated volume (40,000 CY)	Assume $62 per CY based on cost estimates developed for the YRERFS.	$2,480,000
Hydraulic roughness/ structural complexity element replacement or addition	Repair of existing and/or installation of new hydraulic roughness elements (boulders, large woody material, and engineered log jams) to maintain aquatic feature suitable characteristics (depth velocity). Assume replacement of 5% of an aggregate of these features (~5 features)	Assume $9000 per unit of wood, ELJ, or Boulder, based on cost estimates developed for the YRERFS.	$45,000
TOTAL ADAPTIVE MANAGEMENT			**$3,011,500**
TOTAL MONITORING AND ADAPTIVE MANAGEMENT			**$3,750,700**

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Environmental Appendix D
Attachment 7

Model Approval Documents
Yuba River Ecosystem Restoration Feasibility Study

November 2017

U.S. Army Corps of Engineers

Sacramento District

The Juvenile Steelhead HSI Model was approved for use by the USACE HQ Model Certification Panel for single-use in the Yuba River Ecosystem Restoration Feasibility Study. An official memo documenting the approval is being drafted [to be dated October 31, 2017] and will be included in the Final Feasibility Report/ Environmental Assessment.

Environmental Appendix D
Attachment 8

Habitat Evaluation Assessment Approach Technical Memorandum
Yuba River Ecosystem Restoration Feasibility Study

November 2017
U.S. Army Corps of Engineers
Sacramento District

CONTENTS

1.0 Introduction

The purpose of this technical memorandum (TM) is to document the assessment approach applied in the formulation, evaluation, and comparison of alternatives for the Yuba River Ecosystem Restoration Feasibility Study (YRERFS). The assessment approach will also support the identification of a National Ecosystem Restoration (NER) plan. Alternative comparison and NER identification will be completed by running a stand-alone cost effectiveness / incremental cost analysis (CE/ICA). The focus of this document is in describing the process by which the inputs for the CE/ICA were developed. Several additional TMs were developed to support this assessment approach and are referenced in this document.

2.0 Background

The primary consideration in developing an assessment approach was to provide inputs to the CE/ICA in the form of annualized ecosystem outputs for each relevant project action. The CE/ICA will then be used to evaluate project increments, formulate alternatives, and support identification of the NER plan. "Increments" are geographic groupings of inter-related measures into logical and efficient units for the formulation of alternatives. This assessment approach will be applied to changes in habitat quantity and quality, but is not intended to be used to assess changes in fish passage efficiency.

In providing adequate inputs for the CE/ICA, it was determined that the assessment approach would need to (1) provide an equitable evaluation that adequately distinguishes between all increments, and (2) be based in 3x3x3 planning principals. The first consideration was satisfied by developing an assessment approach that would produce a broadly applicable output (habitat units) based on a multi-species/ multi-habitat evaluation. The second consideration resulted in a number of assumptions and simplifications that streamlined the overall assessment approach and maximized the use of existing information.

The PDT identified the Habitat Evaluation Procedures (HEP) framework as meeting the needs for an assessment approach. The assessment approach would provide an evaluation in terms of acre-based habitat units. The quality component of habitat units would be calculated through the application of habitat suitability relationships of representative species. An integral part of this assessment approach would include hydraulic modeling of increments to evaluate changes to key features of aquatic habitat.

3.0 Assessment Approach Framework

The PDT determined that a HEP framework would provide a suitable multi-habitat/ multi-species assessment approach to evaluate and compare increments. The HEP is a process developed by the U.S. Fish and Wildlife Service (1980a and 1980b) to facilitate the identification of impacts from various types of actions on fish and wildlife habitat. The basic premise of HEP is that habitat quantity and quality can be numerically described. HEP can provide a comparison of habitat quality between different sites or between different times at one site (for example, pre-construction versus post-construction). A key assumption in HEP is that an individual species "prefers" (or survives/reproduces better) in habitats with certain physical characteristics that can be measured. For example, if yellow warblers typically nest in deciduous shrubs, then sites with greater deciduous shrub cover are more suitable for yellow warblers than sites which have little or no deciduous shrub cover.

A habitat suitability index (HSI) is the typical format used in HEP which is a mathematical relationship between a physical, chemical, or biological habitat attribute and its suitability for a single species or assemblage of species. In this assessment, the habitat attributes used to indicate suitability for a given species are referred to as Habitat Suitability Criteria (HSC). The Suitability Index (SI) is a unit-less number that describes the requirements of a species for certain attributes such as cover, distance to foraging, etc. The relative suitability value of an HSC ranges from 0.0 (indicating unsuitable habitat) to 1.0 (indicating optimal habitat) (YCWA 2013). Each HSC will have a corresponding SI. A set of one or more SIs that represent key habitat requisites for the species during one or more life history stages are combined into an overall HSI by adding or multiplying the individual indices. The mathematical combination of HSCs into an overall HSI, justified through biological relationships is referred to as an HSI model. The attributes are measured in the field or via analysis using geographic information system (GIS) programs and data, and their corresponding index values are inserted into the model to produce a score that describes existing habitat suitability. The overall HSI value is also an index score between 0 and 1. This index value can be multiplied by the area of the site to yield Habitat Units (HUs), or it can be used as an index score for a habitat quality comparison only.

The juvenile steelhead HSI model along with the yellow warbler HSI model and the downy woodpecker HSI model will be used to evaluate habitat response (habitat units) for each key habitat type under Future-Without-Project (FWOP) and Future-With-Project (FWP) conditions. The results from each of the affected key habitat types would be summed to evaluate overall habitat response of each increment. Prior to discussing the step-by-step calculation of ecosystem output, some background is required on a number of concepts that provide a framework for the assessment approach.

3.1 Key Habitat Types and Representative Species

In developing the HEP framework, the PDT identified key habitat types likely to be affected by proposed project actions. Key habitats identified for evaluation include: (1) riverine habitat; (2) riparian scrub-shrub; and (3) riparian forest. Riverine habitat describes the continuous open-water areas that occur within the channel. The physical extent of riverine habitat varies with flow. Riparian scrub-shrub describes dry floodplain habitat with hydrophytic vegetation <5 m in height. Riparian forest describes dry floodplain moving into upland habitat >5 m in height. These key habitat types were selected based on a GIS analysis of existing conditions in the project area. Additional habitat types were identified in the project area, including barren, grassland, and agricultural; however, these habitat types were not included in the assessment approach because either their existing value was considered to be insignificant or they were not likely to be subject to change as the result of any proposed actions. The key habitat types selected for inclusion in this assessment approach are adequate to support evaluation of the full range of actions.

Representative evaluation species were selected for each key habitat type based on several criteria: (1) species known to be sensitive to specific land- and water- use actions; (2) species that play a key role in nutrient cycling or energy flow; (3) species that utilize a common environmental resource; (4) species that are associated with important resource problems, such as anadromous fish and migratory birds; (5) species have existing habitat response models relative to the proposed actions; (6) habitat data available or easily collected to support modeling; (7) species provides relevant evaluation throughout the geographic range of proposed actions and across the broad range of effects of proposed actions. The species and corresponding HSI models selected to evaluate habitat were Central Valley steelhead (*Oncorhynchus mykiss*, juvenile rearing lifestage), yellow warbler (*Dendroica petechial*, Schroeder 1982a), and downy woodpecker (*Dryobates pubescens*, Schroeder 1982b) (Table 1).

3.1.1 Juvenile Steelhead

The juvenile steelhead was selected as a representative species for the riverine key habitat type because it meets the criteria above and provides advantages over similar species.

- steelhead are known to be sensitive to specific land- and water- use actions and there is a well-documented history on the effect of anthropogenic actions on steelhead in the watershed;
- steelhead and other anadromous salmonids play a key role in ecosystems by bringing marine derived nutrients into a system on which a wide variety of plants and wildlife depend;
- steelhead are dependent on the broadly used resource of riverine and riparian habitat;
- steelhead and other anadromous salmonids have been at the focus of natural resource management in the watershed;
- there are existing habitat response models relative to the proposed actions for steelhead, although the models will require review and approval for use under USACE policy;
- there is habitat data available to support ecosystem benefits modeling;
- various life stages and life histories (resident & anadromous) occur throughout the watershed and all life stages occur within the area of effect of proposed actions.

Chinook salmon also meet many of the criteria described above, however, steelhead provide several advantages as a representative species. Steelhead provide a broader context as they exhibit both migratory and non-migratory life histories and are generally tolerant of a wider range of habitat conditions (i.e. temperature). The juvenile rearing life stage was selected for study because juveniles are dependent on the type of habitat features most relevant to the proposed habitat restoration actions (i.e. improvements to shallow water habitat/ seasonally inundated floodplain habitat). These species habitat relationships are reflected in the selected juvenile steelhead HSI model. Adult salmonid models are often focused on habitat requirements for spawning. The proposed actions under evaluation are targeted at improving habitat features associated with shallow water habitat (i.e. juvenile habitat features) rather than improvements to habitat features associated with adult habitat (i.e. spawning gravel, water quality).

The habitat suitability criteria selected for inclusion in the Juvenile Steelhead HSI model were depth, velocity, and cover. These habitat variables are critical to the juvenile steelhead habitat suitability and also are directly related to proposed measures.

3.1.2 Yellow Warbler

The yellow warbler was selected as a representative species for the riparian scrub-shrub key habitat type because it generally meets the criteria above and provides advantages over similar species.

- The yellow warbler nesting life requisites are associated closely with riparian and floodplain vegetation communities (particularly early seral cottonwood and willows);
- The yellow warbler occurs throughout the study area;
- The yellow warbler has an existing habitat response model relative to the proposed actions;
- Existing data for relevant yellow warbler habitat variables are available or easily collected to support modeling.

3.1.3 Downy Woodpecker

The downy woodpecker was selected as a representative species for the riparian forest key habitat type because it generally meets the criteria above and provides advantages over similar species.

- The downy woodpecker food life requisites is associated with riparian forest vegetation communities;
- The downy woodpecker occurs throughout the study area;
- The downy woodpecker has an existing habitat response model relative to the proposed actions;
- Relevant downy woodpecker habitat variables are easily developed from existing data to support modeling.
- The downy woodpecker HSI model was recommended for inclusion in this study by USFWS.

3.2 Affected Habitat Evaluation

For the purpose of this assessment approach, ecosystem output is defined as the net gain in habitat value as measured by acre-based habitat units for a given action. Because the evaluation of ecosystem output is a measure of change in value rather than a measure of absolute value, the evaluation of each increment was simplified by focusing on the anticipated effects of each increment. This approach will serve to limit the study area to include only the key habitat types identified above as well as guide the evaluation of project effects. For the purpose of this

Table 1. Key Habitat Types, Evaluation Species, and Habitat Suitability Criteria.

Key Habitat Type	Evaluation Species	Habitat Suitability Criteria
Riverine	Steelhead juvenile rearing life stage	• Depth • Velocity • Cover
Riparian Scrub-Shrub	Yellow warbler	• Percent deciduous shrub crown cover <5m • Average height of deciduous shrub canopy • Percent of deciduous shrub canopy comprised of hydrophytic shrubs
Riparian Forest	Downy woodpecker	• Basal area of forest

assessment approach, proposed actions were evaluated within an area corresponding 84,000 cfs (84,000 cfs is the upper limit of flow included in the hydraulic modeling and is inclusive of the full width of the floodway ~21,000 cfs) with an upstream/downstream limit of approximately 500 ft. beyond the extents of proposed habitat modifications. The upstream/downstream limits were based on a professional judgment estimate of a reasonable limit of hydraulic effects from proposedproject actions. This assumption is consistent with the general level of detail included in the modeling. In some instances these evaluation boundaries were reduced to accommodate adjacent evaluation units and/or exclude gaps within an evaluation unit.

3.3 Hydrologic Considerations

The ecological function and corresponding value of riverine and adjacent habitat types vary depending on seasonal fluctuations in flow. The riverine key habitat type will be evaluated through the application of a juvenile steelhead habitat suitability model; which includes physical habitat indicators of depth, velocity, and cover. The range of optimal depths, velocity, and cover conditions are typically associated with near shore, secondary channel, or temporally inundated areas; these areas will be generally concentrated along the margins of the river, which at any given time are dependent on flow. Riparian scrub-shrub and riparian forest key habitat types will be evaluated through application of yellow warbler and downy woodpecker habitat suitability models respectively, which include vegetation based habitat indicators such as height, cover, and basal area.

One key assumption of the HEP framework applied in this assessment approach is that the maximum potential output is one habitat unit per unit area (acre). For example, habitat units are calculated as the product of quality (habitat suitability) and quantity (habitat area). Quality is evaluated through application of HSI models, resulting in a value from 0 - 1. Quantity is evaluated in terms of acres. Because the maximum value for habitat quality is 1, the maximum habitat units per unit area is 1. For the purpose of this assessment approach, in which ecosystem output will be calculated as the sum of multiple key habitat types, for any single area, only 1 key habitat type will be identified and only 1 HSI model will be used to develop outputs. Given this assumption, as wetted area expands laterally with natural hydrologic patterns, the riverine key habitat type will also expand. The extents of riparian scrub-shrub and riparian forest key habitat types would conversely be reduced. This dynamic process is key to understanding potential ecosystem function and has been incorporated into the assessment approach in a number of ways. First, as described above, the extent of each key habitat type will be evaluated consistent with the extent of wetted area for a given flow. Second, proposed project increments were evaluated under a range of representative flow conditions. Evaluating a range of flows serves to provide understanding of habitat value as it varies spatially (depths, velocities, cover associated with shallow water habitat) and temporally (as flows fluctuate throughout the year). Under any given flow, inundated area will be evaluated as riverine habitat and the juvenile steelhead HSI model will be applied. In riparian scrub-shrub and riparian forest habitat types will be evaluated under conditions where appropriate vegetation exists above the water surface elevation. The range of flows selected for evaluation are documented below. Habitat units calculated for different flows will be combined into a single weighted average output based on relative frequency of each flow (described in more detail below).

3.3.1 Modeled Flow Considerations

As described above, consideration of a range of flows was necessary to provide a comprehensive evaluation of habitat value under naturally occurring conditions. The selection of flows to incorporate into hydraulic modeling was based on two primary considerations: (1) the range of flows needed to facilitate an evaluation of the natural range of hydrologic conditions in the Yuba River as they relate to assessing ecosystem outputs of proposed actions, and (2) the incorporation of flows into the hydraulic modeling should be done in a manner consistent with the level of detail of the overall assessment approach. Given these considerations, it was decided that a low flow case medium flow case, and high flow case would be modeled. For the purpose of the YRERFS a low flow case was based on minimum flow requirements in the Lower Yuba River described by the Yuba Accord (YCWA 2007), a medium flow case was based on an approximation of average annual discharge, and a high flow case was based on approximate bankfull discharge. Although annual flows greatly exceed the bankfull discharge, those high flows are less relevant to the evaluation as the proposed actions are designed to address habitat deficiencies at lower discharges. The high; medium and low flows are representative of around 94% of occurring annual flows. 42 years of flow record taken from Proposed Project and Base Case scenario from the YCWA relicensing website (YCWA 2012a, 2012b) were utilized to develop an annual average flow and bins of flow frequency over the period of record. Forty-two years of daily data is a robust data set that allows for a straightforward frequency analysis based on number of observations in a range vs total observations for the data set. The methodology for determining these high, medium, and low flows is given below.

3.3.1.1 Average Annual Flow

Flow observations for each calendar year were averaged, giving a data set of 42 average annual flow rates. Outlier flows greater than bankfull flow were assigned a bankfull value of 5,000 cfs for purposes of determining an average annual flow, so that outliers (extreme, infrequent events) did not disproportionately skew the average. The 42 average annual flow rates were then averaged, yielding an annual average of 1816 cfs. This average annual value was rounded to 1,850 cfs and was chosen as the target value for a bin, since average annual is an intuitive and representative value for the system.

3.3.1.2 - 700 TO 800 CFS BIN

Current and future operations call for a minimum flow of 700 cfs. In order to not fall below that minimum flow, a practical low flow of ~730 cfs to 750 cfs is expected in future operations. Choosing 800 cfs as an upper bound to this "low" bin yielded an average value of 750 cfs for all observations with the bin, giving a reasonable flow condition to model and a reasonable 100 cfs bin range (a smaller bin range could be problematic due to the accuracy of flow rate data). 7,205 observations fell within this 700 to 800 cfs bin, resulting in a frequency weighting of 7,205/14,610 = 49.3%.

3.3.1.3 - -800 TO 3240 CFS BIN

With 800 as a lower bound, the goal of the second "med" bin was to have the average of the observations within the bin to be close to the annual average flow of 1850 cfs. Setting the bin upper bound at 3240 cfs resulted in an average bin flow of 1852.7 cfs. The 800 to 3240 cfs bin contains 3,666 observations, resulting in a frequency weighting of 3,666/14,610 = 25.1%.

3.3.1.4 - 3,240 TO 8,000 CFS BIN

With 3,240 as a lower bound, the goal of the third bin was to have the average of the observations within the "high" bin to be close to a high end, near bankfull flow of 5,000 cfs. Using the full data set without outlier (>5,000 cfs) value reassignment, a bin upper bound of 8,000 cfs results in a bin average 5,000 cfs. The number of observations in the full data set contained within the 3,240 to 8,000 cfs bin is 2,815, resulting in a frequency weighting of 2,815/14,610 = 19.3%.

3.3.1.5 - 8,000+ CFS BIN

The remaining observations greater than 8,000 cfs have a frequency weighting of 6.3%. These flows were considered to be outlier flows, resulting in hydrologic conditions beyond the range of anticipated performance for proposed actions. During high flows, the Lower Yuba overtops its normal banks and spreads out over a broad area; the benefits of the proposed restoration features would not be expected to be significant under these conditions. Therefore, while a fourth bin of flows was identified, these flows were not included in the hydraulic modeling. For the purpose of the ecosystem modeling, these flows (weighted at 6.3%) were assumed to have 0 value for both Future Without Project (FWOP) and Future With Project (FWP) conditions. A summary of the bins and the observations within them for the 750, 1,850, and 5,000 cfs flow scenarios is presented in Table 2 below.

Table 2. Summary of hydraulic modeling representative flows and binning of observations

	Low Flow	Medium Flow	High Flow
Target Average Flow (cfs)	750	1850	5000
Lower Bound of Bin	700	800	3240
Upper Bound of Bin	800	3240	8000
Number of observations (14610 total)	7205	3666	2815
Weighting (% of total flows)	49.3%	25.1%	19.3%
Average Flow (cfs)	751	1853	5001

3.3.1.6 - Application

The representative low, medium, high flows will be incorporated into the hydraulic and ecosystem modeling. The overall assessment approach strategy will evaluate ecosystem output through a modular approach; ecosystem value will be evaluated as the aggregate of key habitat types. Key habitat type value will be evaluated through the use of representative species. This approach will be accomplished by applying HSI models for representative species to key habitat types in a HEP framework. This evaluation strategy will be applied iteratively to each sub-unit of analysis under a wide range of scenarios; habitat value for sub-units of evaluation (i.e. key habitat types) will be used to develop averages to facilitate a broader comparison of alternatives. Scenarios include, for each proposed action: a range of hydrologic conditions, a range of key years of analysis, under both FWOP and FWP conditions. Additional details regarding the development of flow weighted average habitat output, is described below.

3.3.1.7 - Hydrologic Uncertainty

The potential disruption of project features from naturally occurring dynamic processes is important to understand as incurred effects could be beneficial or detrimental to the ecosystem. For the purpose of this assessment approach it was assumed that the relative risk of disruption to any particular feature and subsequent effect to ecosystem benefits would be equal, therefore, any estimate of risk would be applied equally to all proposed increments and would not affect the relative evaluation and comparison of these proposed increments. Given this consideration and the inability at this time to reasonably quantify potential risk from dynamic riverine processes, these processes have not been incorporated into the modeling. These dynamic processes will be taken into consideration in the Monitoring and Adaptive Management Plan (Environmental Appendix D) and in the development of project costs (specifically OMRR described in the Engineering Appendix). Furthermore, it is anticipated that detailed designs will take into consideration the site specific dynamic riverine processes and develop features to be resilient to disruption and/or benefit from the natural conditions to ensure that the project continues to meet objectives.

3.4 Model Platform

Although HSI models are traditionally performed in a spreadsheet environment, for the purpose of the YRERFS, the HSI models will be applied in the ArcGIS platform. Specifically, ArcGIS will be used to calculate habitat suitability for each representative species and corresponding key habitat type. The application of the assessment approach within ArcGIS accommodates all considerations described within this document, including 3 key habitat types, future without and future with-project conditions, a range of flows, and a range of key years of analysis. Calculation of habitat units for each key habitat type would be followed by a process of combining and annualizing outputs for key habitat types. This will be conducted using more traditional spreadsheet-based methods.

ArcGIS will facilitate an evaluation of increments at a resolution critical to understanding and evaluating benefits. As the range of anticipated benefits of habitat improvement measures (SIs presented in Tables 3 - 5 below) are focused in shallow and or low velocity areas. A HSI applied through a spreadsheet model would result in an averaging of physical habitat indicator conditions over a defined project area. This process of averaging is suitable for the evaluation of relatively uniform habitat types or project features, as is the case with riparian scrub-shrub and riparian forest. In the case of riverine habitat as evaluated through the juvenile steelhead HSI model, the averaging of depths, velocities, or cover across the full width of a riverine area could result in a single representative value that provides little or no habitat suitability value to the representative species. In other words, a broad scale application of an HSI model can result in a loss of the ability of the model to evaluate changes in microhabitat types. The juvenile steelhead HSI habitat-suitability relationships (SIs) describe a relatively narrow range of suitable depths and velocities. Although a spreadsheet application of the HSI model is not technically limited to a broad scale application, it is impractical to design a highly spatially detailed application of an HSI model without the support of a GIS program to manage data. ArcGIS will facilitate the evaluation of habitat suitability across a grid of fine scale, discrete locations, such that the anticipated ecosystem benefits that occur across a narrow range of habitat conditions would not be averaged out of consideration by areas of unsuitable habitat conditions. Furthermore, ArcGIS would facilitate the added complexity by providing a framework for managing the large data sets and synthesizing that fine scale analysis in a single output.

Specific application of the assessment approach in ArcGIS is summarized below.

4.0 Ecosystem Output Calculations

The process by which ecosystem outputs is calculated is summarized briefly below:

1. Develop inputs for each physical habitat variable (i.e., vegetation and hydraulic parameters included in each representative species HSI model)
2. Calculate the relative habitat suitability for each physical habitat variable type through the application of SIs.

3. Calculate the total habitat suitability value of each key habitat type by combining the habitat suitability for each physical habitat variable through application of HSI model formulas.
4. Calculate habitat units for each key habitat type by multiplying habitat suitability for each key habitat type by the corresponding area.
5. Calculate flow weighted average habitat units for each key habitat type based on frequency of occurrence of flows.
6. For each increment, calculate total habitat units as the sum of habitat units for each key habitat type. Habitat units for FWOP and FWP conditions are calculated separately.
7. Calculate average annual habitat units (AAHUs) for FWOP and FWP using the IWR Planning Suite Annualizer Tool. Annualization requires that habitat units for FWOP and FWP conditions (steps 1 – 5) be calculated for key years of analysis (i.e., 0, 1, 5, 15, 25, and 50).
8. Calculate ecosystem output as the difference between FWP and FWOP AAHUs.

Following is a more detailed outline of the ecosystem output calculation process (Figure 1). The full calculation of ecosystem outputs for the YRERFS involves a large number of assumptions in the development of inputs as well as the specific process-related calculations applied in ArcGIS. Therefore this TM will only outline the process at a broad level of detail necessary to understanding the general process by which habitat units and ecosystem output would be calculated. Some additional context and detail is described in subsequent sections for each key habitat type.

1) Step 1 will involve the development of inputs for relevant physical habitat variables. These physical habitat variables will be evaluated in later steps for relative suitability for representative species. Step 1 processes will be conducted in ArcGIS.
    a. The inputs required for this analysis include those variables that correspond to HSCs for the representative species HSI models. For the riverine key habitat type/ juvenile steelhead HSI, HSC include depth, velocity, and cover. For the riparian scrub-shrub habitat type/ yellow warbler HSI, HSCs include vegetation type, canopy height, and canopy cover. For the riparian forest habitat type/ downy woodpecker HSI, HSCs include basal area. The specific development of inputs is detailed in the Engineering Appendix for the YRERFS and summarized below. At a minimum all inputs must be developed to evaluate FWOP and FWP conditions (including various flow scenarios) and key analysis years following construction (0, 1, 5, 15, 25, 50).
        i. Riverine habitat type inputs will include depth, velocity, and cover. FWOP and FWP depth and velocity inputs will be developed through hydraulic modeling. FWOP hydraulic modeling will be based on an existing terrain digital elevation model (DEM) developed in support of the Yuba River Development Plan (YRDP) (YCWA 2013b). FWP hydraulic modeling will

be based on a terrain model modified from the existing terrain DEM to include proposed features. FWOP cover inputs will be developed from existing information developed in support of the YRDP. FWP cover inputs will be developed by modifying the FWOP inputs as described in the Engineering Appendix.

ii. Riparian scrub-shrub habitat type inputs will include vegetation type, canopy height, and canopy cover. FWOP inputs will be developed from existing information developed in support of the YRDP (YCWA 2013a). FWP inputs will be developed by modifying the FWOP inputs as described in the design criteria TM.

iii. Riparian forest habitat type inputs will include basal area. FWOP inputs will be estimated from existing information developed in support of the YRDP (YCWA 2013a). FWP inputs will be developed by modifying the FWOP inputs as described in the design criteria TM.

b. Additional inputs for defining the spatial extents of analysis will be developed including wetted area extents for modeled flows, upstream and downstream extents of analysis (+500 ft. buffer from project footprint), and lateral extents of analysis at 84,000 cfs flows).

c. In general data sets will be developed in an ArcGIS compatible format, generally as a raster or shapefile format. To facilitate calculations in later steps, after initial development and import into the ArcGIS platform, physical habitat input data sets will be converted to raster format. For the purpose of this analysis, rasters were developed with a 3ft by 3ft pixel size. Physical habitat input raster data sets detail the specific physical conditions for a given variable at each specific location (pixel).

2) Step 2 involves the calculation of relative habitat suitability for each physical habitat variable type through the application of SIs. SIs describe a relationship between a single physical habitat variable and the relative suitability (from 0 to 1) for a species. The SIs for the representative species and corresponding HSCs are described in more detail below (Tables 3 – 5). For this assessment approach the SIs described in Tables 3 – 5 were applied to each corresponding physical habitat input raster using a lookup table function in ArcGIS. The result from this step is the conversion of physical habitat input rasters to a set of SI rasters (grid of suitability values from 0 to 1). At this stage, the set of SI rasters will include separate data for each initial habitat variable (HSC), for FWOP and FWP conditions, for each representative year of analysis (0, 1, 5, 15, 25, 50), and for each modeled flow (750 cfs, 1850 cfs, and 5000 cfs).

3) Step 3 involves the calculation of total habitat suitability value for each key habitat type by combining the SI rasters for each physical habitat variable through application of HSI model formulas. The HSI model formulas for representative species are described in more detail below. For this assessment approach, the HSI formulas will be used to combine SI rasters utilizing the raster calculator tool in ArcGIS. The result from this step is the combination of individual SI rasters (i.e. for riverine habitat depth SI, velocity SI, and cover

SI) into a single HSI raster for each key habitat type. Each cell in the HSI rasters will be representative of the combined suitability (from 0 to 1) for all HSCs for that species model. At this stage, the data set will include separate HSI rasters for each key habitat type (riverine, riparian scrub-shrub, and riparian forest), for FWOP and FWP conditions, for each representative year of analysis (0, 1, 5, 15, 25, 50), and for each representative modeled flow (750 cfs, 1850 cfs, and 5000 cfs).

4) Step 4 involves the calculation of habitat units for each key habitat type by multiplying habitat suitability (HSI raster) by the corresponding area. This process is conducted in ArcGIS through the use of the raster calculator tool in which each cell (HSI value from 0 – 1) is multiplied by its corresponding area (3ft x 3ft cell = 9 ft^2). The sum of all those values is then divided by 43,560 ft^2/ac to represent acre based habitat units. This is the last step conducted in ArcGIS. At this stage, habitat units of each key habitat type (riverine, riparian scrub-shrub, and riparian forest), for FWOP and FWP conditions, for each representative year of analysis (0, 1, 5, 15, 25, 50), and for each representative modeled flow (750 cfs, 1850 cfs, and 5000 cfs) will be output to an Excel table.

5) Step 5 involves the calculation of weighted average habitat units for each key habitat type. Up to this step, each key habitat type was evaluated under 3 representative flows. Weighting was based on the percentage of observed flows in the 41-year period of record hydrology for ranges of flow that averaged the three targeted flows. The flow range that averaged 750 cfs had a lower boundary of 700 cfs, an upper boundary of 800 cfs, and was observed 49.3 percent of the period of record. The 1850 cfs average had flows that ranged from 801 cfs to 3240 cfs and were observed 25.1 percent of the time. The range of flows averaging 5000 cfs were between 3241 cfs and the highest observed flow of the period of record. This range of flows occurred 19.3 percent of the time. Habitat units calculated at 750 cfs will be weighted at (0.493). Habitat units calculated at 1850cfs will be weighted at (0.251). Habitat units calculated at 5000 cfs will be weighted at (0.193). The result of this step is a flow weighted habitat unit values for each key habitat type (riverine, riparian scrub-shrub, and riparian forest), for FWOP and FWP conditions, for each representative year of analysis (0, 1, 5, 15, 25, 50).

6) Step 6 involves the calculation of total habitat units for each increment. The total habitat units for each increment is equal to the sum of habitat units for riverine, riparian scrub-shrub, and riparian forest key habitat types. This step results in total output (habitat units) for each increment for FWOP and FWP conditions and for each representative year of analysis (0, 1, 5, 15, 25, and 50).

7) Step 7 involves the calculation of average annual habitat units (AAHUs) for FWOP and FWP using the IWR Planning Suite Annualizer Tool. AAHUs are calculated as the average output for an increment over a 50 year period of analysis. The inputs for the annualizer tool are the habitat units for each increment under FWOP and FWP for each key year of analysis. The annualizer tool then applies a liner interpolation between habitat units for key years and calculates AAHUs. The result of this step is AAHUs for FWOP and FWP for each increment.

8) The final step involves the calculation of ecosystem output as the difference between FWP and FWOP AAHUs.

4.1 Context for the Calculation of Habitat Units for Riverine Key Habitat Type

For the purpose of this analysis the riverine key habitat type is generally defined as any wetted area. The representative species selected for evaluation of this key habitat is the steelhead, juvenile rearing life stage.

4.1.1 Habitat Suitability Criteria

The Juvenile Steelhead HSI model proposed for the YRERFS was adopted from an HSI model developed by YCWA for the Yuba River Development Project (YRDP) (YCWA 2013b). The juvenile steelhead HSI model is represented by the following formula:

$$juvenile\ steelhead\ HSI = (SI_{depth}\ x\ SI_{velocity}\ x\ SI_{cover})^{1/3}$$

Where:

SI_{depth} is the habitat suitability criteria value for depth

$SI_{velocity}$ is the habitat suitability criteria value for velocity

SI_{cover} is the habitat suitability criteria value for cover

YCWA originally developed the juvenile steelhead HSI to facilitate an evaluation of juvenile steelhead habitat in the lower Yuba River across various flow management scenarios. YCWA's juvenile steelhead HSI included HSCs for depth, velocity, and cover. The SIs developed for this model (Figure 2 and Tables 3 through 5) were collected and reviewed for specific applicability on the Yuba River (YCWA 2013b). The final selection of SIs were developed in a collaborative process between YCWA and YRDP Relicensing Participants. Relicensing Participants included Yuba County Water Agency (YCWA); United States Department of Agriculture, Forest Service (USDA-FS); United States Department of Interior, Fish and Wildlife Service (USFWS); United States Department of Commerce, National Marine Fisheries Service (NMFS); United States Army Corps of Engineers (USACE); California Department of Fish and Wildlife (CDFW); California State Water Resources Control Board (SWRCB); Placer County Water Agency (PCWA); Pacific Gas & Electric Company (PG&E); and other NGOs. The original SIs were sourced from site-specific curves developed from juvenile rearing data collected in the Yuba River downstream of Englebright Dam by the USFWS (Gard 2010a, 2010b), collaborative curves developed for the Tuolumne River (TRTAC 2010), and supplemental SIs for steelhead/rainbow trout fry and juvenile life stages (Hampton 1988; TRPA 2004; Hardin et al. 2005; USFWS 2011). Consensus was reached with agreement from all YRDP Relicensing Participants involved in the HSC selection process (YCWA 2013).

YUBA RIVER ECOSYSTEM RESTORATION FEASIBILITY STUDY

HABITAT EVALUATION ASSESSMENT APPROACH OVERVIEW

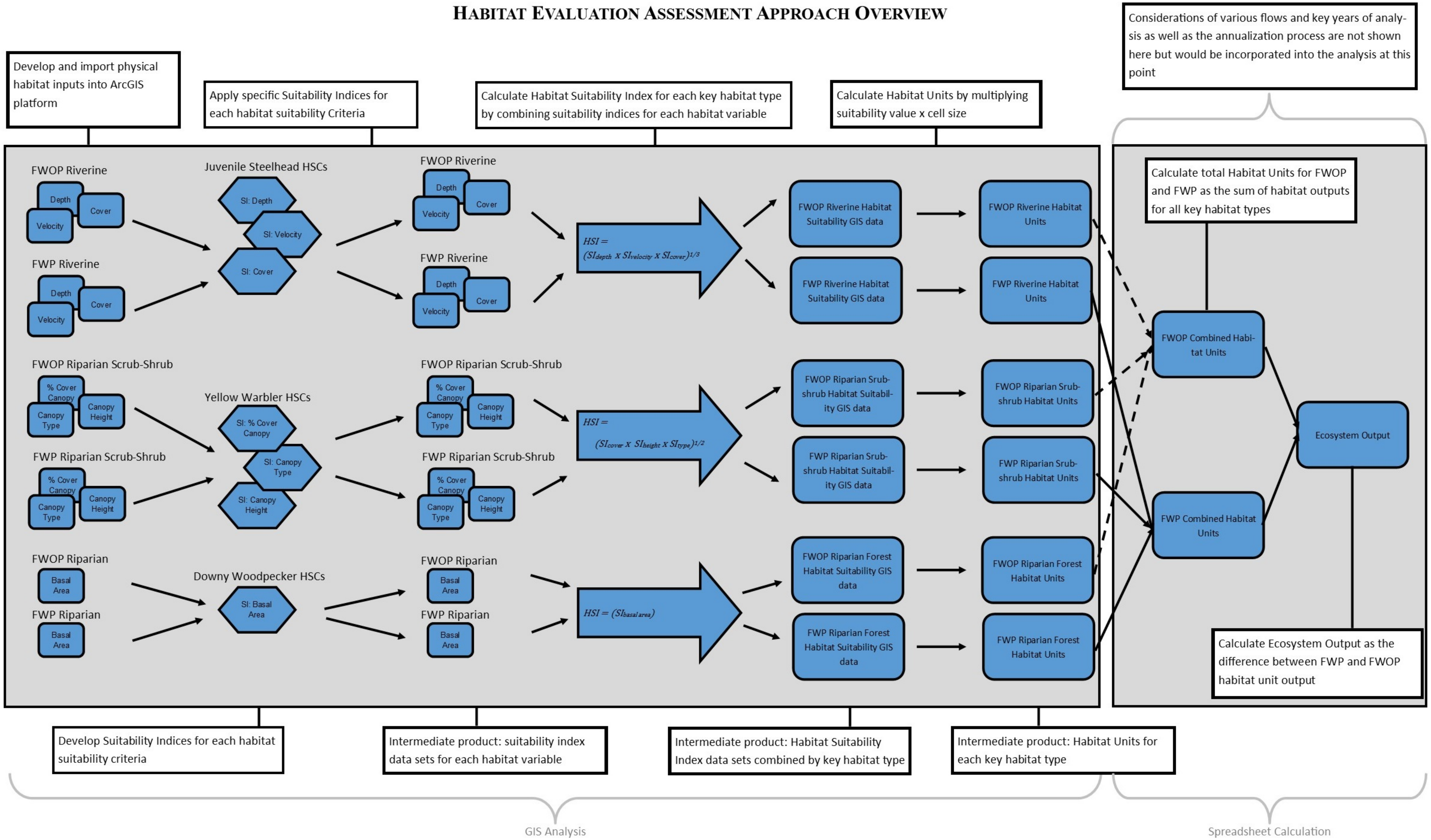

Figure 1. Ecosystem Output Assessment Approach Flow Chart

The juvenile steelhead SI for depth is evaluated in feet and is sensitive from 0 to 15 feet. The juvenile steelhead SI for velocity is evaluated in feet/second and is sensitive from 0 to 4 ft/sec. The juvenile steelhead SI for cover includes 5 structural cover classes: cobble, boulder/riprap, riparian vegetation, and stream wood. Cobble and boulder/riprap classes are measured in particle size (mm). Further documentation regarding the SIs can be found in documentation for the YRDP, Technical Memorandum 7-10 - Instream Flow Downstream of Englebright Dam (YCWA 2013b).

4.1.2 Data Inputs

The input data required for the juvenile steelhead HSI include estimates of depth, velocity, and cover under FWOP and FWP conditions. Depth and velocity estimates were developed using USACE's Hydrologic Engineering Center River Analysis System 2D (HEC-RAS-2D) hydraulic model. The hydraulic model was developed based on an existing digital elevation model (DEM) developed collaboratively by YCWA (YCWA 2013b). For the purpose of this evaluation, existing conditions were adopted to represent FWOP conditions. The existing DEM was used to evaluate depth and velocity under FWOP conditions. Depth and velocity for FWP conditions were evaluated by integrating a modified DEM reflecting physical habitat changes with various enhancement measures (creation of aquatic features including side channels, back waters, bank scalloping, and floodplain lowering). Further information on the development of this hydraulic model and DEM can be found in the technical appendices to the FR/EA and Design Criteria TM. Instream cover estimates for FWOP conditions were developed by leveraging existing vegetation and substrate data sets (YCWA 2013b). Instream cover estimates for FWP conditions were developed by modifying existing data based on measure descriptions.

4.1.3 Assumptions for the Analysis

Temporal and Physical Extent of Analysis – The value of riverine habitat is dependent on naturally fluctuating conditions. As the water surface elevation and shoreline vary over a range of flows, the extent of the riverine key habitat type would also vary. The primary benefits to riverine habitat will be concentrated in shallower water habitat types, typified by slower velocities and shallower depths. Shallow water habitat tends to be concentrated at the margins of the stream, which would be expected to fluctuate with changing flow conditions; therefore, it is important to incorporate consideration of changing flows into the analysis to better understand anticipated project benefits. This evaluation has incorporated consideration of fluctuating conditions through the evaluation of habitat value across a range of flows. The final calculation of habitat value would be representative of an average (weighted by occurrence of flow) of the evaluated flows. The range of flows selected was based on a reasonable representation of low, medium, and high flows relative to the design objectives of proposed measures and rough distributions of flow occurrence. The flows identified for evaluation were 750 cfs which is near Yuba Accord prescribed minimum flows in the Lower Yuba River, 1850 cfs, which is near annual average flow, and 5000 cfs which approximates bankfull flow. It is important to note here, that as area evaluated as riverine habitat (wetted area) expands under higher flow conditions, areas evaluated as riparian scrub-shrub or riparian forest would be reduced such that for any given location, only a single habitat type/value is evaluated.

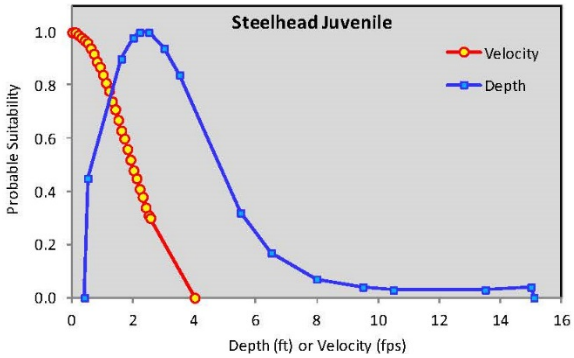

Figure 2. Steelhead habitat suitability for velocity and depth

Table 3. Juvenile Steelhead Suitability Index for Cover

Cover	Suitability Index Value
None	0.30
Cobble	0.50
Boulder/riprap	0.50
Riparian vegetation	1.00
Stream wood	1.00

Table 4. Juvenile Steelhead Suitability Index for Depth

Depth (feet)	Suitability Index Value
0.40	0.00
0.50	0.45
1.60	0.90
2.00	0.98
2.20	1.00
2.50	1.00
3.00	0.94
3.50	0.84
5.50	0.32
6.50	0.17
8.00	0.07
9.50	0.04
10.50	0.03
13.50	0.03
15.00	0.04
15.10	0.00

Table 5. Juvenile Steelhead Suitability Index for Velocity

Velocity (feet/second)	Suitability Index Value
0.00	1.00
0.10	1.00
0.20	0.99
0.30	0.98
0.40	0.97
0.50	0.96
0.60	0.94
0.70	0.92
0.80	0.89
0.90	0.87
1.00	0.84
1.10	0.81
1.20	0.78
1.30	0.74
1.40	0.71
1.50	0.67
1.60	0.63
1.70	0.60
1.80	0.56
1.90	0.52
2.00	0.48
2.10	0.45
2.20	0.41
2.30	0.38
2.40	0.34
2.50	0.31
2.55	0.30
4.00	0.00

This simplification will result in habitat value of some features (i.e., vegetation) transitioning between habitat types under different flow conditions. For example, for a low flow, a patch of willows on the bank would be evaluated as riparian scrub-shrub and under higher flows that vegetation would be evaluated as riverine habitat. While the value of vegetation might be evaluated under different conditions dependent on the flow, ultimately all HSI models provide some evaluation of vegetation (benefits to birds or during inundation benefits to fish as cover) such that the features would be evaluated under all conditions.

4.2 Context for the Calculation of Habitat Units for Riparian Scrub-Shrub Key Habitat Type

For the purpose of this analysis the riparian scrub/shrub key habitat type is defined as vegetated area consisting of hydrophytic vegetation <5m in height (Schroeder 1982b). The representative species selected for evaluation of this key habitat is the yellow warbler.

4.2.1 Habitat Suitability Criteria

The yellow warbler habitat suitability modeling element includes HSCs for percent deciduous shrub crown cover <5m, average height of deciduous shrub canopy, and percent of deciduous shrub canopy comprised of hydrophytic shrubs. SIs were developed as part of the Yellow Warbler blue book HEP model (Figure 3 and Tables 5 through 7) (Schroeder 1982b) and is currently approved for use by USACE. The habitat suitability index for the yellow warbler is calculated as a factor of canopy cover, canopy height, and hydrophytic canopy cover based on the following formula:

$$\begin{aligned}&Riparian\ scrub/shrub\ Habitat\ Units\\&\quad = (SI_{canopy\ cover}\ x\ SI_{canopy\ height}\ x\ SI_{hydrophytic\ canopy})^{1/2}\end{aligned}$$

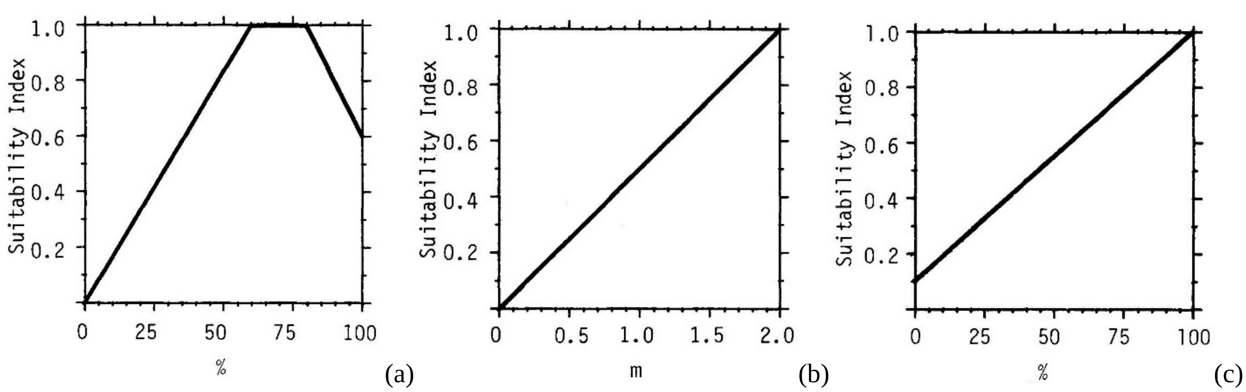

Figure 3. Yellow warbler habitat suitability (a) Percent deciduous shrub crown cover (b) Average height of deciduous shrub canopy (c) Percent of deciduous shrub canopy comprised of hydrophytic shrubs.

Table 6. Percent Deciduous Shrub Cover

% Cover	Suitability Index Value
0	0
25	0.4
50	0.75
60	1.0
80	1.0
90	0.8
100	0.6

Table. 7 Average Height of Deciduous Shrub Canopy

Canopy Height (m)	Suitability Index Value
0	0
1	0.5
>2	1.0

Table 8. Percent Canopy Comprised of Hydrophytic Shrubs

% Hydrophytic shrubs	Suitability Index Value
0	0.1
25	0.3
50	0.55
75	0.8
100	1.0

For the purpose of this assessment approach, functions were developed for the percent deciduous shrub crown cover, average height of deciduous shrub canopy, and percent of deciduous shrub canopy comprised of hydrophytic shrubs Tables 9 – 11).

Table 9. Functions for % Deciduous Shrub Cover

% cover range	Formula
for % cover from 0 to 60%	SI = 0.0167 x % Cover
for % cover from 60 to 80%	SI =1
for % cover from 80 to 100%	SI = (-0.05 x % Cover) + 5

Table 10. Functions for Average Height of Deciduous Shrub Canopy

Average Canopy Height (ft)	Formula
for canopy height from 0 to 6.56ft	SI = 0.1524 x height
for canopy height greater than 6.56ft	SI =1

Table 11. Function for % Canopy Comprised of Hydrophytic Shrubs

% Hydrophytic Cover	Formula
All values	SI = (0.009 x canopy type) + 0.1

4.2.2 Data Inputs

The input data required for this modeling element include the extent of FWOP vegetation and estimates for extent of vegetation under FWP conditions, as well as percent deciduous shrub crown cover <5m (% cover), average height of deciduous shrub canopy (height), and percent of deciduous shrub canopy comprised of hydrophytic shrubs (canopy type). For the purpose of this evaluation, existing extents of vegetation were assumed to be representative of FWOP conditions.

FWOP extents of vegetation were developed from existing data developed for the YRDP (TM 6-2 Riparian Habitat Downstream of Englebright Dam, YCWA 2013a). Data included fine scale canopy extents, vegetation type classification, and canopy heights. These data sets were developed through analysis of imagery, LiDAR, and ground based surveys. The existing vegetation extents and attributes were transformed as described in the Design Criteria TM to be suitable for evaluation through the yellow warbler SIs. FWP vegetation extents were developed by modifying the existing vegetation extents based on the descriptions of measures and guidelines developed in the Design Criteria TM.

4.2.3 Assumptions for the Analysis

Temporal and Physical Extent of Analysis – As stated above, the extent of riparian scrub-shrub habitat is dependent on naturally fluctuating conditions. For the purpose of this evaluation, the spatial extent of the riparian scrub-shrub key habitat type will be defined as any vegetation <5m in height excluding inundated areas under any given flow condition.

Similar to dynamic hydrologic processes, the long term growth of vegetation requires consideration. Both existing and planted vegetation have the potential for long term growth. In general, existing habitat conditions, including terrain and vegetation are assumed to be constant throughout the period of analysis. While terrain modifications are generally assumed to be static following construction for FWP conditions, planted vegetation can be reasonably expected to provide a range of benefits as it establishes and matures over the period of analysis.

The growth of planted vegetation was taken into consideration by applying a simple set of assumptions with regards to relevant HSCs. For the yellow warbler these assumptions included percent cover, height, and canopy type. In general, the anticipated "growth" of these attributes was estimated by referencing existing data for representative years and developing simple regressions to extrapolate data for the key analysis years used in this study (0, 1, 5, 15, 25, and 50). More detail on the development of long term growth assumption for the yellow warbler HSCs is included in the Design TM. For the purpose of this assessment approach, areas of planted vegetation were defined in an ArcGIS polygon shapefile format. The growth assumptions were then applied to the polygons such that for any given year of analysis, the appropriate estimated variables (% cover, height, and canopy types) would be applied.

An important note is that the simplified assumptions applied to height resulted in estimations for planted vegetation <5m in early years and >5m in later years. This resulted in areas of planted vegetation being evaluated as riparian scrub-shrub in early years and as riparian forest in later years. This is similar to the situation in which changing flows affected the wetted area/ extent of riverine vs vegetative habitat types. Although a given area is evaluated as different habitat type under different conditions (analysis years), the project feature (vegetation) will be adequately valued under either habitat type/ HSI model and no area of habitat will be double counted.

4.3 Context for Calculation of Habitat Units for Riparian Forest Key Habitat Type

For the purpose of this analysis the riparian forest key habitat type is defined as vegetated area consisting of vegetation >5m in height. The representative species selected for evaluation of this key habitat is the downy woodpecker.

4.3.1 Habitat Suitability Criteria

The downy woodpecker habitat suitability modeling element includes HSCs for basal area of forest and number of snags >6 inches. For the purpose of this analysis, only the HSC for basal area will be considered. The HSC for number of snags was not included because (1) existing information for number of snags was not readily available, (2) lack of data to reasonably project the number of snags likely to occur within a planted stand of vegetation, (3) the production of snags would be an indirect effect rather than direct effect of riparian planting, and (4) the natural production of snags occurs on a time scale incommensurate with the period of analysis for this study. SIs were developed as part of the Downy Woodpecker blue book HEP model (Figure 4 and Table 12)

(Schroeder 1982a) and is currently approved for use by USACE. The HSI for downy woodpecker is equivalent to the suitability criteria value for basal area:

$$Riparian\ Forest\ Habitat\ Units\ = (SI_{basal\ area})$$

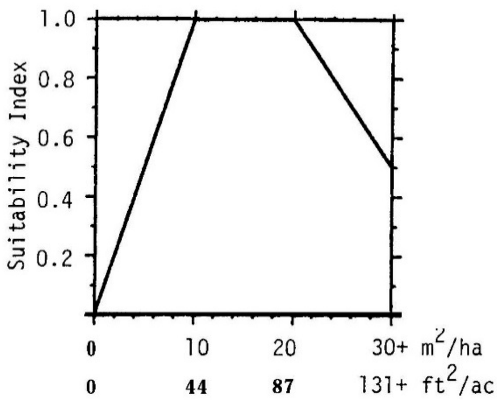

Figure 4. Downy woodpecker habitat suitability for basal area.

Table 12. Basal Area Suitability Index Value

Basal Area (m^2/ acre)	Suitability Index Value
0	0
2	0.2
4	0.4
6	0.6
8	0.8
10	1.0
12	1.0
14	1.0
16	1.0
18	1.0
20	1.0
22	0.9
24	0.8
26	0.7
28	0.6
30	0.5

For the purpose of this assessment approach functions were developed for basal area (Table 13).

Table 13. Functions for Basal Area

Basal Area Range	Formula
for basal area from 0 to 10 (m2/ hectare)	SI = 0.1 x Basal Area
for basal area from 10 to 20 (m2/ hectare)	SI =1
for basal area from 20 to 30 (m2/ hectare)	SI = (-0.05 x Basal Area) + 2
for basal area greater than 30 (m2/ hectare)	SI = 0.5

4.3.2 Data Inputs

The input data required for this modeling element include the extent of FWOP vegetation and estimates for extent of vegetation under FWP conditions, as well as basal area. FWOP extents of vegetation were developed from existing data included in the YRDP's TM 6-2 Riparian Habitat Downstream of Englebright Dam (YCWA 2013a). Existing data used in the development of vegetation extents included fine scale canopy extents, vegetation type classification, and canopy heights. These data sets were developed through analysis of imagery, LiDAR, and ground based surveys. For the purpose of this evaluation, existing extents of vegetation were assumed to be representative of FWOP conditions. The existing vegetation extents and attributes were transformed as described in the Design Criteria TM to be suitable for evaluation through the downy woodpecker HSCs. FWP vegetation extents were developed by modifying the existing vegetation extents based the on descriptions of measures and guidelines developed in the Design Criteria TM.

4.3.3 Assumptions for the Analysis

Temporal and Physical Extent of Analysis **–** As stated above, the extent of the riparian forest key habitat type is dependent on naturally fluctuating conditions. For the purpose of this evaluation, the spatial extent of the riparian forest key habitat type will be defined as any vegetation >5m in height excluding inundated areas under any given flow condition.

As described above, the long term growth of vegetation requires consideration within the context of the riparian forest key habitat type and the downy woodpecker HSI model. Similar to the yellow warbler HIS model the growth of planted vegetation was taken into consideration by applying a simple set of assumptions for relevant downy woodpecker HSCs. For the downy woodpecker, these assumptions included basal area. The anticipated "growth" of basal area was estimated by referencing existing data for representative years and developing simple regressions to extrapolate data for the key analysis years used in this study (0, 1, 5, 15, 25, and 50). More detail on the development of long term growth assumption for the downy woodpecker HSCs is included in the Design TM. For the purpose of this assessment approach, areas of planted vegetation were defined in an ArcGIS polygon shapefile format. The growth assumptions were then applied to the polygons such that for any given year of analysis, the appropriate estimated variables (basal area) would be applied.

4.4 Annualization of Habitat Units

One of the last steps in developing ecosystem outputs for the CE/ICA is annualization of habitat units. The CE/ICA requires inputs (ecosystem outputs and costs) to be annualized. Annualization of outputs will convert habitat units to AAHUs. First, habitat units for FWOP and FWP will be annualized into AAHUs using the IWR Planning Suite Annualizer Tool. Then as a final step, ecosystem output will be calculated as the difference between FWP and FWOP AAHUs.

To support the annualization process, habitat units would be developed in ArcGIS for key years of analysis (year 0, 1, 5, 15, 25, 50 following construction) for both FWOP and FWP conditions for each habitat increment under consideration. A critical point in developing ecosystem outputs is giving appropriate consideration to construction schedule. In discussing construction schedule, it is important to restate the context for this assessment approach which is to develop ecosystem outputs for increments (distinct actions) rather than alternatives (combinations of increments). Alternatives would be evaluated and formulated through a CE/ICA of costs and ecosystem outputs developed for individual habitat increments. This distinction is important because in the absence of developed alternatives, assumptions regarding construction schedule were made independently for each increment. The basic assumption for construction schedule applied to each habitat increment is that construction for any given habitat increment would take 3 years. Also is assumed that during the construction period, no net benefits or net impacts would occur and that benefits would begin to accrue in the year following construction. The assumption that no net impacts or benefits would occur during construction is based on the assumption that proposed actions would largely occur out of water and avoid impacts where practical to existing vegetation. Under a more refined analysis, it is likely that some impacts as well as potential benefits would occur during construction years, but these impacts and benefits are unlikely to affect the evaluation of habitat increments within the context of the feasibility study and therefore will not be included in this assessment approach. In practical application the assumption of a 3 year construction period will result in benefits being accrued following in year 4 which will slightly reduce the final calculated AAHUs for FWP conditions. For the purpose of annualization, the habitat units developed for representative years (0, 1, 5, 15, 25, and 50 following construction) will be effectively applied as years (3, 4, 8, 18, 28, and 53).

5.0 Model Review Requirements

The application of the assessment approach will be subject to review as part of the Draft Integrated Feasibility Report/ Environmental Assessment (dFR/EA); however, additional review and approval of modeling elements will be required as defined in the Corps guidelines for Assuring Quality Planning Models (EC 1105-2-412). Most of the modeling elements proposed for use on this study have been approved or certified for use. The Juvenile Steelhead HSI model will be subject to review by the USACE Ecosystem Restoration Program Center of Expertise (Eco-PCX) and approval by USACE HQ. The Sacramento District will request a one-time approval for use of the modeling elements in the development of ecosystem outputs for the YRERFS. Model approval would be in place prior to Tentatively Selected Plan milestone.

6.0 Literature Cited

Schroeder, R. L. 1982 (a). Habitat suitability index models: Down woodpecker. U.S. Dept. Int., Fish Wildl. Serv. FWS/OBS-82/10.38. 10 pp.

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Yuba County Water Agency. 2007. Yuba River Development Project FERC Project No. 2246. Final Fisheries Agreement. November 2007 http://www.yubaaccordrmt.com/Yuba%20Accord%20Documents/Forms/AllItems.aspx?RootFolder=%2fYuba%20Accord%20Documents%2fYuba%20Accord%20Documents&FolderCTID=&View=%7bB86CA5B0%2d7D95%2d45E5%2dA951%2d795AB3A3A8AF%7d

Yuba County Water Agency. 2012a. Yuba River Development Project FERC Project No. 2246. Technical Memorandum 2-2. Water Balance /Operations Model. November 2012.

Yuba County Water Agency. 2012b. Yuba River Development Project FERC Project No. 2246. Water Balance /Operations Model. YRDP 1.19.2 Base Case. http://www.ycwa-relicensing.com/Modeling%20Information/Forms/AllItems.aspx?RootFolder=%2fModeling%20Information%2fOperations%20Model&FolderCTID=&View=%7b768D86D7%2dFC78%2d434C%2dB1DD%2d57D0A189345F%7d.

Yuba County Water Agency. 2013a. Yuba River Development Project FERC Project No. 2246. Technical Memorandum 6-2 – Riparian Habitat Downstream of Englebright Dam. June 2013.

Yuba County Water Agency. 2013b. Yuba River Development Project FERC Project No. 2246. Technical Memorandum 7-10 - Instream Flow Downstream of Englebright Dam. September 2013.

Environmental Appendix D
Attachment 9

Notice of Intent

Yuba River Ecosystem Restoration Feasibility Study

November 2017

U.S. Army Corps of Engineers

Sacramento District

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BILLING CODE: 3720-58

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Notice of Intent to Prepare an Integrated Feasibility Report & Draft Environmental Impact Statement for the Yuba River, California, Ecosystem Restoration Feasibility Study

AGENCY: Department of the Army, U.S. Army Corps of Engineers; DOD.

ACTION: Notice of Intent.

SUMMARY: The U.S. Army Corps of Engineers, Sacramento District (Corps), intends to prepare an integrated Feasibility Report & Draft Environmental Impact Statement (DEIS) for the Yuba River Ecosystem Restoration Feasibility Study. The Corps will serve as the lead agency for compliance with the National Environmental Policy Act. The Yuba County Water Agency (YCWA) will serve as the non-federal sponsor. The feasibility study is evaluating opportunities for ecosystem restoration in the Yuba River watershed, located in portions of Sierra, Placer, Yuba, and Nevada counties.

DATES: Written comments should be submitted by November 9, 2015.

ADDRESSES: Written comments should be sent to U.S. Army Corps of Engineers, Sacramento District, Attn: Michael Fong, CESPK-PD-RP, 1325 J Street, Sacramento, CA, 95814-2922.

FOR FURTHER INFORMATION CONTACT: Questions about the feasibility study and the DEIS may be addressed to U.S. Army Corps of Engineers, Sacramento District, Attn: Michael Fong, CESPK-PD-RP, 1325 J Street, Sacramento, CA, 95814-2922 or submitted by e-mail to *Michael.R.Fong@usace.army.mil.* Requests to be placed on the mailing list should also be sent to this address.

SUPPLEMENTARY INFORMATION:

1. *Study Purpose*. The Corps, in cooperation with YCWA, is conducting a cost-shared feasibility study to identify and respond to problems and opportunities associated with ecosystem restoration in the Yuba River watershed. The authority to study the Sacramento River Basin, including the Yuba River watershed, for flood control and allied purposes, was granted in the Rivers and Harbors Act of 1962, Public Law 87-874, Section 209. A reconnaissance study of ecosystem restoration opportunities in the Yuba River watershed was conducted in 2014 under the authorization of the Energy and Water Development Appropriations Act of 2014, Division D of Public Law 113-76, the Consolidated Appropriations Act, 2014. The Civil Works study process provides a systematic and rational framework for developing and analyzing alternative plans. This feasibility study will be conducted under the SMART Planning framework, an efficient, risk-informed process.

2. *Study Area.* The Yuba River Watershed is located in northern California on the western slopes of the Sierra Nevada Mountain Range. The watershed encompasses 1,340 square miles in portions of Sierra, Placer, Yuba, and Nevada counties. The Yuba River is a tributary of the Feather River which, in turn, flows into the Sacramento River near the town of Verona, California. The study area begins in the city of Marysville and extends upstream approximately 90 miles, past Sierra City, California, in Sierra County.

The Yuba River flows through forest, foothill chaparral, and agricultural lands. Levees are absent from most of its course except for near the river's confluence with the Feather River. At that point, the Yuba River is bounded by setback levees for approximately six miles.

The primary watercourses of the upper Yuba River watershed are the South, Middle, and North Yuba rivers. The Middle Yuba River flows into the North Yuba River and together they are referred to as the upper Yuba River. Current conditions in the Yuba River watershed are largely defined by the legacy of historic gold mining and presence of dams.

3. *Scoping Process.* A series of public Scoping meetings will be held in October and November 2015 to present information and receive comments from the public. These meetings are intended to initiate the process to involve concerned individuals, non-governmental organizations, interested parties, and local, State, and Federal agencies. Public Scoping meetings will be held as follows:

Meeting #1 – Wednesday, October 28, 2015, 1:00pm – 3:00pm at John E. Moss Federal Building Stanford Room (650 Capitol Mall, Sacramento, CA 95814).

Meeting #2 – Thursday, October 29, 2015, 5:00pm – 7:00pm at Nevada County Library Community Room (980 Helling Way, Nevada City, CA 95959).

Meeting #3 – Wednesday, November 4, 2015, 5:00pm – 7:00pm at Yuba County Government Center Marysville and Wheatland Conference Room (915 8th Street, Marysville, CA 95901).

Significant issues to be analyzed in depth in the integrated Feasibility Report & DEIS include effects on hydraulics, wetlands and other waters of the U.S., vegetation and wildlife resources, special-status species, aesthetics, cultural resources, recreation, land use, fisheries, water quality, air quality, noise, transportation, socioeconomics, and cumulative effects of related projects in the study area.

The Corps will coordinate with State and Federal resource agencies in order to comply with all pertinent environmental laws, regulations, and policies. Moreover, the Corps will coordinate with effected Native American Tribes to address their concerns and to ensure compliance with all applicable Federal statutes, executive orders, and Corps policies.

4. *Availability.* The integrated feasibility report & DEIS is scheduled to be available for public review and comment in December 2016. A 45-day public review period will be provided for individuals and agencies to review and comment on the DEIS. All interested parties are encouraged to respond to this notice and provide a current address if they wish to be notified of the DEIS circulation.

SEP 28 2015

Date:

for Michael J. Farrell
COL, U.S. Army
District Commander

Environmental Appendix D

Attachment 10

Air Quality Emissions Modeling

YUBA RIVER ECOSYSTEM RESTORATION FEASIBLILITY STUDY

November 2017

U.S. Army Corps of Engineers

Sacramento District

Contents

1.0 Introduction

The air quality emissions analysis for the YRERFS utilized the Road Construction Emissions Model (RCEM) v8.1.0 developed by the SMAQMD and approved for use by the FRAQMD. Although the RCEM was not developed specifically for application to ecosystem restoration projects it has been applied to various linear construction projects and the actions yielding the largest amount of emissions (i.e., excavation and hauling of material) are adequately captured by the model.

It was determined through internal discussions, as well as discussions with staff from the FRAQMD and SMAQMD, that the most reasonable approach to determine if the project was to be in compliance with Federal standards was to base the evaluation on a "worst case scenario" construction year. The project team determined that construction that would take place in the first year would be the construction season that would likely result in the most combined air emissions. In general, all construction activities would be completed at any given location within a single construction year; therefore, each construction year would be similar in the types of activities and implementation. The first year of construction would be expected to be representative of the highest emissions as advances in technology and equipment is expected to result in reduced emissions as time progresses. Estimates for quantities and equipment were based on an assumption that the work completed in year 1 would represent approximately a third of the total effort. An emissions analysis was performed for Alternative 5 (TSP) and Alternative 6.

The air quality emissions analysis for the YRERFS was developed based on several interrelated assumptions and constraints as described below:

2.0 Alternatives

Alternatives 5 and 6 are similar in the type and scope of proposed restoration measures; Alternative 5 is the TSP and Alternative 6 includes an additional habitat increment (increment 1) that reduces the overall cost effectiveness of implementation. Alternative 5 includes increments 2, 5b, 5a, and 3a at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, Bar C, Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, and North Silica Bar, which would result in 173.5 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation, as described above. The total cost of this alternative is $89.4 million. Alternative 6 includes increments 2, 5b, 5a, 3a, and 1 at Upper Gilt Edge Bar, Unnamed Bar, Narrow Bar, River Mile 6.5, Bar E, Island B, Bar C, Lower Gilt Edge Bar, Hidden Island, First Island, Silica Bar, North Silica Bar, and Upstream of Highway 20, which would result in 192.8 acres of restored habitat by lowering the floodplain to facilitate inundation and planting riparian vegetation, as described above. The total cost of this alternative is $109.6 million.

3.0 Construction Schedule

The assumptions for construction schedule incorporated into the air quality emissions analysis were intended to represent a worse case scenario and may differ from construction schedule developed for later stages of this study. The general assumptions applied in developing a worse case scenario for construction schedule include:

- The project would require 3 separate years to construct the required features;
- General construction would occur over 6 months (June 1 to November 30);
- In water construction would occur over 4 months (July 1 to October 30);
- Construction will begin in 2022;
- All required administrative, legal, real estate and environmental clearances/approvals will be acquired prior to initiation of construction;
- In general, all construction activities would be completed at any given location within a single construction year. Annual construction would include: staging/clearing, excavation, installation of hydraulic roughness/ structural complexity elements, and planting of vegetation. For the purpose of emissions modeling this work will be analyzed in 3 phases proscribed in the RCEM: (1) staging/ clearing (Gubbing/ Land Clearing), (2) excavation and installation of hydraulic roughness/ structural complexity elements (Grading/Excavation), and (3) planting of vegetation (Drainage/Utilities/Sub-Grade). The Drainage/Utilities/Sub-Grade phase of the RCEM was used to evaluate emissions associated with planting of riparian vegetation and will be referred to in this document as the Planting Phase.
- The conceptual construction schedule in Figure 1 below would be applied to Alternative 5 and Alternative 6. Additional construction requirements of Alternative 6 would require additional equipment to meet the below schedule.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					Staging/ Site Prep	Excavation and Installation of non-vegetative restoration features (in water work)					
								Preparation for planting	Harvest and Planting of Vegetative Features		

Figure 1. Conceptual construction schedule

4.0 Equipment Standards

- All project plans and specifications will require that construction contractors use only offroad equipment that implements the Feather River Air Quality Management Districts' (FRAQMD) Enhanced Exhaust Control Practices and only use on-road hauling equipment that was manufactured in 2010, or later. In addition all offroad equipment would meet CARB Tier 4 standards.
- If the off-road equipment and on-road hauling specifications stated above are not met, it cannot be assured that the project air emissions can meet the Federal *de minimis* standards.

5.0 Equipment

Estimates for equipment were made for each modeled phase: Staging, Excavation, and planting. The RCEM calculates emissions for each piece of equipment in each phase for the duration of the phase. In some cases, equipment use was not anticipated to occur for the full duration of a construction phase, and therefore was applied to different phase that provided a better estimate of anticipated use (i.e. graders used periodically in the excavation phase were incorporated into the shorter staging phase).

Inputs and results for the emissions modeling are presented below by Alternative. The results are representative of a worst case scenario for annual emissions for construction of Alternative 5 (TSP) and Alternative 6. Where appropriate, additional context is provided regarding assumptions made in the development of this emissions analysis. Results from this analysis were discussed in Section 4.2.1 of the integrated Feasibility Report/ Environmental Assessment.

Road Construction Emissions Model **Version 8.1.0**

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells D10 through D24, E28 through G35, and D38 through D41 for all project types.
Please use "Clear Data Input & User Overrides" button first before changing the Project Type or begin a new project.

Clear Data Input & User Overrides

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type

Project Name	Yuba River Ecosystem Restoration Feasibility Study	
Construction Start Year	2022	Enter a Year between 2014 and 2025 (inclusive)
Project Type For 4: Other Linear Project Type, please provide project specific off-road equipment population and vehicle trip data	4	1) New Road Construction : Project to build a roadway from bare ground, which generally requires more site preparation than widening an existing roadway 2) Road Widening : Project to add a new lane to an existing roadway 3) Bridge/Overpass Construction : Project to build an elevated roadway, which generally requires some different equipment than a new roadway, such as a crane 4) Other Linear Project Type: Non-roadway project such as a pipeline, transmission line, or levee construction
Project Construction Time	7.00	months
Working Days per Month	26.00	days (assume 22 if unknown)
Predominant Soil/Site Type: Enter 1, 2, or 3 (for project within "Sacramento County", follow soil type selection instructions in cells E18 to E20 otherwise see instructions provided in cells J18 to J22)	1	1) Sand Gravel : Use for quaternary deposits (Delta/West County) 2) Weathered Rock-Earth : Use for Laguna formation (Jackson Highway area) or the Ione formation (Scott Road, Rancho Murieta) 3) Blasted Rock : Use for Salt Springs Slate or Copper Hill Volcanics (Folsom South of Highway 50, Rancho Murieta)
Project Length	2.63	miles
Total Project Area	59.53	acres
Maximum Area Disturbed/Day	1.00	acre
Water Trucks Used?	1	1. Yes 2. No

Please note that the soil type instructions provided in cells E18 to E20 are specific to Sacramento County. Maps available from the California Geologic Survey (see weblink below) can be used to determine soil type outside Sacramento County.

http://www.conservation.ca.gov/cgs/information/geologic_mapping/Pages/googlemaps.aspx#regionalseries

Material Hauling Quantity Input

Material Type	Phase	Haul Truck Capacity (yd^3) (assume 20 if unknown)	Import Volume (yd^3/day)	Export Volume (yd^3/day)
Soil	Grubbing/Land Clearing	13.00		13.00
	Grading/Excavation	13.00		2509.00
	Drainage/Utilities/Sub-Grade			
	Paving			
Asphalt	Grubbing/Land Clearing			
	Grading/Excavation			
	Drainage/Utilities/Sub-Grade			
	Paving			

Mitigation Options

On-road Fleet Emissions Mitigation	2010 and Newer On-road Vehicles Fleet	Select "2010 and Newer On-road Vehicles Fleet" option when the on-road heavy-duty truck fleet for the project will be limited to vehicles of model year 2010 or newer
Off-road Equipment Emissions Mitigation	Tier 4 Equipment	Select "20% NOx and 45% Exhaust PM reduction" option if the project will be required to use a lower emitting off-road construction fleet. The SMAQMD Construction Mitigation Calculator can be used to confirm compliance with this mitigation measure (http://www.airquality.org/ceqa/mitigation.shtml). Select "Tier 4 Equipment" option if some or all off-road equipment used for the project meets CARB Tier 4 Standard
Will all off-road equipment be tier 4?	All Tier 4 Equipment	

Figure 2. Inputs for Alternative 5 – Road Construction Emissions Model v8.1.0

Construction Periods	User Override of Construction Months	Program Calculated Months	User Override of Phase Starting Date	Program Default Phase Starting Date
Grubbing/Land Clearing	1.00	0.70	6/1/2022	1/1/2022
Grading/Excavation	4.00	2.80	7/1/2022	2/1/2022
Drainage/Utilities/Sub-Grade	2.00	2.45	10/1/2022	6/3/2022
Paving	0.00	1.05	7/1/2023	8/3/2022
Totals (Months)	7			

Figure 2. Inputs for Alternative 5 – Road Construction Emissions Model v8.1.0 (cont.)

- Although the proposed construction schedule would take 6 months, the automated calculation function of the RCEM does not account for overlap, therefore for the purpose of consistency, the total project length has been identified as 7 months.
- The project length and areas were calculated as the sum of each unit of the project area. For the purpose of this analysis, the total project length and area are representative of 1/3 of that total value, which would be the amount of work that would be expected to occur over one construction year. This is consistent with running a worst case scenario to evaluate annual emissions.
- 2 truck trips per day were added to the soil hauling emissions calculations (2 trips per day x 26 days/month x 4 months = 208 truck trips) to accommodate for truck hauling associated with hydraulic roughness elements (boulders and wood).

Soil Hauling Emissions	User Override of	Program Estimate of	User Override of Truck	Default Values	Calculated
User Input	Miles/Round Trip	Miles/Round Trip	Round Trips/Day	Round Trips/Day	Daily VMT
Miles/round trip: Grubbing/Land Clearing	40.00		1	1	40.00
Miles/round trip: Grading/Excavation	40.00		195	193	7800.00
Miles/round trip: Drainage/Utilities/Sub-Grade				0	0.00
Miles/round trip: Paving				0	0.00

2010+ Model Year Mitigation Option Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Grading/Excavation (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Draining/Utilities/Sub-Grade (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Paving (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hauling Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.01	0.03	0.12	0.01	0.00	0.00	136.57	0.00	0.00	137.92
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	1.78	0.00	0.00	1.79
Pounds per day - Grading/Excavation	1.15	6.39	23.91	1.76	0.69	0.25	26,631.76	0.05	0.88	26,894.17
Tons per const. Period - Grading/Excavation	0.06	0.33	1.24	0.09	0.04	0.01	1,384.85	0.00	0.05	1,398.50
Pounds per day - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.06	0.33	1.24	0.09	0.04	0.01	1,386.63	0.00	0.05	1,400.29

Figure 2. Inputs for Alternative 5 – Road Construction Emissions Model v8.1.0 (cont.)

Worker Commute Emissions User Input	User Override of Worker Commute Default Values	Default Values	Calculated Daily Trips	Calculated Daily VMT
Miles/ one-way trip	50			
One-way trips/day	2			
No. of employees: Grubbing/Land Clearing	5		10	500.00
No. of employees: Grading/Excavation	13		26	1,300.00
No. of employees: Drainage/Utilities/Sub-Grade	21		42	2,100.00
No. of employees: Paving			0	0.00

Emission Rates	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grubbing/Land Clearing (grams/mile)	0.02	0.92	0.09	0.05	0.02	0.00	348.29	0.01	0.00	349.59
Grading/Excavation (grams/mile)	0.02	0.92	0.09	0.05	0.02	0.00	348.29	0.01	0.00	349.59
Draining/Utilities/Sub-Grade (grams/mile)	0.02	0.92	0.09	0.05	0.02	0.00	348.29	0.01	0.00	349.59
Paving (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grubbing/Land Clearing (grams/trip)	0.87	2.06	0.16	0.00	0.00	0.00	79.59	0.01	0.01	81.77
Grading/Excavation (grams/trip)	0.87	2.06	0.16	0.00	0.00	0.00	79.59	0.01	0.01	81.77
Draining/Utilities/Sub-Grade (grams/trip)	0.87	2.06	0.16	0.00	0.00	0.00	79.59	0.01	0.01	81.77
Paving (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.04	1.06	0.10	0.05	0.02	0.00	385.68	0.01	0.00	387.17
Tons per const. Period - Grubbing/Land Clearing	0.00	0.01	0.00	0.00	0.00	0.00	5.01	0.00	0.00	5.03
Pounds per day - Grading/Excavation	0.10	2.75	0.27	0.13	0.06	0.01	1,002.76	0.02	0.01	1,006.63
Tons per const. Period - Grading/Excavation	0.01	0.14	0.01	0.01	0.00	0.00	52.14	0.00	0.00	52.34
Pounds per day - Drainage/Utilities/Sub-Grade	0.16	4.44	0.44	0.22	0.09	0.02	1,619.84	0.03	0.02	1,626.09
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.12	0.01	0.01	0.00	0.00	42.12	0.00	0.00	42.28
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.01	0.27	0.03	0.01	0.01	0.00	99.27	0.00	0.00	99.66

Figure 2. Inputs for Alternative 5 – Road Construction Emissions Model v8.1.0 (cont.)

- 50 miles one way trip is representative of distances that may be travelled from nearby major population centers (Sacramento, Ca and Chico, Ca).
- Number of employees estimated does not include truck drivers as their emissions are included in the soil hauling emissions estimate.

Water Truck Emissions / **User Input**	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Vehicle/Day	Default Values Miles Traveled/Vehicle/Day	Calculated Daily VMT
Grubbing/Land Clearing - Exhaust	1		50.00		50.00
Grading/Excavation - Exhaust	2		200.00		400.00
Drainage/Utilities/Subgrade	1		50.00		50.00
Paving					0.00

2010+ Model Year Mitigation Option Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Grading/Excavation (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Draining/Utilities/Sub-Grade (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Paving (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.01	0.04	0.15	0.01	0.00	0.00	170.72	0.00	0.01	172.40
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	2.22	0.00	0.00	2.24
Pounds per day - Grading/Excavation	0.06	0.33	1.23	0.09	0.04	0.01	1,365.73	0.00	0.04	1,379.19
Tons per const. Period - Grading/Excavation	0.00	0.02	0.06	0.00	0.00	0.00	71.02	0.00	0.00	71.72
Pounds per day - Drainage/Utilities/Sub-Grade	0.01	0.04	0.15	0.01	0.00	0.00	170.72	0.00	0.01	172.40
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	4.44	0.00	0.00	4.48
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.00	0.02	0.07	0.01	0.00	0.00	77.68	0.00	0.00	78.44

Figure 2. Inputs for Alternative 5 – Road Construction Emissions Model v8.1.0 (cont.)

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing	1.00		10.00	0.13	2.08	0.03
Fugitive Dust - Grading/Excavation	1.00		10.00	0.52	2.08	0.11
Fugitive Dust - Drainage/Utilities/Subgrade	1.00		10.00	0.26	2.08	0.05

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Tier 4	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Tier 4	Graders	0.24	4.11	0.47	0.02	0.02	0.01	757.00	0.24	0.01	765.14
			Tier 4	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other General Industrial Equipme	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Material Handling Equipme	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Tier 4	Tractors/Loaders/Backhoes	0.12	2.96	0.24	0.01	0.01	0.00	380.43	0.12	0.00	384.52
			Tier 4	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grubbing/Land Clearing	pounds per day	0.36	7.07	0.71	0.04	0.03	0.01	1,137.44	0.37	0.01	1,149.67
Grubbing/Land Clearing	tons per phase	0.00	0.09	0.01	0.00	0.00	0.00	14.79	0.00	0.00	14.95

Figure 2. Inputs for Alternative 5 – Road Construction Emissions Model v8.1.0 (cont.)

- A grader would be used during the excavation phase to maintain access roads, however, it is not expected that the grader would be required every day for the entire 4 month duration of the excavation phase, therefore, the additional equipment was added to the staging phase, resulting in an estimated use for (260 hours = 1 month x 26 days x 10 hour days) of run time.

Grading/Excavation Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Tier 4	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00			Tier 4	Excavators	0.61	15.16	1.23	0.06	0.06	0.02	1,934.40	0.63	0.02	1,955.25
			Tier 4	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other General Industrial Equipme	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Material Handling Equipmer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00			Tier 4	Rubber Tired Loaders	0.48	8.25	0.95	0.05	0.04	0.02	1,491.79	0.48	0.01	1,507.89
			Tier 4	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment — If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Grading/Excavation	pounds per day	1.09	23.41	2.18	0.11	0.10	0.04	3,426.18	1.11	0.03	3,463.15
Grading/Excavation	tons per phase	0.06	1.22	0.11	0.01	0.01	0.00	178.16	0.06	0.00	180.08

Figure 2. Inputs for Alternative 5 – Road Construction Emissions Model v8.1.0 (cont.)

- 3 excavators would be required during the excavation phase: 2 excavators dedicated to excavation and 1 excavator dedicated to installation of hydraulic roughness and structural complexity features (wood/ boulders). Installation of these elements is not expected to occur for the entire duration of the excavation phase and the 3rd excavator would be used to improve excavation efficiency.
- 2 loaders would be used to support transfer of material from the excavators to haul trucks in locations where hauls trucks cannot access.

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Tier 4	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00			Tier 4	Excavators	0.41	10.11	0.82	0.04	0.04	0.01	1,289.60	0.42	0.01	1,303.50
			Tier 4	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other General Industrial Equipme	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Material Handling Equipmer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00			Tier 4	Tractors/Loaders/Backhoes	0.24	5.92	0.48	0.02	0.02	0.01	760.86	0.25	0.01	769.05
			Tier 4	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade		pounds per day		0.65	16.02	1.30	0.06	0.06	0.02	2,050.46	0.66	0.02	2,072.55
Drainage/Utilities/Sub-Grade		tons per phase		0.02	0.42	0.03	0.00	0.00	0.00	53.31	0.02	0.00	53.89

Figure 2. Inputs for Alternative 5 – Road Construction Emissions Model v8.1.0 (cont.)

- The planting phase assumes 2 planting crews, each including: 1 excavators with stinger attachments and 1 small support tractors or bobcats to handle material.

Equipment	User Override of Horsepower	Default Values Horsepower	User Override of Hours/day	Default Values Hours/day
Aerial Lifts		63		8
Air Compressors		78		8
Bore/Drill Rigs		206		8
Cement and Mortar Mixers		9		8
Concrete/Industrial Saws		81		8
Cranes		226		8
Crawler Tractors		208		8
Crushing/Proc. Equipment		85		8
Excavators		163	10.00	8
Forklifts		89		8
Generator Sets		84		8
Graders		175	10.00	8
Off-Highway Tractors		123		8
Off-Highway Trucks		400		8
Other Construction Equipment		172		8
Other General Industrial Equipment		88		8
Other Material Handling Equipment		167		8
Pavers		126		8
Paving Equipment		131		8
Plate Compactors		8		8
Pressure Washers		13		8
Pumps		84		8
Rollers		81		8
Rough Terrain Forklifts		100		8
Rubber Tired Dozers		255		8
Rubber Tired Loaders		200	10.00	8
Scrapers		362		8
Signal Boards		6		8
Skid Steer Loaders		65		8
Surfacing Equipment		254		8
Sweepers/Scrubbers		64		8
Tractors/Loaders/Backhoes		98	10.00	8
Trenchers		81		8
Welders		46		8

Figure 2. Inputs for Alternative 5 – Road Construction Emissions Model v8.1.0 (cont.)

- All equipment is assumed to be operated over 10 hour days.

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Daily Emission Estimates for -> Yuba River Ecosystem Restoration Feasibility Study														
Project Phases (Pounds)	**ROG (lbs/day)**	**CO (lbs/day)**	**NOx (lbs/day)**	**Total PM10 (lbs/day)**	**Exhaust PM10 (lbs/day)**	**Fugitive Dust PM10 (lbs/day)**	**Total PM2.5 (lbs/day)**	**Exhaust PM2.5 (lbs/day)**	**Fugitive Dust PM2.5 (lbs/day)**	**SOx (lbs/day)**	**CO_2 (lbs/day)**	**CH_4 (lbs/day)**	**N_2O (lbs/day)**	**CO_2e (lbs/day)**
Grubbing/Land Clearing	0.41	8.20	1.09	10.11	0.11	10.00	2.14	0.06	2.08	0.02	1,830.40	0.38	0.02	1,847.15
Grading/Excavation	2.40	32.88	27.59	12.10	2.10	10.00	2.96	0.88	2.08	0.31	32,426.43	1.18	0.96	32,743.14
Drainage/Utilities/Sub-Grade	0.82	20.50	1.89	10.29	0.29	10.00	2.23	0.15	2.08	0.04	3,841.01	0.70	0.04	3,871.04
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (pounds/day)	3.62	61.58	30.57	32.50	2.50	30.00	7.34	1.10	6.24	0.37	38,097.84	2.26	1.03	38,461.33
Total (tons/construction project)	0.15	2.35	1.50	1.03	0.12	0.91	0.24	0.05	0.19	0.02	1,809.84	0.08	0.05	1,827.30

Notes:

Project Start Year ->	2022
Project Length (months) ->	7
Total Project Area (acres) ->	60
Maximum Area Disturbed/Day (acres) ->	1
Water Truck Used? ->	Yes

	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
Phase	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	13	0	40	0	500	50
Grading/Excavation	2,509	0	7,800	0	1,300	400
Drainage/Utilities/Sub-Grade	0	0	0	0	2,100	50
Paving	0	0	0	0	0	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H. Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.

CO_2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO_2, CH_4 and N_2O, respectively. Total CO_2e is then estimated by summing CO_2e estimates over all GHGs.

Total Emission Estimates by Phase for -> Yuba River Ecosystem Restoration Feasibility Study														
Project Phases (Tons for all except CO_2e. Metric tonnes for CO_2e)	**ROG (tons/phase)**	**CO (tons/phase)**	**NOx (tons/phase)**	**Total PM10 (tons/phase)**	**Exhaust PM10 (tons/phase)**	**Fugitive Dust PM10 (tons/phase)**	**Total PM2.5 (tons/phase)**	**Exhaust PM2.5 (tons/phase)**	**Fugitive Dust PM2.5 (tons/phase)**	**SOx (tons/phase)**	**CO_2 (tons/phase)**	**CH_4 (tons/phase)**	**N_2O (tons/phase)**	**CO_2e (MT/phase)**
Grubbing/Land Clearing	0.01	0.11	0.01	0.13	0.00	0.13	0.03	0.00	0.03	0.00	23.80	0.00	0.00	21.78
Grading/Excavation	0.12	1.71	1.43	0.63	0.11	0.52	0.15	0.05	0.11	0.02	1,686.17	0.06	0.05	1,544.63
Drainage/Utilities/Sub-Grade	0.02	0.53	0.05	0.27	0.01	0.26	0.06	0.00	0.05	0.00	99.87	0.02	0.00	91.31
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (tons/phase)	0.12	1.71	1.43	0.63	0.11	0.52	0.15	0.05	0.11	0.02	1686.17	0.06	0.05	1,544.63
Total (tons/construction project)	0.15	2.35	1.50	1.03	0.12	0.91	0.24	0.05	0.19	0.02	1809.84	0.08	0.05	1,657.72

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns G and H. Total PM2.5 emissions shown in Column I are the sum of exhaust and fugitive dust emissions shown in columns J and K.

CO_2e emissions are estimated by multiplying mass emissions for each GHG by its global warming potential (GWP), 1 , 25 and 298 for CO_2, CH_4 and N_2O, respectively. Total CO_2e is then estimated by summing CO_2e estimates over all GHGs.

The CO_2e emissions are reported as metric tons per phase.

Figure 3. Road Construction Emissions Model v8.1.0 Result for Alternative 5 (TSP) – Habitat Increments 2, 3a, 5a, and 5b.

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Road Construction Emissions Model **Version 8.1.0**

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells D10 through D24, E28 through G35, and D38 through D41 for all project types.
Please use "Clear Data Input & User Overrides" button first before changing the Project Type or begin a new project.

Clear Data Input & User Overrides

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type

Project Name	Yuba River Ecosystem Restoration Feasibility Study	
Construction Start Year	2022	Enter a Year between 2014 and 2025 (inclusive)
Project Type For 4: Other Linear Project Type, please provide project specific off-road equipment population and vehicle trip data	4	1) New Road Construction : Project to build a roadway from bare ground, which generally requires more site preparation than widening an existing roadway 2) Road Widening : Project to add a new lane to an existing roadway 3) Bridge/Overpass Construction : Project to build an elevated roadway, which generally requires some different equipment than a new roadway, such as a crane 4) Other Linear Project Type: Non-roadway project such as a pipeline, transmission line, or levee construction
Project Construction Time	7.00	months
Working Days per Month	26.00	days (assume 22 if unknown)
Predominant Soil/Site Type: Enter 1, 2, or 3 (for project within "Sacramento County", follow soil type selection instructions in cells E18 to E20 otherwise see instructions provided in cells J18 to J22)	1	1) Sand Gravel : Use for quaternary deposits (Delta/West County) 2) Weathered Rock-Earth : Use for Laguna formation (Jackson Highway area) or the Ione formation (Scott Road, Rancho Murieta) 3) Blasted Rock : Use for Salt Springs Slate or Copper Hill Volcanics (Folsom South of Highway 50, Rancho Murieta)
Project Length	2.63	miles
Total Project Area	59.53	acres
Maximum Area Disturbed/Day	1.00	acre
Water Trucks Used?	1	1. Yes 2. No

Please note that the soil type instructions provided in cells E18 to E20 are specific to Sacramento County. Maps available from the California Geologic Survey (see weblink below) can be used to determine soil type outside Sacramento County.

http://www.conservation.ca.gov/cgs/information/geologic_mapping/Pages/googlemaps.aspx#regionalseries

Material Hauling Quantity Input

Material Type	Phase	Haul Truck Capacity (yd^3) (assume 20 if unknown)	Import Volume (yd^3/day)	Export Volume (yd^3/day)
Soil	Grubbing/Land Clearing	13.00		13.00
	Grading/Excavation	13.00		3433.00
	Drainage/Utilities/Sub-Grade			
	Paving			
Asphalt	Grubbing/Land Clearing			
	Grading/Excavation			
	Drainage/Utilities/Sub-Grade			
	Paving			

Mitigation Options

On-road Fleet Emissions Mitigation	2010 and Newer On-road Vehicles Fleet	Select "2010 and Newer On-road Vehicles Fleet" option when the on-road heavy-duty truck fleet for the project will be limited to vehicles of model year 2010 or newer
Off-road Equipment Emissions Mitigation	Tier 4 Equipment	Select "20% NOx and 45% Exhaust PM reduction" option if the project will be required to use a lower emitting off-road construction fleet. The SMAQMD Construction Mitigation Calculator can be used to confirm compliance with this mitigation measure (http://www.airquality.org/ceqa/mitigation.shtml). Select "Tier 4 Equipment" option if some or all off-road equipment used for the project meets CARB Tier 4 Standard
Will all off-road equipment be tier 4?	All Tier 4 Equipment	

Figure 4. Inputs for Alternative 6 – Road Construction Emissions Model v8.1.0

Construction Periods	User Override of Construction Months	Program Calculated Months	User Override of Phase Starting Date	Program Default Phase Starting Date
Grubbing/Land Clearing	1.00	0.70	6/1/2022	1/1/2022
Grading/Excavation	4.00	2.80	7/1/2022	2/1/2022
Drainage/Utilities/Sub-Grade	2.00	2.45	10/1/2022	6/3/2022
Paving	0.00	1.05	7/1/2023	8/3/2022
Totals (Months)	7			

Figure 4. Inputs for Alternative 6 – Road Construction Emissions Model v8.1.0 (cont.)

- Although the proposed construction schedule would take 6 months, the automated calculation function of the RCEM does not account for overlap, therefore for the purpose of consistency, the total project length has been identified as 7 months.
- The project length and areas were calculated as the sum of each unit of the project area. For the purpose of this analysis, the total project length and area are representative of 1/3 of that total value, which would be the amount of work that would be expected to occur over one construction year. This is consistent with running a worst case scenario to evaluate annual emissions.
- 2 truck trips per day were added to the soil hauling emissions calculations (2 trips per day x 26 days/month x 4 months = 208 truck trips) to accommodate for truck hauling associated with hydraulic roughness elements (boulders and wood).

Soil Hauling Emissions **User Input**	User Override of Miles/Round Trip	Program Estimate of Miles/Round Trip	User Override of Truck Round Trips/Day	Default Values Round Trips/Day	Calculated Daily VMT
Miles/round trip: Grubbing/Land Clearing	40.00		1	1	40.00
Miles/round trip: Grading/Excavation	40.00		267	265	10680.00
Miles/round trip: Drainage/Utilities/Sub-Grade				0	0.00
Miles/round trip: Paving				0	0.00

2010+ Model Year Mitigation Option Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Grading/Excavation (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Draining/Utilities/Sub-Grade (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Paving (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hauling Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.01	0.03	0.12	0.01	0.00	0.00	136.57	0.00	0.00	137.92
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	1.78	0.00	0.00	1.79
Pounds per day - Grading/Excavation	1.57	8.75	32.73	2.42	0.94	0.35	36,465.02	0.07	1.20	36,824.33
Tons per const. Period - Grading/Excavation	0.08	0.46	1.70	0.13	0.05	0.02	1,896.18	0.00	0.06	1,914.87
Pounds per day - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.08	0.46	1.70	0.13	0.05	0.02	1,897.96	0.00	0.06	1,916.66

Figure 4. Inputs for Alternative 6 – Road Construction Emissions Model v8.1.0 (cont.)

Worker Commute Emissions	User Override of Worker Commute Default Values	Default Values	Calculated Daily Trips	Calculated Daily VMT
User Input				
Miles/ one-way trip	50			
One-way trips/day	2			
No. of employees: Grubbing/Land Clearing	5		10	500.00
No. of employees: Grading/Excavation	17		34	1,700.00
No. of employees: Drainage/Utilities/Sub-Grade	21		42	2,100.00
No. of employees: Paving			0	0.00

Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile)	0.02	0.92	0.09	0.05	0.02	0.00	348.29	0.01	0.00	349.59
Grading/Excavation (grams/mile)	0.02	0.92	0.09	0.05	0.02	0.00	348.29	0.01	0.00	349.59
Draining/Utilities/Sub-Grade (grams/mile)	0.02	0.92	0.09	0.05	0.02	0.00	348.29	0.01	0.00	349.59
Paving (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grubbing/Land Clearing (grams/trip)	0.87	2.06	0.16	0.00	0.00	0.00	79.59	0.01	0.01	81.77
Grading/Excavation (grams/trip)	0.87	2.06	0.16	0.00	0.00	0.00	79.59	0.01	0.01	81.77
Draining/Utilities/Sub-Grade (grams/trip)	0.87	2.06	0.16	0.00	0.00	0.00	79.59	0.01	0.01	81.77
Paving (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.04	1.06	0.10	0.05	0.02	0.00	385.68	0.01	0.00	387.17
Tons per const. Period - Grubbing/Land Clearing	0.00	0.01	0.00	0.00	0.00	0.00	5.01	0.00	0.00	5.03
Pounds per day - Grading/Excavation	0.13	3.59	0.35	0.17	0.07	0.01	1,311.30	0.03	0.01	1,316.36
Tons per const. Period - Grading/Excavation	0.01	0.19	0.02	0.01	0.00	0.00	68.19	0.00	0.00	68.45
Pounds per day - Drainage/Utilities/Sub-Grade	0.16	4.44	0.44	0.22	0.09	0.02	1,619.84	0.03	0.02	1,626.09
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.12	0.01	0.01	0.00	0.00	42.12	0.00	0.00	42.28
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.01	0.32	0.03	0.02	0.01	0.00	115.32	0.00	0.00	115.76

Figure 4. Inputs for Alternative 6 – Road Construction Emissions Model v8.1.0 (cont.)

- 50 miles one way trip is representative of distances that may be travelled from nearby major population centers (Sacramento, Ca and Chico, Ca).
- Number of employees estimated does not include truck drivers as their emissions are included in the soil hauling emissions estimate.

Water Truck Emissions	User Override of	Program Estimate of	User Override of Truck	Default Values	Calculated
User Input	Default # Water Trucks	Number of Water Trucks	Miles Traveled/Vehicle/Day	Miles Traveled/Vehicle/Day	Daily VMT
Grubbing/Land Clearing - Exhaust	1		50.00		50.00
Grading/Excavation - Exhaust	2		200.00		400.00
Drainage/Utilities/Subgrade	1		50.00		50.00
Paving					0.00

2010+ Model Year Mitigation Option Emission Rates	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grubbing/Land Clearing (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Grading/Excavation (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Draining/Utilities/Sub-Grade (grams/mile)	0.07	0.37	1.39	0.10	0.04	0.01	1,548.71	0.00	0.05	1,563.97
Paving (grams/mile)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Pounds per day - Grubbing/Land Clearing	0.01	0.04	0.15	0.01	0.00	0.00	170.72	0.00	0.01	172.40
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	2.22	0.00	0.00	2.24
Pounds per day - Grading/Excavation	0.06	0.33	1.23	0.09	0.04	0.01	1,365.73	0.00	0.04	1,379.19
Tons per const. Period - Grading/Excavation	0.00	0.02	0.06	0.00	0.00	0.00	71.02	0.00	0.00	71.72
Pounds per day - Drainage/Utilities/Sub-Grade	0.01	0.04	0.15	0.01	0.00	0.00	170.72	0.00	0.01	172.40
Tons per const. Period - Drainage/Utilities/Sub-Grade	0.00	0.00	0.00	0.00	0.00	0.00	4.44	0.00	0.00	4.48
Pounds per day - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons per construction project	0.00	0.02	0.07	0.01	0.00	0.00	77.68	0.00	0.00	78.44

Figure 4. Inputs for Alternative 6 – Road Construction Emissions Model v8.1.0 (cont.)

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing	1.00		10.00	0.13	2.08	0.03
Fugitive Dust - Grading/Excavation	1.00		10.00	0.52	2.08	0.11
Fugitive Dust - Drainage/Utilities/Subgrade	1.00		10.00	0.26	2.08	0.05

Figure 4. Inputs for Alternative 6 – Road Construction Emissions Model v8.1.0 (cont.)

Off-Road Equipment Emissions

Grubbing/Land Clearing

Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Tier 4	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Tier 4	Graders	0.24	4.11	0.47	0.02	0.02	0.01	757.00	0.24	0.01	765.14
			Tier 4	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other General Industrial Equipme	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Material Handling Equipmer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Tier 4	Tractors/Loaders/Backhoes	0.12	2.96	0.24	0.01	0.01	0.00	380.43	0.12	0.00	384.52
			Tier 4	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Grubbing/Land Clearing	pounds per day	0.36	7.07	0.71	0.04	0.03	0.01	1,137.44	0.37	0.01	1,149.67
Grubbing/Land Clearing	tons per phase	0.00	0.09	0.01	0.00	0.00	0.00	14.79	0.00	0.00	14.95

Figure 4. Inputs for Alternative 6 – Road Construction Emissions Model v8.1.0 (cont.)

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- A grader would be used during the excavation phase to maintain access roads, however, it is not expected that the grader would be required everyday for the entire 4 month duration of the excavation phase, therefore, the additional equipment was added to the staging phase, resulting in an estimated use for (260 hours = 1 month x 26 days x 10 hour days) of run time.

Grading/Excavation Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Tier 4	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00			Tier 4	Excavators	0.82	20.21	1.64	0.08	0.08	0.03	2,579.19	0.83	0.02	2,607.00
			Tier 4	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other General Industrial Equipme	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Material Handling Equipmer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00			Tier 4	Rubber Tired Loaders	0.71	12.38	1.43	0.07	0.07	0.02	2,237.68	0.72	0.02	2,261.84
			Tier 4	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment Number of Vehicles	If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation		pounds per day		1.53	32.59	3.07	0.15	0.14	0.05	4,816.87	1.56	0.04	4,868.84
Grading/Excavation		tons per phase		0.08	1.69	0.16	0.01	0.01	0.00	250.48	0.08	0.00	253.18

Figure 4. Inputs for Alternative 6 – Road Construction Emissions Model v8.1.0 (cont.)

- 4 excavators would be required during the excavation phase: 3 excavators dedicated to excavation and 1 excavator dedicated to installation of hydraulic roughness and structural complexity features (wood/ boulders). Installation of these elements is not expected to occur for the entire duration of the excavation phase and the 3rd excavator would be used to improve excavation efficiency.
- 2 loaders would be used to support transfer of material from the excavators to haul trucks in locations where hauls trucks cannot access.

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Mitigation Option Override of Default Equipment Tier (applicable only when "Tier 4 Mitigation" Option Selected)	Default Equipment Tier	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
			Tier 4	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00			Tier 4	Excavators	0.41	10.11	0.82	0.04	0.04	0.01	1,289.60	0.42	0.01	1,303.50
			Tier 4	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other General Industrial Equipme	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Other Material Handling Equipmer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00			Tier 4	Tractors/Loaders/Backhoes	0.24	5.92	0.48	0.02	0.02	0.01	760.86	0.25	0.01	769.05
			Tier 4	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			Tier 4	Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

User-Defined Off-road Equipment If non-default vehicles are used, please provide information in 'Non-default Off-road Equipment' tab

Number of Vehicles	Equipment Tier	Type		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	SOx pounds/day	CO2 pounds/day	CH4 pounds/day	N2O pounds/day	CO2e pounds/day
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	N/A		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Drainage/Utilities/Sub-Grade	pounds per day	0.65	16.02	1.30	0.06	0.06	0.02	2,050.46	0.66	0.02	2,072.55
Drainage/Utilities/Sub-Grade	tons per phase	0.02	0.42	0.03	0.00	0.00	0.00	53.31	0.02	0.00	53.89

Figure 4. Inputs for Alternative 6 – Road Construction Emissions Model v8.1.0 (cont.)

- The planting phase assumes 2 planting crews, each including: 1 excavators with stinger attachments and 1 small support tractors or bobcats to handle material.

Equipment	User Override of Horsepower	Default Values Horsepower	User Override of Hours/day	Default Values Hours/day
Aerial Lifts		63		8
Air Compressors		78		8
Bore/Drill Rigs		206		8
Cement and Mortar Mixers		9		8
Concrete/Industrial Saws		81		8
Cranes		226		8
Crawler Tractors		208		8
Crushing/Proc. Equipment		85		8
Excavators		163	10.00	8
Forklifts		89		8
Generator Sets		84		8
Graders		175	10.00	8
Off-Highway Tractors		123		8
Off-Highway Trucks		400		8
Other Construction Equipment		172		8
Other General Industrial Equipment		88		8
Other Material Handling Equipment		167		8
Pavers		126		8
Paving Equipment		131		8
Plate Compactors		8		8
Pressure Washers		13		8
Pumps		84		8
Rollers		81		8
Rough Terrain Forklifts		100		8
Rubber Tired Dozers		255		8
Rubber Tired Loaders		200	10.00	8
Scrapers		362		8
Signal Boards		6		8
Skid Steer Loaders		65		8
Surfacing Equipment		254		8
Sweepers/Scrubbers		64		8
Tractors/Loaders/Backhoes		98	10.00	8
Trenchers		81		8
Welders		46		8

Figure 4. Inputs for Alternative 6 – Road Construction Emissions Model v8.1.0 (cont.)

- All equipment is assumed to be operated over 10 hour days.

Daily Emission Estimates for -> Yuba River Ecosystem Restoration Feasibility Study				Total	Exhaust	Fugitive Dust	Total	Exhaust	Fugitive Dust					
Project Phases (Pounds)	ROG (lbs/day)	CO (lbs/day)	NOx (lbs/day)	PM10 (lbs/day)	PM10 (lbs/day)	PM10 (lbs/day)	PM2.5 (lbs/day)	PM2.5 (lbs/day)	PM2.5 (lbs/day)	SOx (lbs/day)	CO2 (lbs/day)	CH4 (lbs/day)	N2O (lbs/day)	CO2e (lbs/day)
Grubbing/Land Clearing	0.41	8.20	1.09	10.11	0.11	10.00	2.14	0.06	2.08	0.02	1,830.40	0.38	0.02	1,847.15
Grading/Excavation	3.29	45.26	37.38	12.84	2.84	10.00	3.27	1.19	2.08	0.42	43,958.93	1.66	1.30	44,388.72
Drainage/Utilities/Sub-Grade	0.82	20.50	1.89	10.29	0.29	10.00	2.23	0.15	2.08	0.04	3,841.01	0.70	0.04	3,871.04
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (pounds/day)	4.52	73.97	40.37	33.24	3.24	30.00	7.65	1.41	6.24	0.48	49,630.34	2.73	1.37	50,106.92
Total (tons/construction project)	0.20	2.99	2.01	1.07	0.16	0.91	0.26	0.07	0.19	0.02	2,409.53	0.11	0.07	2,432.87

Notes: Project Start Year -> 2022
Project Length (months) -> 7
Total Project Area (acres) -> 60
Maximum Area Disturbed/Day (acres) -> 1
Water Truck Used? -> Yes

	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
Phase	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	13	0	40	0	500	50
Grading/Excavation	3,433	0	10,680	0	1,700	400
Drainage/Utilities/Sub-Grade	0	0	0	0	2,100	50
Paving	0	0	0	0	0	0

PM10 and PM2.5 estimates assume 50% control of fugitive dust from w atering and associated dust control measures if a minimum number of w ater trucks are specified.
Total PM10 emissions show n in column F are the sum of exhaust and fugitive dust emissions show n in columns G and H. Total PM2.5 emissions show n in Column I are the sum of exhaust and fugitive dust emissions show n in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global w arming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively. Total CO2e is then estimated by summing CO2e estimates over all GHGs.

Total Emission Estimates by Phase for -> Yuba River Ecosystem Restoration Feasibility Study				Total	Exhaust	Fugitive Dust	Total	Exhaust	Fugitive Dust					
Project Phases (Tons for all except CO2e. Metric tonnes for CO2e)	ROG (tons/phase)	CO (tons/phase)	NOx (tons/phase)	PM10 (tons/phase)	PM10 (tons/phase)	PM10 (tons/phase)	PM2.5 (tons/phase)	PM2.5 (tons/phase)	PM2.5 (tons/phase)	SOx (tons/phase)	CO2 (tons/phase)	CH4 (tons/phase)	N2O (tons/phase)	CO2e (MT/phase)
Grubbing/Land Clearing	0.01	0.11	0.01	0.13	0.00	0.13	0.03	0.00	0.03	0.00	23.80	0.00	0.00	21.78
Grading/Excavation	0.17	2.35	1.94	0.67	0.15	0.52	0.17	0.06	0.11	0.02	2,285.86	0.09	0.07	2,094.00
Drainage/Utilities/Sub-Grade	0.02	0.53	0.05	0.27	0.01	0.26	0.06	0.00	0.05	0.00	99.87	0.02	0.00	91.31
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum (tons/phase)	0.17	2.35	1.94	0.67	0.15	0.52	0.17	0.06	0.11	0.02	2285.86	0.09	0.07	2,094.00
Total (tons/construction project)	0.20	2.99	2.01	1.07	0.16	0.91	0.26	0.07	0.19	0.02	2409.53	0.11	0.07	2,207.09

PM10 and PM2.5 estimates assume 50% control of fugitive dust from w atering and associated dust control measures if a minimum number of w ater trucks are specified.
Total PM10 emissions show n in column F are the sum of exhaust and fugitive dust emissions show n in columns G and H. Total PM2.5 emissions show n in Column I are the sum of exhaust and fugitive dust emissions show n in columns J and K.
CO2e emissions are estimated by multiplying mass emissions for each GHG by its global w arming potential (GWP), 1 , 25 and 298 for CO2, CH4 and N2O, respectively. Total CO2e is then estimated by summing CO2e estimates over all GHGs.
The CO2e emissions are reported as metric tons per phase.

Figure 5. Road Construction Emissions Model v8.1.0 Result for Alternative 6 – Habitat Increments 1, 2, 3a, 5a, and 5b.

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