Appendix A: Biological Resources Data

CALIFORNIA DEPARTMENT OF FISH and WILDLIFE RareFind

Query Summary:
Quad IS (Sacramento West (3812155))

Print Close

CNDDB Element Query Results

Scientific Name	Common Name	Taxonomic Group	Element Code	Total Occs	Returned Occs	Federal Status	State Status	Global Rank	State Rank	CA Rare Plant Rank	Other Status	Habitats
Agelaius tricolor	tricolored blackbird	Birds	ABPBXB0020	955	3	None	Threatened	G2G3	S1S2	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_EN-Endangered, NABCI_RWL-Red Watch List, USFWS_BCC-Birds of Conservation Concern	Freshwater marsh, Marsh & swamp, Swamp, Wetland
Archoplites interruptus	Sacramento perch	Fish	AFCQB07010	5	1	None	None	G2G3	S1	null	AFS_TH-Threatened, CDFW_SSC-Species of Special Concern	Aquatic, Sacramento/San Joaquin flowing waters, Sacramento/San Joaquin standing waters
Astragalus tener var. ferrisiae	Ferris' milk-vetch	Dicots	PDFAB0F8R3	18	1	None	None	G2T1	S1	1B.1	BLM_S-Sensitive	Meadow & seep, Valley & foothill grassland, Wetland
Athene cunicularia	burrowing owl	Birds	ABNSB10010	1989	2	None	None	G4	S3	null	BLM_S-Sensitive, CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	Coastal prairie, Coastal scrub, Great Basin grassland, Great Basin scrub, Mojavean desert scrub, Sonoran desert scrub, Valley & foothill grassland
Buteo swainsoni	Swainson's hawk	Birds	ABNKC19070	2518	53	None	Threatened	G5	S3	null	BLM_S-Sensitive, IUCN_LC-Least Concern, USFWS_BCC-Birds of Conservation Concern	Great Basin grassland, Riparian forest, Riparian woodland, Valley & foothill grassland
Cicindela hirticollis abrupta	Sacramento Valley tiger beetle	Insects	IICOL02106	6	1	None	None	G5TH	SH	null	null	Sand shore
Coccyzus americanus occidentalis	western yellow-billed cuckoo	Birds	ABNRB02022	156	1	Threatened	Endangered	G5T2T3	S1	null	BLM_S-Sensitive, NABCI_RWL-Red Watch List, USFS_S-Sensitive, USFWS_BCC-Birds of Conservation Concern	Riparian forest
Desmocerus californicus dimorphus	valley elderberry longhorn beetle	Insects	IICOL48011	271	7	Threatened	None	G3T2	S2	null	null	Riparian scrub
Elanus leucurus	white-tailed kite	Birds	ABNKC06010	180	1	None	None	G5	S3S4	null	BLM_S-Sensitive,	Cismontane woodland,

												CDFW_FP-Fully Protected, IUCN_LC-Least Concern	Marsh & swamp, Riparian woodland, Valley & foothill grassland, Wetland
Elderberry Savanna	Elderberry Savanna	Riparian	CTT63440CA	4	1	None	None	G2	S2.1	null	null	Riparian scrub
Great Valley Cottonwood Riparian Forest	Great Valley Cottonwood Riparian Forest	Riparian	CTT61410CA	56	1	None	None	G2	S2.1	null	null	Riparian forest
Hibiscus lasiocarpos var. occidentalis	woolly rose-mallow	Dicots	PDMAL0H0R3	173	1	None	None	G5T3	S3	1B.2	SB_RSABG-Rancho Santa Ana Botanic Garden, SB_UCBG-UC Botanical Garden at Berkeley	Freshwater marsh, Marsh & swamp, Wetland
Lasiurus cinereus	hoary bat	Mammals	AMACC05030	238	1	None	None	G5	S4	null	IUCN_LC-Least Concern, WBWG_M-Medium Priority	Broadleaved upland forest, Cismontane woodland, Lower montane coniferous forest, North coast coniferous forest
Laterallus jamaicensis coturniculus	California black rail	Birds	ABNME03041	303	1	None	Threatened	G3G4T1	S1	null	BLM_S-Sensitive, CDFW_FP-Fully Protected, IUCN_NT-Near Threatened, NABCI_RWL-Red Watch List, USFWS_BCC-Birds of Conservation Concern	Brackish marsh, Freshwater marsh, Marsh & swamp, Salt marsh, Wetland
Melospiza melodia	song sparrow ("Modesto" population)	Birds	ABPBXA3010	92	2	None	None	G5	S3?	null	CDFW_SSC-Species of Special Concern	null
Oncorhynchus mykiss irideus pop. 11	steelhead - Central Valley DPS	Fish	AFCHA0209K	31	2	Threatened	None	G5T2Q	S2	null	AFS_TH-Threatened	Aquatic, Sacramento/San Joaquin flowing waters
Oncorhynchus tshawytscha pop. 6	chinook salmon - Central Valley spring-run ESU	Fish	AFCHA0205A	13	1	Threatened	Threatened	G5	S1	null	AFS_TH-Threatened	Aquatic, Sacramento/San Joaquin flowing waters
Oncorhynchus tshawytscha pop. 7	chinook salmon - Sacramento River winter-run ESU	Fish	AFCHA0205B	2	1	Endangered	Endangered	G5	S1	null	AFS_EN-Endangered	Aquatic, Sacramento/San Joaquin flowing waters
Pogonichthys macrolepidotus	Sacramento splittail	Fish	AFCJB34020	15	1	None	None	GNR	S3	null	AFS_VU-Vulnerable, CDFW_SSC-Species of Special Concern, IUCN_EN-Endangered	Aquatic, Estuary, Freshwater marsh, Sacramento/San Joaquin flowing waters
Progne subis	purple martin	Birds	ABPAU01010	71	1	None	None	G5	S3	null	CDFW_SSC-Species of Special Concern, IUCN_LC-Least Concern	Broadleaved upland forest, Lower montane coniferous forest
Spirinchus thaleichthys	longfin smelt	Fish	AFCHB03010	46	1	Candidate	Threatened	G5	S1	null	null	Aquatic, Estuary
Symphyotrichum lentum	Suisun Marsh aster	Dicots	PDASTE8470	175	1	None	None	G2	S2	1B.2	SB_RSABG-Rancho Santa Ana Botanic Garden,	Brackish marsh, Freshwater marsh, Marsh & swamp, Wetland

											SB_USDA-US Dept of Agriculture	
Thamnophis gigas	giant gartersnake	Reptiles	ARADB36150	366	4	Threatened	Threatened	G2	S2	null	IUCN_VU-Vulnerable	Marsh & swamp, Riparian scrub, Wetland
Vireo bellii pusillus	least Bell's vireo	Birds	ABPBW01114	503	2	Endangered	Endangered	G5T2	S2	null	IUCN_NT-Near Threatened, NABCI_YWL-Yellow Watch List	Riparian forest, Riparian scrub, Riparian woodland

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:
Consultation Code: 08ESMF00-2019-SLI-1867
Event Code: 08ESMF00-2019-E-05992
Project Name: American River Common Features East Sacramento Contract 1

May 08, 2019

Subject: 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

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

San Francisco Bay-Delta Fish And Wildlife
650 Capitol Mall
Suite 8-300
Sacramento, CA 95814
(916) 930-5603

Project Summary

Consultation Code: 08ESMF00-2019-SLI-1867

Event Code: 08ESMF00-2019-E-05992

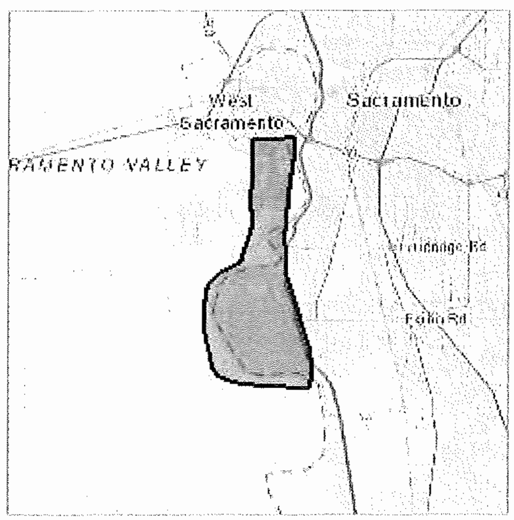
Project Name: American River Common Features East Sacramento Contract 1

Project Type: LAND - FLOODING

Project Description: Cutoff wall and seepage berm construction in April 2020 at approximately seven reaches in East Sacramento on the Sacramento River

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/38.51847170513964N121.53458974895136W



Counties: Sacramento, CA | Yolo, 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.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

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.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Birds

NAME	STATUS
Least Bell's Vireo *Vireo bellii pusillus* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5945	Endangered
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **proposed** critical habitat for this species. Your location is outside the 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 **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander *Ambystoma californiense* Population: U.S.A. (Central CA DPS) There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2076	Threatened

Fishes

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/321	Threatened

Insects

NAME	STATUS
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7850 Habitat assessment guidelines: https://ecos.fws.gov/ipac/guideline/assessment/population/436/office/11420.pdf	Threatened

Crustaceans

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

Table 1. Special-status Plant Species with Potential to Occur in the Project Area

Species Name	Legal Status[1]	Habitat, Elevation Range, and Blooming Period	Potential for Occurrence[2]
Watershield *Brasenia schreberi*	CRPR 2B.3	Freshwater ponds, marshes, and swamps, often in association with duckweed (*Lemna* spp.), from 98 to 7,218 feet in elevation. Blooms April–October.	Unlikely to occur
Bristly sedge *Carex comosa*	CRPR 2B.1	Marshes and swamps, generally on lake margins and wet places such as ditches, sloughs, and freshwater marsh, from 0 to 2,050 feet in elevation. Blooms May–September.	Unlikely occur
Bolander's water hemlock *Cicuta maculata* var. *bolanderi*	CRPR 2B.1	Coastal, freshwater, or brackish marshes and swamps, from 0 to 650 feet in elevation. Blooms July–September.	Unlikely to occur
Peruvian dodder *Cuscuta obtusiflora* var. *glandulosa*	CRPR 2B.2	Freshwater marshes and swamps; from 49 to 919 feet in elevation. Blooms July–October.	Unlikely to occur
Woolly rose-mallow *Hibiscus lasiocarpos* var. *occidentalis*	CRPR 1B.2	Freshwater marshes and swamps, generally found on wetted river banks and low peat islands in sloughs; known from the Delta watershed, also recorded in riprap on levee slopes, from 0 to 390 feet in elevation. Blooms June–November.	Known to occur
Northern California black walnut *Juglans hindsii*	CRPR 1B.1	Riparian forest and woodland, from 0 to 1,440 feet in elevation. Although there is one documented occurrence along the Sacramento River between Freeport and Walnut Grove (CNDDB occurrence number 3), it is believed to have been extirpated and the species is believed to be extirpated from Sacramento County. Blooms April–May.	Unlikely to occur
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	CRPR 1B.2	Freshwater and brackish marshes; generally restricted to the Delta, also recorded in riprap on levee slopes, from 0 to 13 feet in elevation. Blooms May–July (rarely into September).	Unlikely to occur
Mason's lilaeopsis *Lilaeopsis masonii*	CR; CRPR 1B.1	Freshwater and brackish marshes, riparian scrub; generally found in tidal zones, on bare depositional soils in the Delta, from 0 to 33 feet in elevation. Blooms April–November.	Unlikely to occur
Delta mudwort *Limosella australis*	CRPR 2B.1	Riparian scrub, freshwater marsh, brackish marsh; generally occurs on intertidal mud banks of the Delta in marshy or scrubby riparian associations, from 0 to 10 feet in elevation. Blooms April–August.	Unlikely to occur
Sanford's arrowhead *Sagittaria sanfordii*	CRPR 1B.2	Assorted shallow freshwater marshes and swamps; generally occurs in standing or slow-moving freshwater ponds, marshes, ditches, and sloughs from 0 to 2,000 feet in elevation. Blooms May–October.	Unlikely to occur
Marsh skullcap *Scutellaria galericulata*	CRPR 2B.2	Lower montane coniferous forest, meadows and seeps, and marshes and swamps; generally occurs in swamps and wet places, also recorded on floating logs and pilings in river and slough channels, from 3,000 to 6,900 feet in elevation. Blooms June–September.	Unlikely to occur

Table 1. Special-status Plant Species with Potential to Occur in the Project Area

Species Name	Legal Status[1]	Habitat, Elevation Range, and Blooming Period	Potential for Occurrence[2]
Side-flowering skullcap *Scutellaria lateriflora*	CRPR 2B.2	Meadows and seeps, marshes and swamps; generally occurs in wet meadows and marshes in the Delta, also recorded on floating logs and pilings in river and slough channels, from 0 to 1,600 feet in elevation. Blooms May–September.	Unlikely to occur
Suisun Marsh aster *Symphyotrichum lentum*	CRPR 1B.2	Brackish and freshwater marshes and swamps; endemic to the Delta; generally occurs in marshes and swamps, often along sloughs, also recorded in riprap on levee slopes and pilings in river and slough channels, from 0 to 10 feet in elevation. Blooms May–November.	Unlikely to occur

Notes: CNDDB = California Natural Diversity Database; CRPR = California Rare Plant Rank; Delta = Sacramento–San Joaquin Delta

[1] **Legal Status Definitions**

CR = State status of Rare (legally protected).

California Rare Plant Ranks:

1B Plant species considered rare or endangered in California and elsewhere (but not legally protected under the Federal or California Endangered Species Acts).

2B Plant species considered rare or endangered in California but more common elsewhere (but not legally protected under the Federal or California Endangered Species Acts).

California Rare Plant Rank Extensions:

.1 Seriously endangered in California (greater than 80 percent of occurrences are threatened and/or have a high degree and immediacy of threat).

.2 Fairly endangered in California (20 to 80 percent of occurrences are threatened and/or have a moderate degree and immediacy of threat).

.3 Not very endangered in California.

[2] **Potential for Occurrence Definitions**:

- *No potential to occur:* Potentially suitable habitat is not present.
- *Unlikely to occur:* Potentially suitable habitat present but species unlikely to be present because of very restricted distribution and/or because it was not observed during focused surveys.
- *Known to occur:* The species was observed during focused surveys.

Sources: Baldwin et. al. 2012; CDFW 2019; CNPS 2019

Table 2. Special-Status Fishes With Potential to Occur in the Project Area

Scientific Name Common Name	Status[1] (Federal/State)	Description
Entosphenus tridentatus Pacific lamprey	–/SSC	Anadromous; expected to occur at the proposed levee improvement sites. Adults and rearing juveniles have the potential to be present year-round.
Lampetra ayresi river lamprey	–/SSC	Anadromous; though the distribution is not well known, the project area is within the species' known range and habitat is present in the Lower Sacramento River. Adults enter the streams in the fall, and spawning is believed to occur in April and May; young hatch in 2–3 weeks and remain in freshwater streams for 3–5 years (Moyle 2002).
Acipenser medirostris green sturgeon	FT, FX/SSC	Anadromous; expected to occur at the proposed levee improvement sites as adults migrating upstream to their spawning habitat (between late February and late July), and as larvae and juveniles, rearing and migrating to the ocean (year-round).
Acipenser transmontanus white sturgeon	–/SSC	Anadromous; expected to occur at the proposed levee improvement sites as adults migrating upstream to their spawning habitat (winter and spring), and as larvae moving downstream to the estuary (spring to early summer).
Mylopharadon conocephalus hardhead	–/SSC	Resident; expected to occur year-round in the Lower Sacramento River. Adults occur in deep, clear pool and run habitats, whereas juveniles are found in shallow water and along the shoreline (Moyle et al. 1982, Moyle 2002).
Pogonichthys macrolepidotus Sacramento splittail	–/SSC	Resident/semi-anadromous; expected to occur in wet years in the project area along the Lower Sacramento River as adults migrating from the Delta to flooded spawning areas in February–June, and as juveniles migrating from upstream spawning habitats to tidal habitat shortly after emergence, primarily in April and May (Sommer et al. 1997; Baxter 1999, 2000, both as cited in Moyle 2002).
Hypomesus transpacificus delta smelt	FT, FX/SE	Semi-anadromous; adults and juveniles are uncommon at the proposed levee improvement sites, but may be present in December–July, though typically restricted to the Delta and the Lower Sacramento River downstream of Isleton (RM 18); juveniles move downstream with the currents (USFWS 1996, Sommer et al. 2001a, Moyle 2002).
Spirinchus thaleichthys longfin smelt	FC/ST, SSC	Anadromous; rare migrant to the project area. Similar to delta smelt, adults and juveniles are uncommon, but may be present along the Lower Sacramento River in December–July when they enter freshwater streams to spawn, though typically restricted to the Delta and the lower Sacramento River downstream of Rio Vista (RM 12) (Moyle 2002, Baxter et al. 2008).
Oncorhynchus mykiss Central Valley steelhead	FT, FX/–	Anadromous; expected to occur in the Lower Sacramento River as adults migrating to their upstream spawning habitat, and as juveniles and smolts rearing and migrating towards the ocean. Adult migration to upstream spawning areas occurs in July–March (Hallock 1987). Juveniles typically spend 1–3 years in fresh water before migrating to the ocean, generally in December–August (McEwan 2001).
Oncorhynchus tshawytscha Central Valley spring-run Chinook salmon	FT, FX/ST	Anadromous; expected to occur in the Lower Sacramento River as adults migrating upstream in March–September, (peak May–June) (Yoshiyama et al. 1998), and as juveniles and yearlings migrating downstream from the onset of the winter storm season through June (CDFG 1998, Fisher 1994, S.P. Cramer and Associates 1995, Hill and Webber 1999, NMFS 2014).
Oncorhynchus tshawytscha Sacramento River winter-run Chinook salmon	FE, FX/SE	Anadromous; expected to occur in the Lower Sacramento River as adults, migrating upstream in December–July (peak in March) (Moyle 2002), and as juveniles migrating downstream soon after fry emerge, typically beginning in August and peaking in September and October (Vogel and Marine 1991). Juveniles and smolts (juveniles that are physiologically ready to enter seawater) may migrate through the project area in November–May (Yoshiyama et al. 1998).

Table 2. Special-Status Fishes With Potential to Occur in the Project Area

Scientific Name Common Name	Status[1] (Federal/State)	Description
Oncorhynchus tshawytscha Central Valley fall-/late fall-run Chinook salmon	FSC/SSC	Anadromous; fall-run are expected to occur throughout the project area, either as adults migrating upstream to their spawning habitat, or as juveniles and smolts rearing and migrating toward the ocean. Late fall-run are expected to occur in the Lower Sacramento River. Fall-run adults migrate through the project area in June–December. Fall-run juveniles rear in fresh water for only a few months after emerging, migrating downstream through the project area in March–July (Yoshiyama et al. 1998). Late fall-run adults migrate through the project area in October–April. Late fall-run juveniles rear in their natal stream during summer; in some streams they remain throughout the year. Late fall-run smolt outmigration can occur in November–May (Yoshiyama et al. 1998).

Notes: CDFG = California Department of Fish and Game; CDFW = California Department of Fish and Wildlife; CESA = California Endangered Species Act; Delta = Sacramento-San Joaquin Delta; ESA = Federal Endangered Species Act; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service

1 Status (CDFW 2016, NMFS 2016, USFWS 2016):

Federal

FE = endangered under the ESA
FT = threatened under the ESA
FC = candidate species for listing under the ESA
FSC = Federal sensitive, or species of concern
FX = designated critical habitat under the ESA
– = no status

State

SE = endangered under CESA
ST = threatened under CESA
SSC = CDFW Species of Special Concern
– = no status

Source: Data compiled by Stillwater Sciences in 2016

Table 3. Special-status Wildlife Species Evaluated for Potential to Occur in the Project Area

Species Name	Legal Status[1] Federal	State	Habitat Associations and Species Occurrences	Potential for Occurrence[2]
Invertebrates				
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	FT	–	Closely associated with blue elderberry (*Sambucus* sp.), which is an obligate host for the beetle larvae; occurrences along the Sacramento River.	Known to occur
Reptiles				
Giant garter snake *Thamnophis gigas*	FT	ST	Open water associated with marshes, sloughs, and irrigation/drainage ditches within the Central Valley; requires emergent herbaceous wetland vegetation, grassy banks, and openings in waterside vegetation, and higher elevation upland habitat. A historical occurrence is recorded from Laguna Creek (CDFW 2016), but species experts consider this record to be an error, and there is no reliable evidence of giant garter snake presence in the Upper Beach Lake area (E. Hansen, pers. comm., 2015).	Unlikely to occur
Northwestern pond turtle *Emys marmorata*	–	SSC	Permanent or nearly permanent water bodies with abundant vegetation and rocky or muddy bottoms in a variety of habitat types; also require basking sites such as logs, rocks, cattail mats, and exposed banks; documented in the levee improvements area and Upper Beach Lake area.	Known to occur
Birds				
California least tern *Sterna antillarum browni*	FE	SE	Typically found at coastal beaches, bays, estuaries, and other water bodies, but known to occur at several scattered inland sites, including very small numbers in some years at the Sacramento Regional WWTP (SRCSD 2014).	Could occur
Western snowy plover *Charadrius alexandrines nivosus*	FT	–	Primarily a coastal species, but scattered inland breeding populations exist; CNDDB occurrences of migrant individuals from several wastewater treatment facilities in the region.	Unlikely to occur
Greater sandhill crane *Grus canadensis tabida*	–	ST	Grasslands, moist croplands with stubble, and open, emergent wetlands; does not breed in the Central Valley but regularly occurs in the Sacramento Regional WWTP Bufferlands in September through March (SRCSD 2014).	Could occur
White-tailed kite *Elanus leucurus*	–	FP	Nests in woodlands and isolated trees and forages in grasslands, pasture, and agricultural fields; nests documented in the Woodlake area and adjacent to Sacramento Regional WWTP Bufferlands.	Known to occur
Swainson's hawk *Buteo swainsoni*	–	ST	Nests in woodlands and scattered trees and forages in grasslands and agricultural fields; known to nest and forage in the vicinity of the project area, including potential woodland mitigation sites.	Known to occur

Table 3. Special-status Wildlife Species Evaluated for Potential to Occur in the Project Area

Species Name	Legal Status[1] Federal	State	Habitat Associations and Species Occurrences	Potential for Occurrence[2]
Northern harrier *Circus cyaneus*	–	SSC	Nests and forages in grasslands, agricultural fields, and marshes, mostly within dense patches of vegetation no CNDDB occurrences in vicinity of project area, but this species is rarely documented in the CNDDB.	Could occur
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	FT	SE	Riparian forest with dense deciduous trees and shrubs; migrant individuals are likely to pass through the area in transit to breeding sites along the Sacramento River north of Colusa.	Could occur
Burrowing owl *Athene cunicularia*	–	SSC	Nests and forages in grasslands, agricultural lands, open shrublands, and open woodlands with natural or artificial burrows or friable soils; known to occur near the Upper Beach Lake potential woodland mitigation area (SRCSD 2000).	Could occur
Bank swallow *Riparia riparia*	–	ST	Forages in a variety of habitats and nests in vertical banks or bluffs of suitable soil, typically adjacent to water; historical CNDDB occurrences of nest colonies have been documented along the lower American River, but no documented occurrences along the Sacramento River in the vicinity of the project area.	Could occur
Purple martin *Progne subis*	–	SSC	Nests in bridges in the Sacramento urban area and forages in adjacent open habitats; nest colonies are documented in the CNDDB, but no suitable nest sites are present in the project area or vicinity.	Could occur
Loggerhead shrike *Lanius ludovicianus*	–	SSC	Forages and nests in grasslands, shrublands, and open woodlands; no CNDDB occurrences in the project area or vicinity, but this species is rarely documented in the CNDDB.	Could occur
Least Bell's vireo *Vireo bellii pusillus*	FE	SE	Typically occurs in structurally diverse riparian habitat with dense shrub layer; the subspecies is largely extirpated from the Central Valley, but has recently been documented attempting to nest in the Yolo Bypass Wildlife Area, and a migrant individual has been observed in the Sacramento Regional WWTP Bufferlands (SRCSD 2014).	Could occur
Grasshopper sparrow *Ammodramus savannarum*	–	SSC	Nests and forages in grasslands, with a mix of grasses, forbs, and scattered shrubs, on rolling hills and lowland plains; CNDDB occurrences in the project area and vicinity are limited to eastern Sacramento County.	Unlikely to occur
Song sparrow ("Modesto" population) *Melospiza melodia*	–	SSC	Nests and forages in emergent freshwater marsh and riparian scrub and woodland; several CNDDB occurrences in the Upper Beach Lake area.	Could occur
Tricolored blackbird *Agelaius tricolor*	–	SE	Nests in freshwater marsh, riparian scrub, grain crops, and other dense, low vegetation and forages in grasslands and agricultural fields; CNDDB nesting colony locations nearest to the project area are in the Natomas Basin and Yolo Bypass.	Unlikely to occur

Table 3. Special-status Wildlife Species Evaluated for Potential to Occur in the Project Area

Species Name	Legal Status[1] Federal	State	Habitat Associations and Species Occurrences	Potential for Occurrence[2]
Mammals				
Pallid bat *Antrozous pallidus*	–	SSC	Occurs in a wide variety of habitats and roosts in tree cavities and caves, as well as artificial sites (e.g., bridges and buildings); several historic and recent occurrences from Sacramento (County of Sacramento et al. 2010) and Yolo Counties.	Likely to occur
Western red bat *Lasiurus blossevillii*	–	SSC	Roosts solitarily in foliage of mature trees associated with woodland borders, rivers, and walnut orchards, especially in mature riparian corridors more than 164 feet wide; numerous historic and recent occurrences from Sacramento County (County of Sacramento et al. 2010).	Likely to occur
American badger *Taxidea taxus*	–	SSC	Arid, open grassland, shrubland, and woodland with soils suitable for burrowing; historic and recent CNDDB occurrences from Sacramento County, but none closer to the project area than the former Mather Air Force Base.	Unlikely to occur

Notes: CNDDB = California Natural Diversity Database; Sacramento Regional WWTP = Sacramento Regional Wastewater Treatment Plant; USFWS = U.S. Fish and Wildlife Service

[1] **Status Definitions:**
FT = Federally listed as Threatened under the Federal Endangered Species Act
FE = Federally listed as Endangered under the Federal Endangered Species Act
ST = State-listed as Threatened under the California Endangered Species Act
SE = State-listed as Endangered under the California Endangered Species Act
FP = State fully protected
SSC = State species of special concern
– = No status

[2] **Potential for Occurrence Definitions:**

- *No potential to occur:* Potentially suitable habitat is not present.
- *Unlikely to occur:* Potentially suitable habitat present but species unlikely to be present because of very restricted distribution.
- *Could occur:* Suitable habitat is available; however, there are few or no other indicators that the species may be present.
- *Likely to occur:* Habitat conditions, behavior of the species, known occurrences in the vicinity, or other factors indicate a relatively high likelihood that the species would occur.
- *Known to occur:* The species, or evidence of its presence, was observed during reconnaissance-level surveys or was reported by others.

Sources: CDFW 2016; CNDDB 2016; County of Sacramento et al. 2010; SRCSD 2000, 2014; USFWS 2016a

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Memorandum

To	Heather Swinney, USACE; Patrick Caden, USACE; KC Sorgen, SAFCA
Subject	American River Watershed Common Features (ARCF) 2016, Sacramento River East Levee Erosion Contract 1 Standard Assessment Methodology (SAM) Analysis for Site River Mile 55.2 Left Bank
From	Kristin Asmus, AECOM; Steve Pagliughi, AECOM
Date	April 8, 2020

Introduction

This memo presents the draft project specific Standard Assessment Methodology (SAM) analysis for the American River Watershed Common Features (ARCF) Sacramento River East Levee (SREL) Project Site River Mile (RM) 55.2 Left Bank (L). With completion of the 65% design plans for SREL RM 55.2L, project impacts to relevant fish taxa were analyzed using SAM parameters measured from the specific project designs and from field surveys conducted in fall 2019 to winter 2020 to establish existing conditions. Methods and results of this analysis are presented below. Special-status fish species expected to occur at SREL RM 55.2L and included in this analysis are:

- Central Valley Spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) Evolutionarily Significant Unit (ESU)
- Sacramento River Winter-run Chinook Salmon ESU
- Central Valley Fall-run Chinook Salmon ESU
- Central Valley Late Fall-run Chinook Salmon ESU
- Central Valley Steelhead (Oncorhynchus mykiss) Distinct Population Segment (DPS)

Methods

This SAM analysis was conducted consistent with the methods described in the ARCF General Reevaluation Report National Marine Fisheries Service (NMFS) Biological Opinion (BO; NMFS 2015). Default SAM life-history timing tables were used for special-status fish species expected to occur at SREL RM 55.2L. Temporal change (decay) for instream structure in both existing and 65% design conditions was added to the analysis to maintain consistency with prior SAM analyses prepared for the Lower American River.

Decay of instream structure was estimated using the data compiled in Roni et al. (2015), with a logistic regression used to fit the data and produce estimates of remaining structure at years 0, 1, 5, 15, 25, and 50 (Table 1). These estimates were used to scale down the measured values of shoreline coverage by instream structure over time.

Table 1. Estimates of Remaining Instream Structure Over the 50-Year SAM Modeling Time Period

Year	Percentage of Maximum Instream Structure Shoreline Coverage
0	100%
1	95%
5	90%
15	85%
25	80%
50	48%

For existing conditions, the SAM variables Shade and Vegetation were assumed to stay constant for 50 years to maintain consistency with the original NMFS BO. For the 65% design conditions, temporal change in the SAM variables Shade and Vegetation followed previous growth models consistent with the NMFS BO.

The 65% design plans show a flat riparian bench design. Therefore, the flat riparian bench generalized overstory planting plan's shade evolution model (USACE 2009, Table 4a) was applied for this analysis and is shown below in Table 2. On the 65% design plans, trees which will be preserved are not marked; therefore, no estimates of shade contributed from preserved trees is included in this 65% design analysis.

Table 2. Estimates of Growth in Overhanging Shade Over the 50-Year SAM Modeling Time Period

Year	Fall	Winter	Spring	Summer
0	0%	1%	2%	0%
1	0%	1%	3%	0%
5	0%	13%	40%	0%
15	100%	25%	75%	100%
25	100%	25%	75%	100%
50	100%	25%	75%	100%

Note: Percentage of Maximum Planted Overhanging Shade Shoreline Coverage

Temporal change for the SAM variable Aquatic Vegetation followed the approach used in the original NMFS BO and is shown in Table 3.

Table 3. Estimates of Growth in Aquatic Vegetation Over the 50-Year SAM Modeling Time Period

Year	Fall	Winter	Spring	Summer
0	0%	0%	0%	0%
1	10%	25%	50%	50%
5	100%	100%	100%	100%
15	100%	100%	100%	100%
25	100%	100%	100%	100%
50	100%	100%	100%	100%

Note: Percentage of Maximum Planted Overhanging Shade Shoreline Coverage

SAM Measurements

Table 4 and Table 5 show the measured values of the SAM variables at existing and 65% design conditions, respectively, for SREL RM 55.2L.

Table 4. Existing Condition Measurements (2020) of the Sam Variables for SREL RM 55.2L

Habitat Parameter	Water Year	Fall	Winter	Spring	Summer
Water Surface Elevation (Feet)	2020	10.1	14.5	14.5	10.1
	2070	10.1	14.5	14.5	10.1
Wetted Area (square feet)	2020	108,945	108,945	108,945	108,945
	2070	108,945	108,945	108,945	108,945
Shoreline Length (feet)	2020	1,392	1,392	1,392	1,392
	2070	1,392	1,392	1,392	1,392
Bank Slope (dH:dV)	2020	29.0	29.0	29.0	29.0
	2070	29.0	29.0	29.0	29.0
Floodplain Inundation Ratio (AQ2:AQavg)	2020	1	1	1	1
	2070	1	1	1	1
Bank Substrate Size (D50 in inches)	2020	0.08	0.08	0.08	0.08
	2070	0.08	0.08	0.08	0.08
Instream Structure (% shoreline)	2020	14	14	14	14
	2070	14	14	14	14
Vegetation (% shoreline)	2020	0	0	0	0
	2070	0	0	0	0
Shade (% shoreline)	2020	100	100	100	100
	2070	100	100	100	100

Source: AECOM 2020

Table 5. 65% Design Condition Measurement of the SAM variables for SREL RM 55.2L

Habitat Parameter	Water Year	Fall	Winter	Spring	Summer
Water Surface Elevation (Feet)	2020	13.5	17.0	17.0	13.5
	2070	13.5	17.0	17.0	13.5
Wetted Area (square feet)	2020	99,953	105,234	105,234	99,953
	2070	99,953	105,234	105,234	99,953
Shoreline Length (feet)	2020	1,392	1,392	1,392	1,392
	2070	1,392	1,392	1,392	1,392
Bank Slope (dH:dV)	2020	26.5	26.5	26.5	26.5
	2021	26.5	26.5	26.5	26.5
	2070	26.5	26.5	26.5	26.5
Floodplain Inundation Ratio (AQ2:AQavg)	2020	1	1	1	1
	2070	1	1	1	1
Bank Substrate Size (D50 in inches)	2020	0.08	0.08	0.08	0.08
	2021	0.08	0.08	0.08	0.08
	2070	0.08	0.08	0.08	0.08
Instream Structure (% shoreline)	2020	14	14	14	14
	2021	66	66	66	66
	2070	34	34	34	34
Vegetation (% shoreline)	2020	0	0	0	0
	2021	0	50	50	0
	2026	0	85	85	0
	2036	0	85	85	0
	2046	0	85	85	0
	2070	0	85	85	0
Shade (% shoreline)	2020	0	1	2	0
	2021	0	1	3	0
	2026	0	13	40	0
	2036	100	25	75	100
	2046	100	25	75	100
	2070	100	25	75	100

Source: AECOM 2020

WY = water year includes fall, winter, spring, and summer; rock and soil placement and instream woody material (IWM) installation assumed during summer WY 2012; revegetation planting assumed during fall WY 2013; designed conditions based on design and construction specififications.

SAM Results

As described in the original NMFS BO (NMFS 2015, pp. 25-26), SAM results are weighted relative response index (WRI) values that represent the difference between modeled fish response to existing (without-project) and designed (with-project) conditions. Negative WRI values indicate that existing conditions are more beneficial for fish and positive WRI values indicate that designed conditions are more beneficial for fish. WRI values are weighted by shoreline length to maintain consistency with the original NMFS BO.

WRI values do not directly represent actual lengths. However, NMFS has used WRI values as proxies to determine mitigation (NMFS 2015, p. 177). Appropriate mitigation is typically determined by identifying the maximum negative WRI for critical life stages (NMFS 2015, p. 118). By mitigating for the maximum negative WRI, lesser impacts are expected to be appropriately mitigated (NMFS 2015, p. 181).

The maximum WRI values (negative and positive) for each life stage, and by season, of each special-status fish species expected to occur at SREL RM 55.2L is shown in Table 6a-e. Only those life stages of each species expected to occur at SREL RM 55.2L during each season are shown in Table 6a-e. Please note that the SAM results suggest there are instances where there are no differences in benefits to fish between existing and designed conditions; where this occurs, “None” is entered in the cell in Table 6a-e.

Table 6a. Maximum SAM Modeled WRI Deficits and Benefits, SREL RM 55.2L–Spring-Run Chinook Salmon

Season	Life Stage	Maximum WRI Deficit (feet)	Deficit Duration (years)	Maximum WRI Benefit (feet)	Benefit Duration (years)
Fall	Adult Migration	-56	19	27	31
	Fry & Juvenile Rearing	-17	9	35	41
	Juvenile Migration	**-66***	13	63	37
Winter	Adult Migration	-54	50	None	None
	Fry & Juvenile Rearing	None	None	102	50
	Juvenile Migration	None	None	340	50
Spring	Adult Migration	-51	8	31	42
	Fry & Juvenile Rearing	None	None	157	50
	Juvenile Migration	None	None	**378****	50
Summer	Adult Migration	-56	19	27	31
	Fry & Juvenile Rearing	-17	9	35	41
	Juvenile Migration	-66	13	63	37

* indicates largest maximum deficit; ** indicates largest maximum benefit

Table 6b. Maximum SAM Modeled WRI Deficits and Benefits, SREL RM 55.2L–Winter-Run Chinook Salmon

Season	Life Stage	Maximum WRI Deficit (feet)	Deficit Duration (years)	Maximum WRI Benefit (feet)	Benefit Duration (years)
Fall	Adult Migration	-56	19	27	31
	Fry & Juvenile Rearing	-17	9	35	41
	Juvenile Migration	**-66***	13	63	37
Winter	Adult Migration	-54	50	None	None
	Fry & Juvenile Rearing	None	None	102	50
	Juvenile Migration	None	None	340	50
Spring	Adult Migration	-51	8	31	42
	Fry & Juvenile Rearing	None	None	157	50
	Juvenile Migration	None	None	**378****	50
Summer	Adult Migration	-56	19	27	31
	Fry & Juvenile Rearing	-17	9	35	41

* indicates largest maximum deficit; ** indicates largest maximum benefit

Table 6c. Maximum SAM Modeled WRI Deficits and Benefits, SREL RM 55.2L–Fall-Run Chinook Salmon

Season	Life Stage	Maximum WRI Deficit (feet)	Deficit Duration (years)	Maximum WRI Benefit (feet)	Benefit Duration (years)
Fall	Adult Migration	**-56***	19	27	31
	Fry & Juvenile Rearing	-17	9	35	41
Winter	Adult Migration	-54	50	None	None
	Fry & Juvenile Rearing	None	None	102	50
	Juvenile Migration	None	None	**340****	50
Spring	Fry & Juvenile Rearing	None	None	157	50
Summer	Adult Migration	-56	19	27	31
	Fry & Juvenile Rearing	-17	9	35	41

* indicates largest maximum deficit; ** indicates largest maximum benefit

Table 6d. Maximum SAM Modeled WRI Deficits and Benefits, SREL RM 55.2L–Late Fall-Run Chinook Salmon

Season	Life Stage	Maximum WRI Deficit (feet)	Deficit Duration (years)	Maximum WRI Benefit (feet)	Benefit Duration (years)
Fall	Adult Migration	-56	19	27	31
	Fry & Juvenile Rearing	-17	9	35	41
	Juvenile Migration	**-66***	13	63	37
Winter	Adult Migration	-54	50	None	None
	Fry & Juvenile Rearing	None	None	102	50
	Juvenile Migration	None	None	**340****	50
Spring	Adult Migration	-51	8	31	42
	Fry & Juvenile Rearing	None	None	157	50
Summer	Fry & Juvenile Rearing	-17	9	35	41

* indicates largest maximum deficit; ** indicates largest maximum benefit

Table 6e. Maximum SAM Modeled WRI Deficits and Benefits, SREL RM 55.2L–Steelhead

Season	Life Stage	Maximum WRI Deficit (feet)	Deficit Duration (years)	Maximum WRI Benefit (feet)	Benefit Duration (years)
Fall	Adult Migration	-78	14	70	36
	Fry & Juvenile Rearing	-31	9	51	41
	Juvenile Migration	**-87***	21	33	29
	Adult Residence	-78	14	70	36
Winter	Adult Migration	-74	9	33	41
	Fry & Juvenile Rearing	None	None	138	50
	Juvenile Migration	None	None	214	50
	Adult Residence	-74	9	33	41
Spring	Adult Migration	-67	4	82	46
	Fry & Juvenile Rearing	None	None	203	50
	Juvenile Migration	None	None	**253****	50
	Adult Residence	-67	4	82	46
Summer	Adult Migration	-78	14	70	36
	Fry & Juvenile Rearing	-31	9	51	41
	Adult Residence	-78	14	70	36

* indicates largest maximum deficit; ** indicates largest maximum benefit

For salmonids, most season/life stage combinations show a WRI deficit for a number of years following project completion that eventually begins to show a WRI benefit. In each instance, the benefit duration exceeds the deficit duration, often significantly. There are a number of season/life stage combinations that have a WRI benefit throughout the entire 50-year modeled time period. Chinook Salmon adult migration in winter is the only salmonid season/life stage combination that has a WRI deficit throughout the entire 50-year modeled time period, and this trend is consistent among all Chinook Salmon ESU's. The maximum WRI deficit for Spring-run, Winter-run, and Late Fall-run Chinook Salmon is -66; each occurs in fall for juvenile migration. The maximum WRI deficit for Fall-run Chinook Salmon is -56 and occurs in fall for adult migration. The maximum WRI deficit for Steelhead is -87 and occurs in fall for juvenile migration. Figure 1 and Figure 2 show the yearly WRI values by season for the Chinook Salmon juvenile migration and the Steelhead adult residence life stages, respectively. The temporal trends in each figure generally are representative of the other salmonid season/life stage combinations.

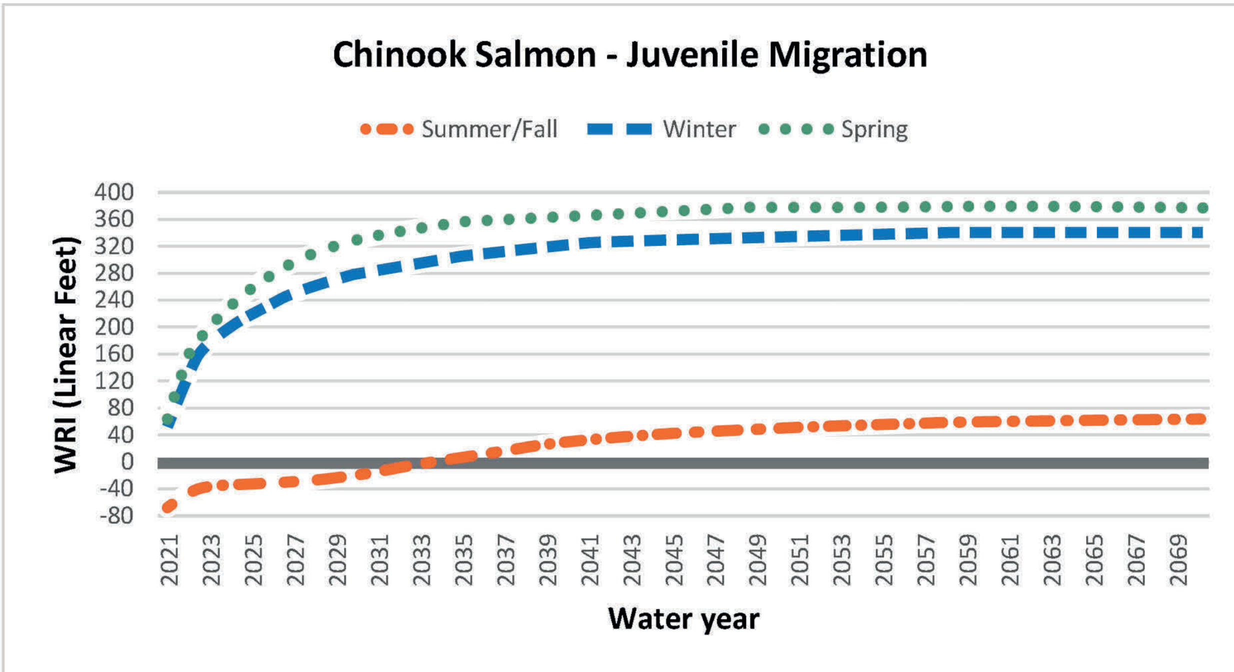

Figure 1. Yearly SAM-Modeled WRI Values for Each Season of the Chinook Salmon Juvenile Migration Life Stage, SREL RM 55.2L

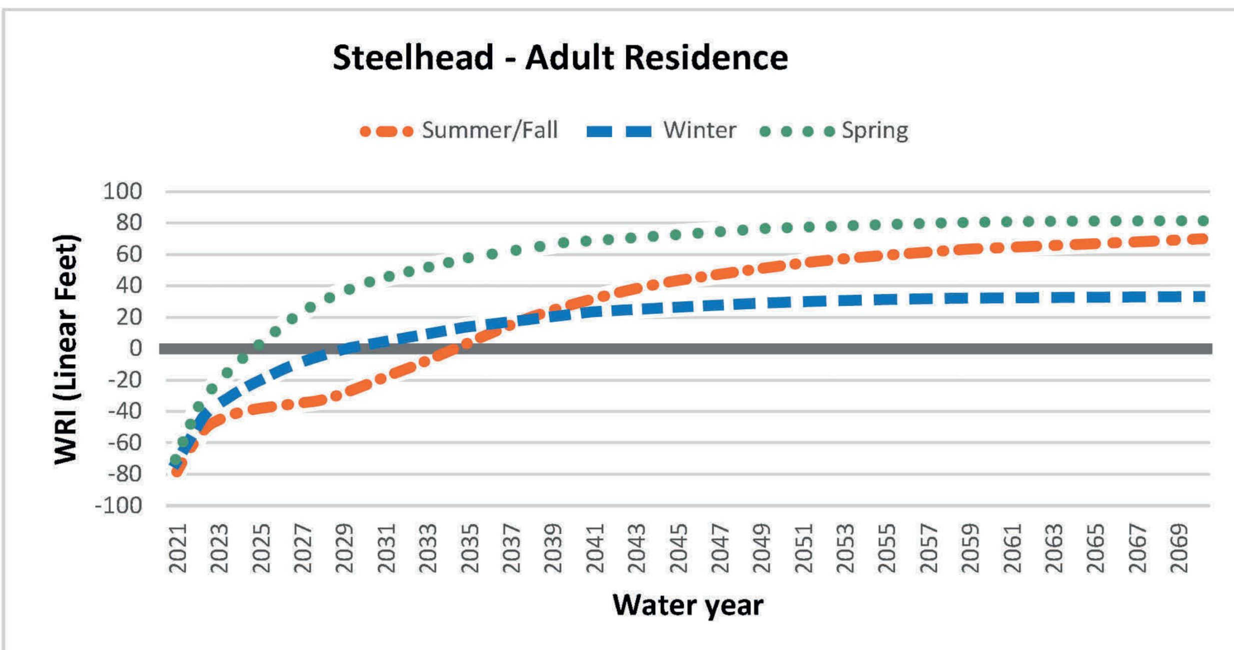

Figure 2. Yearly SAM-Modeled WRI Values for Each Season of the Steelhead Adult Residence Life Stage, SREL RM 55.2L

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In Reply Refer to:
08ESMF00-2014-F-0518-R003

March 31, 2021

Joe Griffin
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Subject: Reinitiation of Formal Consultation on the American River Common Features (ARCF) 2016 Project, Sacramento and Yolo Counties, California

Dear Joe Griffin:

This letter is in response to the U.S. Army Corps of Engineers' (Corps) June 17, 2020, request for reinitiation of formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed American River Common Features (ARCF) 2016 Project (proposed project) in Sacramento and Yolo Counties, California. Your request was received by the Service on June 17, 2020. The Corps has refined some of the project designs and is updating the project description and effects to listed species. Subsequent to the June 17, 2020, letter, the Corps has provided additional changes to the project description. The Service received final major changes to the project description on November 17, with adjustments being made over the last three months. At issue are the proposed project's effects on the federally threatened valley elderberry longhorn beetle (*Democerus californicus dimorphus*), delta smelt (*Hypomesus transpacificus*), giant garter snake (*Thamnophis gigas*), and western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) and delta smelt designated critical habitat. This response is provided under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.) (Act), and in accordance with the implementing regulations pertaining to interagency cooperation (50 CFR 402).

The previous biological opinion (08ESMF00-2014-F-0518-R002 dated May 2, 2019) has been revised and this consultation includes all previous reinitiations and the current changes to the project description and effects that the Corps has included in this current reinitiation.

The federal action on which we are consulting is the Corps' ARCF 2016 Project, which includes levee improvements and bank protection along the Sacramento River, levee improvements along Arcade and Magpie Creeks, widening the Sacramento Weir, and bank protection along the lower American River. Pursuant to 50 CFR 402.12(j), you submitted a biological assessment for our review and requested concurrence with the findings presented therein. These findings conclude that the proposed project may affect, and is likely to adversely affect the valley elderberry longhorn beetle, the delta smelt (smelt) and its critical habitat, the giant garter snake, and the yellow-billed cuckoo. The project is outside of critical habitat designated for the valley elderberry longhorn beetle and critical habitat proposed for the yellow-billed cuckoo.

In considering your request, we based our evaluation on the following:

1) Biological Assessment American River Watershed Common Features;

2) Information to Reinitiate Section 7 Consultation – Sacramento Weir and Sacramento River East Levee Components; and

3) Various e-mails with project modifications provided between June 2020 and March 2021.

The remainder of this document provides our biological opinion on the effects of the proposed project on the valley elderberry longhorn beetle, delta smelt and its critical habitat, giant garter snake, and yellow-billed cuckoo.

Consultation History

September 4, 2013:	The Service commented on the April 2013 draft biological assessment.
April 8, 2014:	The Service commented on the October 2013 draft biological assessment.
June 30, 2014:	The Corps initiated section 7 consultation with the Service.
July 23, 2014:	The Service sent a letter in response to the Corps initiation requesting additional information.
April 3, 2015:	The Corps provided an updated biological assessment with responses to the Service's July 23, 2014, request for additional information.
August 31, 2015:	The Corps provided a revised biological assessment that addressed questions the Service had regarding the project description.
September 11, 2015:	The Service provided the Corps with a biological opinion on the proposed project.
January 25, 2017:	The Corps reinitiated consultation with the Service.
June 8, 2017:	The Service provided an amended biological opinion to the Corps.
April 15, 2019:	The Corps reinitiated consultation with the Service to add geotechnical explorations.
June 17, 2020:	The Corps reinitiated consultation with the Service due to changes in project description and effects to listed species.

June 2020 – March 2021: The Corps provided numerous e-mails and held numerous meetings to discuss changes to the project description and effects to listed species.

BIOLOGICAL OPINION

Description of the Proposed Action

Congress directed the Corps to investigate the feasibility of reducing flood risk to the city of Sacramento and surrounding areas. The Corps completed feasibility studies in 1991 and 1996, recommending a concrete gravity flood detention dam on the north fork of the American River at the Auburn site along with levee improvements downstream of Folsom Dam. Other plans evaluated in the report were Folsom Dam improvements and a stepped release plan for Folsom Dam releases. These additional plans also included levee improvements downstream of Folsom Dam. Congress recognized that levee improvements were "common" to all candidate plans in the report and that there was a Federal interest in participating in these "common features." Thus, the ARCF Project was authorized in the Water Resources Development Act (WRDA) of 1996 and a decision on Auburn Dam was deferred to a later date. Major construction components of ARCF in the WRDA 1996 authorization included construction of seepage remediation along about 22 miles of American River levees and construction of levee strengthening and raising of 12 miles of Sacramento River levee in Natomas.

The following problems were identified within the Sacramento levee system:

- Seepage and underseepage;
- Levee erosion;
- Levee stability;
- Levee overtopping;
- Access for maintenance and flood fighting;
- Vegetation and encroachments;
- Releases from Folsom Dam;
- Floodplain management; and
- Additional upstream storage from existing reservoirs.

The project is designed to allow for the release of 160,000 cubic feet per second (cfs) from Folsom Dam. The levees along the American River are unable to withstand these maximum flows for extended periods of time without increased risk of erosion and potential failure.

The Corps' project involves the construction of fix-in-place levee remediation measures to address seepage, stability, erosion, and height concerns identified for the Sacramento River and American River levees, Natomas East Main Drainage Canal (NEMDC), Arcade, and Magpie Creeks. Most height concerns along the Sacramento River will be addressed by a widening of the Sacramento Weir and Bypass to divert more flood flows into the Yolo Bypass, thereby lowering water surface elevations downstream. Due to the urban nature and proximity of existing development within the American River North and South basins the Corps is planning fix in place remediation. This would improve the flood damage reduction system to safely convey flows to a level that maximizes net benefits. Table 1 summarizes the levee problems discussed above and the proposed measure for each waterway.

Table 1. Remediation by Waterway.

Waterway	Seepage Measures	Stability Measures	Erosion Protection Measures	Overtopping Measures
American River[1]	---	---	Bank Protection (31,000 linear feet), Launchable Rock Trench (45,000 linear feet)	---
Sacramento River	Cutoff Wall (50,300 linear feet)	Cutoff Wall (50,300 linear feet)	Bank Protection (43,000 linear feet)	Sacramento Bypass and Weir Widening, Levee Raise (1,500 feet)
NEMDC	Cutoff Wall (6,000 linear feet)	Cutoff Wall	---	Floodwall (15,600 linear feet)
Arcade Creek	Cutoff Wall (22,000 linear feet)	Cutoff Wall	---	Floodwall (22,000 linear feet)
Dry/Robla Creeks	---	---	---	Floodwall (2,500 linear feet)
Magpie Creek	---	---	---	Levee Raise (2,100 linear feet) and Training Levee (1,000 linear feet)

[1]American River seepage, stability, and overtopping measures were addressed in a previous construction project.

Sacramento Area Flood Control Agency (SAFCA), the project's local sponsor, will complete some portions of the Federal project. SAFCA is seeking permission from the Corps pursuant to 33 USC §408 (Section 408) for alteration of the Federal levees along the NEMDC and Arcade Creek.

In addition to the proposed levee improvements measures shown in Table 1, the following measures and policies would be addressed during construction:

- The Corps will apply a semi-quantitative risk assessment methodology to evaluate the placement of on-site mitigation vegetation.

- The non-Federal sponsor, Central Valley Flood Protection Board (CVFPB), will bring the levees into compliance with the Corps' standard levee footprint using a System Wide Implementation Framework (SWIF) process. A SWIF is a plan developed by the levee sponsor(s) and accepted by the Corps to implement system-wide improvements to a levee system (or multiple levee systems within a watershed) to address system-wide issues, including correction of unacceptable inspection items, in a prioritized way to optimize flood risk reduction. The standard levee footprint consists of a 20-foot crown width, 3 to 1 (height to vertical) (3H:1V) waterside slope and 2H:1V landside slope. There may be locations where a 3H:1V waterside slope design is not possible and, when possible. If the 3H:1V waterside slope is not possible, then a minimum 2H:1V waterside slope will be established with revetment.

American River

Levees along the American River require improvements to address erosion. For design and construction purposes, the lower American River is divided into 4 subreaches. The proposed measures for these areas consist of bank protection or launchable rock trenches with a maximum of 31,000 linear feet (LF) of bank protection, and a maximum of 65 acres/45,000 LF of launchable rock trench. These measures are being implemented to prevent undermining of the levee foundation. Typical designs are described below.

<u>Bank Protection</u>
This measure consists of placing rock revetment on the river's bank to prevent erosion and will consist of the following types of repairs.

Bank protection entails installing revetment along the stream bank based on site-specific analysis. When necessary, the eroded portion of the bank will be filled and compacted prior to the rock placement. The sites will be prepared by clearing and stripping of loose material and understory growth prior to construction. Where possible large woody vegetation will be left on-site. Temporary access ramps will be constructed, if needed, using imported borrow material that would be trucked on site.

The placement of rock onto the bank will occur from a land based staging area using long reach excavators and loader. The loader brings rock from a permitted source and stockpiles it near the levee in the construction area. The excavator then moves the rock from the stockpile to the waterside of the levee. A soil filled planting bench could be established on these rock surfaces for revegetation purposes.

The revetment will be placed on the existing bank at a slope varying from 2H:1V to 3H:1V depending on site specific conditions. Rock will be placed at the toe of the repair which is designed to launch at certain high flows to protect against toe erosion.

After revetment placement has been completed, where hydraulic stage impacts have been deemed acceptable and space allows, a soil-filled planting berm will be constructed on the repair site to allow for vegetation to be planted, outside of the vegetation free zone as required by the Corps. This vegetation will be designed on a site-specific basis in coordination with the Service and in such a way as to not impact the hydraulic conveyance of the channel.

Planting benches will provide on-site mitigation for juvenile salmonids contributing to their foraging and refuge habitat. The planting benches will provide adequate soil volume to establish native tree species. Design of the planting benches should include providing a variety of slopes both parallel and perpendicular to the river and a diverse planting pallet including trees, shrubs, and understory plants. Instream woody material in the form of small dead trees with intact roots will be placed at the lower elevations that are frequently inundated. The planting bench will terminate at the launchable toe where rows of willow stakes will be planted to stabilize the planting bench soil. During the initial plant establishment, planting benches will be protected with biodegradable erosion control fabric on the surface. The planting bench will be placed over a minimum two-foot thick layer of clean riprap. The launchable toe will be of sufficient volume to launch the riprap into scours that could develop along the natural river bottom during high flows.

Launchable Rock Trench

This measure includes construction of a launchable rock filled trench, designed to deploy once erosion has removed the bank material beneath it. All launchable rock trenches will be constructed outside of the natural river channel. The vegetation will be removed from the footprint of the trench and the levee slope prior to excavation of the trench. The trench configuration will include a 2H:1V landside slope and 1H:1V waterside slope and will be excavated at the toe of the existing levee. All soil removed during trench excavation will be stockpiled for potential reuse. The bottom of the trench will be constructed close to the summer mean water surface elevation in order to reduce the rock launching distance and amount of rock required.

After excavation, the trench will be filled with revetment that will be imported from an offsite commercial location. After rock placement the trench will be covered with a minimum of 3 feet of the stockpiled soil. Vegetation may be planted over the trench if it is planted outside of the vegetation-free zone. This vegetation will be limited to native grasses and woody vegetation with shallow root systems to ensure they do not limit the functionality of the trench during a flood event.

Cut Bank

This measure consists of excavating the channel banks to create stable slopes that could be planted with riparian vegetation to provide erosion protection along the channel margins and include the following potential activities.

The design is intended to be deformable vegetated bankline, which will allow small amounts of river processes such as erosion and accretion The design will reduce the likelihood of erosion by reducing bank slope, creating planting areas on the lower slope at elevations observed to recruit and sustain natural riparian vegetation to increase slope stability and erosion resistance. Inclusion of launchable buried rock tiebacks will both protect the levee and the bank.

Island Degrading

At a site in subreach 3, the Corps proposes to degrade the island just upstream of the Howe Ave boat launch, for the purpose of hydraulic mitigation. The mid-channel island will be removed, and the material will be used as fill along the riverbank. The bank fill area extends from the existing bank at approximately elevation 30-foot out into the channel to the 3,900 cfs WSE (approximately 18 ft). The proposed design cuts down half of the island to 16 feet and then cuts down to existing ground at a gradual slope. The area at 16-foot elevation provides shallow fish rearing habitat, as it is in the 95% exceedance flow and will not grow vegetation. The area at and around 18 feet is expected to grow vegetation, as this elevation is where natural recruitment is seen elsewhere on the river. The area is not near known active steelhead spawning areas.

Arden Bar

Along the Lower American River an offsite mitigation area is being designed at Arden Pond (River Mile 12). Arden Pond is approximately 29.5 acres in size. Work at Arden Pond includes grading and fill to reconnect the area with the river by constructing a side channel shoal system and adjacent emergent vegetation. Additional description can be found in the *Arden Pond Supplemental Information for NMFS Consultation* document produced by ESA, January 2021.

Sacramento River

Levees along the Sacramento River require improvements to address seepage, stability, and erosion. About 43,000 LF of bank protection and 50,300 LF of cutoff wall or slope stability work is proposed for the Sacramento River. In addition, these levees require a total of one mile of intermittent height improvements in order to convey additional flows that exceed current design levels.

Levee Raising

Where the existing levee does not meet the levee design requirements, as discussed above, slope flattening, crown widening, and/or a minimal amount of levee raise is required. This improvement measure addresses problems with slope stability, geometry, height and levee crest access and maintenance. To begin levee embankment grading, loose material and vegetation understory will be cleared, grubbed, stripped, and where necessary, portions of the existing embankment will be excavated to allow for bench cuts and keyways to tie in additional embankment fill. Excavated and borrow material (from nearby borrow sites) will be stockpiled at staging areas. Haul trucks and front-end loaders will bring borrow materials to the site, which will then be spread evenly and compacted according to levee design plans.

The levee will be raised about 1 to 2 feet resulting in the levee footprint extending out a maximum of 5 feet on the landside from the existing levee. The levee crown patrol road will be re-established at the completion of construction.

<u>Cutoff Walls</u>
To address seepage concerns, a cutoff wall will be constructed through the levee crown. The cutoff wall will be installed by one of three methods: (1) conventional open trench cutoff walls, (2) deep soil mixing (DSM) cutoff walls, and (3) jet grout cutoff walls. The method of cutoff wall selected for each reach will depend on the depth of the cutoff wall needed to address the seepage. The open trench method can be used to install a cutoff wall to a depth of about 85 feet. For cutoff walls of greater depths, the DSM method will be utilized.

Prior to any cutoff wall construction method, the construction site and any staging areas will be cleared, grubbed, and stripped. The levee crown will be degraded up to half the levee height to create a large enough working platform (about 30 feet) and to reduce the risk of hydraulically fracturing the levee embankment from the insertion of slurry fluids. This method of slurry wall installation will also reduce the risk of slurry mixture following seepage paths and leaking into the river or into landside properties.

<u>Open Trench Cutoff Wall</u>
Under the open trench method, a trench about 3 feet wide will be excavated at the top of levee centerline and into the subsurface materials up to 85 feet deep with a long boom excavator. As the trench is excavated, it is filled with low density temporary bentonite water slurry to prevent cave in. The soil from the excavated trench is mixed nearby with hydrated bentonite, and in some applications cement. The soil bentonite mixture is backfilled into the trench, displacing the temporary slurry. Once the slurry was hardened, it will be capped, and the levee embankment will be reconstructed with impervious or semi-impervious soil.

<u>DSM Cutoff Wall</u>
The DSM method involves a crane supported set of two to four mixing augers used to drill through the levee crown and subsurface to a maximum depth of about 130 feet. As the augers are inserted and withdrawn, a cement bentonite grout will be injected through the augers and mixed with the native soils. An overlapping series of mixed columns will be drilled to create a continuous seepage cutoff barrier. A degrade of up to one half the levee height will be required for construction of the DSM wall. For both methods, once the slurry has hardened it will be capped and the levee embankment will be reconstructed with impervious or semi-impervious soil.

<u>Jet Grout Construction</u>
Jet grout construction involves injecting grout into the soil at very high pressures and will be used in areas where there are utilities that cannot be removed such as the regional sewer line and Pacific Gas and Electric (PG&E) natural gas line near the Pioneer Bridge. The grout is a mixture of cement and water that will be mixed in a batch plant located in the staging area and transported through high- pressure hoses to the location of construction. The jet grout process involves drilling straight down into the levee to a depth of up to approximately 130 feet, then injecting grout into the hole through a high-pressure nozzle. As the grout is injected from the bottom to the top of the hole, the high pressure excavates the soil around the nozzle to a radius of 3 to 4 feet, mixing the soil within the levee with grout. The grout injection may be accompanied with air and water to assist the excavation of soil. The nozzle is rotated and lifted at a slow, smooth, constant speed to achieve thorough mixing and consistent quality. The grout then solidifies to create a column of low permeability. Multiple columns constructed together create a wall through the levee that prevents seepage. Soil that is displaced from the injection site will be piped into drying beds or containment cells located in the staging area for later disposal.

Jet grouting activities near Pioneer Bridge may occur 24 hours a day to expedite work which will generate noise and require night lighting.

<u>Municipal Drainage Systems</u>
Several municipal drainage systems, both legacy and operational, have pipes that run through the levee. These facilities require removal and replacement to install the cutoff walls. Temporary waterside access below the ordinary high-water mark of the river is required to remove or replace these structures. A small portion of the concrete apron will be placed as part of the Sump 70 replacement and will likely extend below the OHWM. Temporary access will consist of dewatering the area with the use of a sandbag cofferdam approximately five feet high (1.75 feet above the typical water level) and approximately 120 feet in length. The sandbag cofferdams would be installed, and work completed between July 1 and October 31, which is outside of sensitive fish species migration windows. A portion of the existing revetment would be sawcut and removed. Work to replace individual drainage facilities is estimated to take up to 15 days. There may be up to five areas where in-water work may be needed to remove or replace these pump systems throughout all Sacramento River east levee contracts.

<u>Stability Berms and Blankets</u>
Stability berms and blankets address shallow foundation and/or levee embankment through-seepage. A stability berm or blanket is a prism of compacted soil that acts as a buttress to increase stability factors of safety and, in some cases, includes an inclined filter/drain zone placed on the landside slope of a levee to capture seepage that would otherwise exist on and potentially erode the unprotected levee slope. Typical stability berms are 10-15 feet high (depending on the height of the levee) and 10-25 feet wide and are considered in limited areas

that do not have substantial right of way issues. Alternatively, the stability berm can be constructed within the existing levee in areas with constrained access along the landside levee toe. The inset stability berm would be constructed by excavating the landside levee slope, constructing the filter/drain zone, and then rebuilding the levee slope to about the original grade with compact fill.

Relief Wells

Relief wells provide protection against levee underseepage by providing a path for underseepage to exist the ground surface at the landside toe of the levee without creating sand boils or piping levee foundation materials. Relief wells would be constructed near the levee landside toe to provide pressure relief beneath surficial fine-grained soils (clay or silt "blanket"). The wells would be constructed using soil-boring equipment to bore a hold vertically though the fine-grained layer. Pipe casings and filters would be installed to allow the pressurized water to flow to the ground surface in the well casing, thereby relieving the pressures beneath the clay blanket layers.

Toe Drains

The primary purpose of a toe drain is to divert through-levee seepage before it reaches the levee slope, where it could cause erosion and instability, and to filter the discharge in such a way as to reduce velocity and fine soil carrying capacity. A toe drain will typically be used when through-seepage or through-seepage driven landslide slope stability is problematic. Toe drains can be used in several limited reaches where the levee does not have an existing shallow cutoff wall and there is a concern regarding potential seepage breakout on the levee slope or the levee toe. Toe drains will be constructed by excavating into the levee prism and constructing a filtered drain within the waterside toe of the levee embankment.

Bank Protection

Proposed bank protection along the Sacramento River will address erosion concerns. Studies have shown that the Sacramento River levees have a medium to high risk of breach due to erosion. Bank protection will be addressed by standard bank protection with planting berm. The standard bank protection measure for the Sacramento River consists of placing rock protection on the bank to prevent erosion. This measure entails filling the eroded portion of the bank, where necessary, and installing revetment along the waterside levee slope and streambank from streambed to a height determined by site-specific analysis. Large trees on the lower half of the waterside slope will be protected in place to retain shaded riverine aquatic (SRA) habitat. The sites will be prepared by removing vegetation along the levee slopes at either end of the site for construction of a temporary access ramp, if needed. The ramp will then be constructed using imported commercial borrow material that will be trucked on site.

The placement of rock onto the levee slope will occur from atop the levee and/or from the waterside by means of barges. Rock required within the channel, both below and slightly above the water line at the time of placement, will be placed by a crane and/or excavator located on a barge. Construction will require two barges: one barge will carry the crane and/or excavator, while the other barge will hold the stockpile of rock to be placed on the channel slopes. Rock required on the upper portions of the slopes will be placed by an excavator located on top of the levee. Rock placement from atop the levee will require one excavator and one loader for each potential placement site. The loader brings the rock from a permitted source and stockpiles it near the levee in the construction area. The excavator then moves the rock from the stockpile to the waterside of the levee.

The revetment will be placed via the methods discussed above on existing bank at a slope varying from 2V:1H to 3V:1H depending on site specific conditions. After revetment placement has been completed, a small planting berm will be constructed in the rock to allow for some revegetation of the site.

Additional Measures
Additional bank protection measures may be considered and found to be appropriate during the implementation of site-specific designs. Design and analysis of any additional measures will be carried out during the site-specific planning and design phase. Examples of additional measures include, but are not limited to, toe protection, flow modification, cut bank, and alternative design and materials for reduction of riprap. These and other measures, which may be developed in the future, will be designed in coordination with the Service and National Marine Fisheries Service (NMFS) to minimize effects to listed species and their habitat from the proposed action and to ensure that the effects from these actions are covered in the effects of this biological opinion.

Natomas East Main Drain Canal

The east levee of the NEMDC requires 6,000 LF of improvements to address seepage and stability at locations where historic creeks had intersected the current levee alignment. A cutoff wall will be constructed at this location to address the seepage and stability problems. The cutoff wall will be constructed by one of the methods described in the Sacramento River section above. SAFCA is proposing to construct 2,500 LF of cutoff wall beginning just south of the confluence of Arcade Creek and extending south along the NEMDC. The Corps will construct the remaining 3,500 LF of cutoff wall.

Arcade Creek

The Arcade Creek levees require improvements to address seepage, slope stability, and overtopping when the event exceeds the current design. A centerline cutoff wall will be constructed to address seepage along 22,000 LF of the Arcade Creek levees. Levees from Rio Linda Boulevard to Marysville Boulevard will have a cutoff wall constructed at the waterside toe of the levee. Construction of the waterside toe cutoff wall will require constructing a work bench along the toe of the levee. Excavation for the bench will extend deep enough below existing grade to remove organic material and soft, unsuitable foundation soils. Bench excavation will also extend into the existing waterside slope of the levee as needed. Riprap will be placed on the waterside benches after construction of the waterside toe cutoff wall. Some portions of the Arcade Creek north levee will require more substantial excavation and reconstruction of the waterside slope to provide a low permeable seepage levee slope barrier. Bench fill material will be integrated with the slope reconstruction fill to provide an integral seepage barrier with the cutoff wall over the full height of the levee slope. A small section of levee will have a sheet pile cutoff wall at the centerline of the levee, rather than the waterside toe cutoff wall.

There is a ditch adjacent to the north levee at the landside toe which provides a shortened seepage path and could affect the stability of the levee. The ditch will be replaced with a conduit or box culvert and then backfilled. This will lengthen the seepage path and improve the stability of the levee. Additionally, pressure relief wells will be installed along the landside toe of the levee along the north levee west of Norwood Avenue.

Most of the Arcade Creek levees have existing floodwalls, however, there remains a height issue in this reach. A 1 to 4-foot floodwall will allow the levees to pass flood events greater than the current design level. The floodwall will be placed on the waterside hinge point of the levee and will be designed to disturb a minimal amount of waterside slope and levee crown for construction. The waterside slope will be re-established to its existing slope and the levee crown will grade away from the wall and be surfaced with aggregate base.

Magpie Creek Diversion Canal

The Magpie Creek Diversion Canal will consist of levee raising and a training levee. About 2,100 LF of levee raise will occur from Raley Boulevard to 100 feet south of Vinci Avenue Bridge. A new training levee will be constructed on the south side of the Magpie Creek Diversion Canal east of Raley Boulevard for 1,000 LF. An arch culvert will be installed across the canal to allow Raley Boulevard to cross. A new maintenance road will be constructed adjacent to the raised levee and the training levee. Finally, from Vinci Avenue to Dry Creek Road vegetation will be cleared from the channel to allow for better water flow during high water events.

Sacramento Weir and Fish Passage Facility

The Sacramento Weir was completed in 1916. It is the only weir in the Sacramento River Flood Control Project that is manually operated; all others overflow by gravity on their own. It is located along the right bank of the Sacramento River about 4 miles upstream of the Tower Bridge, and about 2 miles upstream from the confluence with the American River. Its primary purpose is to protect the city of Sacramento from excessive flood stages in the Sacramento River channel downstream of the American River. The weir limits flood stages (water surface elevations) in the Sacramento River to project design levels through the Sacramento/West Sacramento area. Downstream of the Sacramento Weir, the design flood capacity of the American River is 5,000 cfs higher than that of the Sacramento River. Flows from the American River channel during a major flood event often exceed the capacity of the Sacramento River downstream of the confluence. When this occurs, floodwaters flow upstream from the mouth of the American River to the Sacramento Weir.

A new 1520-foot fixed-crest passive weir structure will be constructed north of the existing Sacramento Weir. Additionally, a new bridge over the new weir will be constructed along Old River Road, a fish passage structure will be constructed in the new weir structure, a levee embankment will be constructed between the existing weir and the new weir, County Road 12 will be realigned, and the railroad embankment will be removed.

The California Department of Water Resources is implementing the Lower Elkhorn Basin Levee Setback project, which will widen the Sacramento Bypass by degrading the existing north levee of the Sacramento Bypass and constructing a new levee 1,500 feet to the north. This project was analyzed in a separate consultation (Service file # 2018-F-0479) and is not part of this project description.

The widening of the Sacramento Weir will result in stage increases of about 0.1 to 0.15 foot in the Yolo Bypass during the 1/100 and 1/200 annual exceedance probability (AEP) events and up to 0.3 feet during the 1/325 AEP event. These increases will not substantially change the area of the Yolo Bypass that will be inundated or substantially increase inundation depths in the bypass.

Due to operational criteria and system hydrology, the Sacramento Weir has historically not spilled on occasions when the Fremont weir was not already overtopping (i.e., the Fremont Weir always spills before the Sacramento Weir). Thus, under current conditions, the Sacramento Bypass has never been inundated by Sacramento Weir flood flows unless the Yolo Bypass was already inundated by flows over Fremont Weir Due to the volume of water that passed over the Fremont Weir, when the Fremont Weir spills and inundates the Yolo Bypass, some of the flow backs up and inundates the Sacramento Bypass. Additionally, because it takes an extended period of time for Yolo Bypass flows to drain back into the Sacramento River near Rio Vista, inundation in the Sacramento and Yolo Bypasses may persist for weeks or months after the weirs have stopped overtopping.

A change in operations will occur because the widened weir crest will be constructed at a lower elevation than the current weir. The lowered weir crest will result in the widened Sacramento Weir spilling more often, than current conditions. However, when the operation is modeled with the last 50 years of historical data, the proposed project will not substantially increase the frequency or duration of inundation in the Yolo Bypass.

New Weir and Bridge

A new 1,496-foot-long passive weir will be constructed along the right bank (looking downstream) of the Sacramento River, north of the existing weir. The new weir and existing weir will be separated by a levee embankment. The proposed weir would be composed of 60-foot-wide weir bays, separated by 3- to 5-foot-wide piers. A concrete approach slab and weir crest will form the floor between the piers. The weir crest elevation will be at 26 feet.

The new primary weir structure will be constructed behind the existing levee and Old River Road; therefore, only 1 year of in-water work is anticipated for the levee degrade, rock slope placement, and fish exit pool construction.

The existing levee, which will be in front of the new weir, once constructed, will be degraded in the final year of construction to create a graded approach to the new weir. The bank will be sloped back impacting 5.56 acres of riverine habitat and 2 acres of upland habitat which will result in 7.5 acres of riverine habitat once completed. The elevation of the graded approach to the new weir will be excavated down to an elevation of 22 feet. Once grading of the approach is completed, part of the area will be seeded with native perennial herbaceous species to stabilize the approach and protect it from erosion. Based on the proposed elevation of the approach, it is anticipated that this area will likely be inundated on an annual to biennial basis, given the OHWM is 2 feet higher than the proposed approach.

Once the graded approach is completed, areas that cannot be seeded due to erosion risk will have rock slope protection placed. Rock placed above the 10-foot contour will be 20 inches thick, while rock placed below this elevation will be 30 inches thick. A total of 18,358 cubic yards of rock are anticipated to be necessary. Placement of the rock will be achieved using an excavator staged from a barge or on land, and/or by bottom dumping rock from a barge. It may also be necessary to install a vibratory driven sheet-pile cofferdam to dewater the work area for installation of the rock slope protection. Turbidity will be controlled via a cofferdam, installation of a turbidity curtain, or other means and methods approved by the Regional Water Quality Control Board and NMFS.

Fish Passage Structure and Channel

The proposed action’s fish passage design includes the following design elements:

- Hydraulic Control Structure and Fishway Exit Pool
- Fish Ladder
- Fish Passage Channel
- Stilling Basin Drain
- Transition of open channel fish way into Tule Canal.

Like the new weir, most of the fish passage facility will be constructed behind the existing Sacramento River and Tule Canal levees.

A fish passage channel begins at the downstream end of the flow control structure and runs parallel to the north wall of the fish ladder. Downstream, the channel turns to connect to the fish ladder entrance pool, then continues west, aligned with the fish ladder centerline. It may be necessary to install a vibratory driven sheet-pile cofferdam to dewater work area where relatively high groundwater levels may otherwise limit dry conditions for channel grading and shaping. The Bypass Transport Channel will extend to the Tule Canal. As the Bypass Transport Channel approaches the Tule Canal a segment of existing canal will be modified resulting in a change in the depth, shape, and alignment of the existing canal. A small amount of riprap will be placed where the Bypass Transport Channel discharges into the Tule Canal.

Fish monitoring will occur in both the Sacramento River and Tule Canal. Active construction monitoring will consist of deploying a hydro acoustic receiver array and acoustic positioning systems. This technology is currently being utilized throughout the west coast and compliments other ongoing acoustic studies in the area. The array and positioning system will determine the fish's site fidelity and behavioral characteristics within the project area as construction activities are occurring. Pre-construction monitoring is anticipated to occur in the spring of 2020, using the acoustic array. Pre-construction monitoring is occurring to establish baseline conditions within the project/action area.

Fish monitoring will include the placement of up to twenty-five individual 14" diameter steel poles or pilings to be placed in the Sacramento River from RM throughout the ARCF action area in the Sacramento River. Minor pile driving activities are anticipated to occur. The purpose of the poles is for the placement/tethering of multi-functioning fish acoustic monitoring equipment, water quality monitoring equipment and an acoustic doppler current profiler. There will be navigation warning signs placed on top of each station. Monitoring will provide data for majority of the fish studies occurring within the Sacramento River.

<u>Interior Drainage</u>

A drainage ditch will be constructed north of the levee parallel to the proposed County Road 124. The new drainage ditch will include a culvert through the railroad embankment and will discharge to a drainage ditch being constructed through the Department of Water Resources' setback levee project.

Utility Relocation

Many utilities will be avoided; however, some utilities may need to be temporarily removed or relocated prior to construction. Temporary bypass pumping may be required for sanitary sewers. SAFCA and the construction contractors will coordinate with utility owners to manage the utilities in advance of construction. Disturbed utilities will be restored after construction consistent with CVFPB requirements.

Stormwater Pollution Prevention

Temporary erosion/runoff best management control measures would be implemented during construction to minimize stormwater pollution resulting from erosion and sediment migration from the construction, borrow, and staging areas. These temporary control measures may include implementing construction staging in a manner that minimizes the amount of area disturbed at any one time; secondary containment for storage of fuel and oil; and the management of stockpiles and disturbed areas by means of earth berms, diversion ditches, straw wattles, straw bales, silt fences, gravel filters, mulching, revegetation, and temporary covers as appropriate. Erosion and stormwater pollution control measures will be consistent with National Pollutant Discharge Elimination System (NPDES) permit requirements and included in a Stormwater Pollution Prevention Plan (SWPPP).

After completion of construction activities, the temporary facilities (construction trailers and batch plants) will be removed and the site would be restored to pre-project conditions. Site restoration activities for areas disturbed by construction activities, including borrow areas and staging areas, will include a combination of regrading, reseeding, constructing permanent diversion ditches, using straw wattles and bales, and applying straw mulch and other measures deemed appropriate.

Geotechnical Explorations

Geotechnical explorations include activities such as: geotechnical borings, erosion jet tests, geotechnical trenching, and geotechnical potholing. A brief description of each follows below.

<u>Geotechnical Borings</u>
Borings are done to determine the geologic composition of the foundation of various flood features (erosion protection, slurry walls, and Sacramento Weir). Each borehole will be about 4 to 6 inches in diameter and will be drilled to a depth of 50 to 100 feet. Equipment will include a tire-mounted drill rig, a support truck, and three crew trucks. Prior to initiating drilling, the workers will clear surface vegetation within the immediate borehole location (about 12 inches in diameter at each borehole). Woody vegetation will be avoided. Upon completion of each boring, the borehole will be backfilled with cement-bentonite grout. Drilling fluid and cuttings will be disposed of at an offsite location.

Erosion Jet Tests – Soil jet tests are used to classify erosion conditions along the waterside banks of the rivers. Tests will be conducted as close to the bank toe as feasibly possible. All jet tests will occur in the dry but may occur below the ordinary high-water mark. Two to six jet tests will be conducted at each site.

<u>Geotechnical Trenching</u>
This action involves digging trenches about 10 feet deep. The purpose of geotechnical trenching is to validate the composition of the levee embankment or other surface soil conditions. Additionally, trenching is often conducted in a similar manner as part of preconstruction geoarchaeological studies to determine the potential for presence of buried archaeological resources in the project area. Following site characterization, the trenches will be backfilled with soil.

Geotechnical Potholing
Geotechnical potholing is used when the purpose of the study is to determine the locations of pipes or other underground features that have the potential to be damaged by other techniques. The potholing is carried out using a vacuum truck to minimize potential damage to the utilities, and to biological resources. Any excess excavated material will be hauled offsite. All disturbed areas will be returned to their original state upon completion of each pothole.

Borrow Sites, Haul Routes, Mobilization, and Staging Areas

Borrow Sites
It is estimated that a maximum amount of borrow material is shown in Table 2 and will be needed to construct the ARCF Project. Detailed studies of the borrow material needs have not been completed. Actual volumes exported from any single borrow site will be adjusted to match demands for fill. Clean rock will be commercially acquired in order to construct the American and Sacramento River bank protection sites.

Borrow material will be obtained from locations on the project site that will undergo grade changes a part of project implementation, or from permitted offsite locations within 30 miles of the project site. Site selection will include the following criteria: avoidance of threatened and endangered species and their habitat, compatible with current land use patterns, and appropriate soil types. Fill may be borrowed from bank protection sites, when available, for the use of project-related mitigation.

Haul Routes
For construction of the enlarged Sacramento Weir, necessary aggregate base rock material will be obtained from a commercial sand and gravel operation, most likely in the Sacramento area, with majority of the riprap material to be transported by barge from quarries located within about 100 miles of the Sacramento Weir. The primary access to the Sacramento Weir project area will be from Interstate (I) 80 and Highway (Hwy) 50 via Harbor Boulevard and/or Reed Avenue, and then along Old River Road. The primary corridor for construction traffic will include temporary construction access roads, and local county roads.

For sites on the American River, haul routes will travel to the sites from either I-80 to the north or from Hwy 50 to the south and then through the residential neighborhoods utilizing various parkway access sites. Internal transfer dump trucks will utilize the top of the levee, the levee toe road, and bike paths to move material from the staging area where needed.

For the Sacramento River, rock will be acquired from a commercial source in the Bay Area and barged up the Sacramento River to the construction sites (see Table 2 for total barge trips estimated). Rock for the American River sites will be acquired from a commercial source within a 50-mile radius and will be hauled in trucks to the construction sites from either I-80 or Hwy 50 and through residential neighborhoods utilizing various Parkway access sites. Internal transfer dump trucks will utilize the top of the levee, the levee toe road, and bike paths to move material from the staging area to erosion repair sites.

Table 2. Barge Traffic Associated with Erosion Activities.

Activity	Total Number of Trips Modeled	Total Volume of Material Transported
Sacramento Weir and Bypass 2021	28 barge trips	25,000 cubic yards (cy)
Sacramento Weir and Bypass 2023	83 barge trips	75,000 cy
Sacramento River Erosion Contract 1	26 barge trips	23,000 cy
Sacramento River Erosion Contracts 2, 3* and 4	1,101 barge trips	1,000,000 cy

*Volume and trips are per year, there are likely to be 2 years of construction.

Mobilization

Mobilization will take place at each project site. Mobilization may include creation of temporary access roads, if needed; securing the site; and transporting equipment and materials to the site (e.g., clearing and grubbing, and construction of the repair). Access routes to construction sites will be primarily along existing roads, levee crown roads, or unpaved private farm roads. Barges will be used to transport rock to the sites on the Sacramento River. At several sites, a barge crane may be used to transport and stockpile rock and soil to the site.

Staging Areas

Staging areas will be selected so removal of trees and shrubs are minimized. Previously disturbed areas will be preferred. Landside staging areas may frequently be required for stockpiling materials and equipment. Activities that will occur within staging areas will include storing necessary imported materials (e.g., rock, soil); parking, refueling, and servicing of construction equipment; establishing a temporary restroom; and parking construction staff transportation vehicles.

Construction Process, Sequencing, and Equipment

Site Preparation

Vegetation clearing may need to occur for site access and construction purposes. Site preparation may also include the removal of submerged wood and fallen trees within the construction footprint. A turbidity curtain or other Service and NMFS approved minimization measure will be installed prior to any in-water work conducted on the waterside of the levee where there is potential for listed fish. The work limits and staging areas will be fenced (orange construction fencing) to prevent vehicles and equipment from approaching the waterside edge of the existing bank (where applicable), to protect sensitive habitat, and to identify disturbance area limits.

Where necessary, existing vegetation within the work area will be removed during project construction except for trees or shrubs identified and marked for protection prior to construction. Trees within the repair area identified for protection and outside the work limit may require trimming or removal for equipment clearance, excavation, or due to severely undermined tree health. All tree and sensitive plant removal will be documented. The construction site may be cleared of grasses, ground cover, or any other undesirable materials, using mechanized equipment.

Construction Process
Rock or other fill material (eg., sand, soil, cobble) will be placed using a long-arm bucket excavator, barge crane, or other heavy equipment. IWM may be installed, if feasible, near the water surface during time of construction to replace or enhance riverine aquatic habitat to the repair area.

Demobilization, Rehabilitation, and Clean-up

Following construction, all equipment and materials will be removed from the work area and excess materials will be disposed of at appropriate facilities. All areas will be cleaned and cleared of rubbish and left in a safe and suitable condition.

Compensatory Mitigation

A compensatory mitigation proposal is under development by the Corps. It will include success criteria, long-term monitoring, and a reporting schedule.

Elderberry Shrub Transplanting
Sites currently being pursued by the Corps, non-Federal sponsor, and local maintaining agency in coordination with the Sacramento County Parks, include, but are not limited to Rio Americano West and East, Glenn Hall, and Rossmoor. Additional sites are being investigated in anticipation of the full implementation of the proposed project. These sites will be used to transplant elderberry shrubs from erosion protection measures along the lower American River. Table 3 shows the size of the current known elderberry and riparian mitigation sites in the lower American River.

Site Elements
Each site will require temporary access for initial construction and mitigation site establishment activities and permanent access for long-term maintenance. Temporary activities include access to the river or a well for irrigation pump facilities, and a staging area. Site fencing will be determined on a site by site basis. Irrigation will be available for at least the first three years. The elderberry shrubs will be removed using an excavator and transplanted in cluster groups of 3 to 12 shrubs. Maintenance of the sites during the establishment period will include irrigation, removal of non-native vegetation, and mowing.

Erosion Protection On-Site Mitigation
The incorporation of IWM, willow fascines, and plantings is being implemented to replace lost habitat. Entire almond or walnut trees with root balls and canopies may be used as IWM. The IWM will be placed at the waterside edge of the riparian bench and anchored into the quarry stone by the root ball. The fascines are anchored near the winter mean water surface elevation. Plantings will include an appropriate mix of local native riparian trees and shrubs and will occur at appropriate elevations.

Vegetation installation within the sites will be developed in coordination with the Service and NMFS during the design phase. A variety of materials for revegetation and site-enhancement may be used depending on the site-specific conditions. Below is a description of commonly used materials and methods used for revegetation purposes.

The incorporation of IWM functions to replace lost in-stream cover and habitat form construction impacts. Entire trees with root balls and canopies are used as the IWM. The trees shall be anchored into the quarry stone to one half of the tree length. They are placed to be submerged when fish are generally present in the area.

Willow fascines and pole cuttings are also incorporated into the site designs in order to replace lost in-stream cover and habitat due to construction. The fascines are anchored just below the winter mean water surface elevation at 15-foot triangular spacing. Pole cuttings will be planted in rows where the planting bench will terminate at the launchable toe to help stabilize the planting bench soil.

Table 3. Valley Elderberry Longhorn Beetle and Riparian Habitats

Site	Total Site Acreage	Mitigation Acreage	Temporary Work Acreages	Permanent Access Route Acreages	Plantable Acreage
Glenn Hall (RM 4.9 L)	17.28	8.71	1.33	0.83	5.72
Rio American West (RM 10.4 R)	12.88	5.32	1.84	2.24	3.33
Rio American East (RM 11.1 R)	5.67	2.44	0.43	0.52	2.13
Rossmoor West (RM 15.5 L)	43.70	21.61	3.60	0.94	15.88
Rossmoor East (RM 16.4 L)	12.77	6.07	0.86	1.04	4.68

Plant material installation is designed to mitigate for lost riparian habitat post construction. The proposed planting design includes an appropriate mix of local system native riparian trees and shrubs. Plantings will be incorporated into the sites at appropriate elevations to provide successful on-site mitigation.

Large Off-Site Mitigation Sites

The Corps is committed developing a large-scale mitigation site to offset effects to fisheries and riparian habitat along the Sacramento River mainstem. Mitigation on the Sacramento River will be sited between the areas of Verona and Walnut Grove, and preferably south of the I Street Bridge along the Sacramento River to benefit all fish species impacted by the project. Not all mitigation may be able to be done at one site, so the Corps is continuing to pursue habitat creation within the Lower American River in addition to the sites discussed above. The Service and NMFS will be provided the opportunity to serve on the mitigation site technical team to provide input to the site selection and design throughout the design process for the sites. Since these sites are not in design at this time the Corps will reinitiate consultation to address any potential effects not currently covered in this biological opinion.

Operation and Maintenance

Operation and maintenance (O&M) of the levees in the Sacramento area are the responsibility of the local maintaining agencies, including the American River Flood Control District, DWR, and the City of Sacramento. The applicable O&M Manual for the Sacramento area levees is the Standard Operation and Maintenance Manual for the Sacramento Flood Control Project. Typical levee O&M in the Sacramento in the Sacramento area currently includes the following actions:

- Vegetation maintenance up to four times a year by mowing or applying herbicide.
- Control of burrowing rodent activity monthly by baiting with pesticide.
- Slope repair, site-specific and as needed, by re-sloping and compacting.
- Patrol road reconditioning up to once a year by placing, spreading, grading, and compacting aggregate base or substrate.
- Visual inspection at least monthly, by driving on the patrol road on the crown and maintenance roads at the base of the levee.
- Post-construction, groundwater levels will be monitored using the piezometers.

The Corps will work with local maintaining agencies to develop additional maintenance activities necessary for long-term operations and maintenance. This will occur during the preconstruction engineering and design phase of the project. The Corps will evaluate if these maintenance activities will affect any Federally listed species and reinitiate section 7 consultation if there will be adverse effects to listed species. Currently, the Corps only has a project description for activities that will affect valley elderberry longhorn beetle habitat. This is included below.

Following construction, the O&M manual for these reaches will be adjusted to reflect the design deviations and the SWIF plan. Under the adjusted O&M manual, large trees that are protected in place under the design deviation will be allowed to remain on the waterside slopes and additional vegetation will be planted on the planting benches.

Vegetation maintenance includes keeping maintenance roads clear of overhanging branches. Some of the vegetation along the levees includes elderberry shrubs. As part of long-term O&M, elderberry shrubs will be trimmed by the three levee maintenance districts. Table 4 describes the maximum amount of elderberry acreage that will be trimmed each year as a result of O&M. Trimming consists of cutting overhanging branches along the levee slopes on both the landside and waterside. Some shrubs may be located adjacent to the levee with branches hanging over the levee maintenance road. Up to a third of a shrub will be trimmed in a single season. Trimming will occur between November 1 and March 15. Loss of habitat will be offset through the development of a conservation area as described in the conservation measures below. Each year the local maintaining agency will document the amount of valley elderberry longhorn beetle habitat that they have trimmed and report that number to the Corps to ensure compliance with this biological opinion. If the local maintaining agency has a need to exceed the amount of valley elderberry longhorn beetle habitat which needs to be trimmed or affected due to routine maintenance, then they will request the Corps reinitiate consultation on this biological opinion for those actions.

Table 4. O&M by Maintaining Agency

Local Maintaining Agency	Levee Systems Covered	Annual Acreage of Trimmed Elderberry Shrubs*	Total Acreage of Elderberry Shrubs Trimmed over the 50 Year Life of the Project
American River Flood Control District	Lower American River, Arcade Creek, NEMDC	0.5	25
Maintenance Area 9	Sacramento River east levee between Sutterville Road and the Beach Lake Levee	0.2	10
City of Sacramento	Sacramento River East Levee between the confluence of the American River and Sutterville Road	0.1	5

*acreage based on an estimated average shrub of 0.027 acre and no more than 1/3 of a shrub trimmed any given year.

Conservation Measures

<u>Valley Elderberry Longhorn Beetle</u>

- The Corps assumes complete avoidance of the valley elderberry longhorn beetle when a 100-foot (or wider) buffer is established and maintained around elderberry shrubs.

- When work will occur within the 100-foot buffer, a setback of 20 feet from the dripline of each elderberry shrub will be maintained whenever possible.

- During construction activities, all areas to be avoided will be fenced and flagged with as large as a buffer as possible.

- Signs will be erected every 50 feet along the edge of the avoidance area, identifying the area as an environmentally sensitive area.

- A qualified biologist will monitor the work area at appropriate intervals to ensure that all avoidance and minimization measures are implemented. The amount and duration of monitoring will depend on the project and will be coordinated with the Service.

- As feasible, all activities that will occur within 50 meters of an elderberry shrub, will be conducted outside of the flight season of the valley elderberry longhorn beetle (March through July).

- Any damage done to the buffer area will be restored.

- Buffer areas will continue to be protected after construction.

- Erosion control will be implemented, and the affected area will be re-vegetated with appropriate native plants.

- Herbicides will not be used within the dripline 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. Mechanical week removal within the dripline of the shrub will be limited to the season within adults are not active (August through February) and will avoid damaging the elderberry shrubs.

- Dust will be controlled by reducing speed limits to 10 miles per hour on unpaved roads, regularly watering roads, and wetting down soil and rock during grading operations and placement.

- Elderberry shrubs that cannot be avoided and that can be feasibly transplanted without safety concerns or detriment to the surrounding environment will be transplanted to an appropriate riparian area at least 100 feet from construction activities; see the 2017 Framework for further information

- It is estimated that no more than 10 percent of the shrubs will not be transplanted due to water quality or safety of personnel. For shrubs that cannot be transplanted, all stems will be cut at ground level, collected, and distributed among the transplanted shrubs within the valley elderberry longhorn beetle conservation areas.

- Elderberry shrubs will be surveyed prior to construction to ensure that the actual effects match the estimated effects of this biological opinion. If the Corps will affect more valley elderberry longhorn beetle habitat than estimated than they will reinitiate consultation with the Service.

- Elderberry shrubs will be transplanted between November 1 and February 15, when shrubs are dormant.

- The Corps is proposing to compensate for effects to valley elderberry longhorn beetle through creation of compensation sites as described in the Service's 2017 Valley Elderberry Longhorn Beetle Framework and as below. The Corps will compensate at a 3:1 ratio for effects to valley elderberry longhorn beetle habitat. Tables 5 through 8 describe the calculated acreages and compensation.

Table 5. American River Elderberry Shrub Habitat and Compensation

Reach	Acreage/Amount	Compensation Ratio	Compensation Acreage
Subreach 2	2.84 acres elderberry shrubs[1] 8.07 acres associated riparian[2]	3:1	24.21
Subreaches 1, 3, and 4	4.27 acres elderberry shrubs[1] 13.71 acres associated riparian[2]	3:1	41.13

1 – There are about 300 to 400 individual elderberry shrubs
2 – This encompasses the riparian habitat within 25 meters of the elderberry shrubs

Table 6. Sacramento River Bank Stabilization Elderberry Shrub Habitat and Compensation

Acreage	Compensation Ratio	Compensation Acreage
0.12 acre elderberry shrubs[1] 2.69 acres associated riparian[2]	3:1	8.43

1 – There are about 300 to 400 individual elderberry shrubs
2 – This encompasses the riparian habitat within 25 meters of the elderberry shrubs

Table 7. Sacramento River Seepage and Stability Elderberry Shrub Habitat and Compensation

Number of Isolated[1] Elderberry Shrubs	Compensation Ratio	Compensation Credits/Acreage
40	2:1	80/3.31

1 – Given the linear nature of the work and the narrow width of the riparian habitat elderberry shrubs in this portion of the project will be compensated by a 2:1 ratio based on the number of shrubs that will be transplanted.

Table 8. Sacramento Weir Elderberry Shrub Habitat and Compensation

Acreage	Compensation Ratio	Compensation Acreage
0.69 acre elderberry shrubs[1] 2.05 acres associated riparian[2]	3:1	8.22

1 – There are about 300 to 400 individual elderberry shrubs
2 – This encompasses the riparian habitat within 25 meters of the elderberry shrubs

- If possible, elderberry shrubs would be transplanted during their dormant season (November through the first two weeks in February). If transplantation occurs during the growing season, increased mitigation will apply.

- The Corps is developing conservation areas to offset the transplantation, and loss of valley elderberry longhorn beetle habitat. Sites are being developed in the Lower

American River and at the Beach Lakes Conservation Area along Morrison Creek. The Corps will find areas within the lower American River parkway which will either expand existing compensation areas or provide for connectivity between conserved valley elderberry longhorn beetle habitat areas. Sites within the lower American River parkway will be coordinated with Sacramento County Parks and the Service during the design phase of the project. Sites will be designed and developed prior to any effects to valley elderberry longhorn beetle habitat. The Corps will create 19.96 acres of riparian habitat which supports valley elderberry longhorn beetle within the lower American River parkway for the transplantation of elderberry shrubs. In addition, the local sponsors will create an additional 40 acres of land to benefit the valley elderberry longhorn beetle or purchase 40 acres of credits at a Service approved conservation bank to offset the loss of habitat due to trimming of elderberry shrubs along the lower American River, Sacramento River, Dry/Robla Creeks, Arcade Creek, Magpie Creek, and NEMDC. If off-site compensation cannot be identified a portion of the compensation can purchase credits at a valley elderberry longhorn beetle conservation bank.

- Management of these lands will include all measures specified in the Service's Framework (2017) related to weed and litter control, fencing, and the placement of signs.

<u>Giant Garter Snake</u>

- Unless approved otherwise by the Service, construction will be initiated only during the giant garter snakes' active period (May 1–October 1, when they are able to move away from disturbance).

- Construction personnel will be given a Service-approved worker environmental awareness program.

- A survey for giant garter snakes will be conducted within 24 hours prior to construction beginning in potential giant garter snake habitat. Should there be any interruption in work for greater than 2 weeks, a biologist will resurvey the area within 24 hours prior to the restart of construction.

- Giant garter snakes encountered during construction will be allowed to move away from construction activities on their own.

- Movement of heavy equipment to and from the construction site will be restricted to established roadways. Stockpiling of construction materials will be restricted to designated staging areas, which will be located more than 200 feet away from giant garter snake aquatic habitat.

- Giant garter snake habitat within 200 feet of construction activities will be designated as an environmentally sensitive area and delineated with signs or fencing. This area will be avoided by all construction personnel.

- Habitat temporarily affected for one season (the 5.5 acre borrow site along the NEMDC and the 3.1 acres of aquatic and 32.7 acres of upland habitat associated with the fish passage channel located between the south Cross Canal and Tule Canal along the landside of the existing Sacramento Bypass North Levee) will be restored after construction by applying appropriate erosion control techniques and replanting/seeding with appropriate native plants and one year of monitoring. If for any reason the construction season in giant garter snake habitat extends into an additional active season, the Corps will replace the habitat on-site and purchase credits at a ratio of 1:1 at a Service-approved conservation bank in advance of the second construction season in suitable habitat.

- Habitat temporarily affected for more than three or more seasons will be restored and twice as much habitat will be created.

- Habitat permanently affected in the Sacramento Bypass in the form of 0.3 acre of drainage ditches and irrigation canals and 2.3 acres of surrounding upland habitat will be offset through the creation of the Bypass Transport Channel, which will create 6.7 acres of aquatic habitat.

- A biological monitor will be on-site during all ground disturbing activities at borrow site 2.

- Exclusionary fencing will be placed at least 10 days prior to the beginning of ground disturbing activities after May 1, to exclude giant garter snakes from entering areas where upland disturbance (borrow site 2) will occur during the active season (May 1 to October 1). Prior to fencing installation, the fence line will be mowed (with a minimum height of 6 inches) in order to conduct a surface survey of potential burrows. Fencing will be installed with a minimum of 6 inches buried in the ground and a minimum of 24 inches above ground. Fence staking will be installed on the inside of the exclusion area. One-way escape funnels will be installed every 50 to 100 feet and sealed along the fence line to provide an escape for any giant garter snake that may be within the exclusion area. The fencing will enclose the entirety of the site, or additional exclusionary fencing can be extended 200 to 400 feet beyond the proposed entrance area. The fencing will be inspected before the start of each workday and maintained by the contractor until completion of the project. The fencing will be removed only when project activities are completed.

<u>Yellow-Billed Cuckoo</u>

- Prior to construction, a Service-approved biologist shall conduct nesting bird surveys to determine the presence of nesting birds, including the yellow-billed cuckoo. If cuckoos are located the Service will be contacted to establish appropriate buffers. Surveys will be repeated if construction stops for a period of two weeks or longer.

- All vegetation removal shall occur between October 1 and March 1 outside of the cuckoo nesting season.

- Loss of riparian habitat that can serve as migratory stopover habitat for the yellow-billed cuckoo will be offset at a 2:1 ratio.

- Riparian habitat that is removed due to project construction will be mitigated within the American River parkway and at the Beach Stone Lakes compensation site. The Corps intends to expand existing conserved riparian lands within the parkway that could support the yellow-billed cuckoo. The design of replacement riparian areas will be coordinated with the Service to ensure that the habitat benefits both the valley elderberry longhorn beetles and yellow-billed cuckoo.

<u>Delta Smelt</u>

- The Corps is proposing to work outside of the delta smelt work window. In-water construction activities (e.g., placement of rock revetment) will be limited to the work window of July 1 through November 30.

- The Corps will purchase 90 acres of delta smelt credits from a Service-approved conservation bank or through the creation of a mitigation site to compensate for the loss of up to 30 acres of shallow water habitat due to the placement of riprap along the river bed and bank. If the Corps creates a compensation site instead of purchasing credits at a conservation bank, the site will be constructed and planted prior to the end of the construction of the Sacramento River sites.

- The Corps will create on-site mitigation in the form of riparian or wetland benches in the shallow water habitat zone. These sites will be developed in coordination with the Service and NMFS.

- The Corps will develop and implement a compensatory mitigation accounting plan to ensure the tracking of compensatory measures associated with the implementation of the proposed project.

- Erosion control measures (BMPs), including Storm Water Pollution Prevention Program and Water Pollution Control Program, that minimize soil or sediment from entering the river shall be installed, monitored for effectiveness, and maintained throughout construction operations to minimize effects to federally listed fish and their designated critical habitat.

- Screen any water pump intakes, as specified by NMFS and the Service screening specifications. Water pumps will maintain an approach velocity of 0.2 feet per second or less when working in areas that may support delta smelt.

- Minimize the removal of existing vegetation during project-related activities.

- The Corps shall include as part of the project, a Riparian Corridor Improvement Plan with the overall goal of maximizing the ecological function and value of the existing levee system within the Sacramento Metropolitan area.

<u>Additional Conservation Measures</u>

- A qualified biologist will provide training for all contractors, work crews, and any onsite personnel on the status of the valley elderberry longhorn beetle, delta smelt, giant garter snake, and yellow-billed cuckoo, their habitats, the need to follow conservation measures, and the possible penalties for not complying with these requirements.

- The Corps will go through the design deviation process to limit vegetation removal prior to final design and construction phase for any contract.

- The Corps will include as part of the project, a Riparian Corridor Improvement Plan with the overall goal of maximizing the ecological function and value of riparian habitat within the existing levee system in the Sacramento Metropolitan area.

- Engineering designs will be modified to avoid potential direct and indirect effects.

- The Corps will include the Service and NMFS during the design of project components, including mitigation sites. This will include soliciting input and comments on designs and plans.

- The Corps will develop and implement a compensatory mitigation accounting plan to ensure the tracking of compensatory measures. The Corps will continue to coordinate with the Service during all phases of construction, implementation, and monitoring by hosting meetings. Additionally, prior to beginning construction, the Corps will provide a brief project description and describe the acres of listed species habitat effected and the amount of compensation for that contract that is being proposed.

- The Corps will develop, in conjunction with the Service and NMFS, interim management plans for mitigation sites. These will include performance standards that will be met. The Corps, in conjunction with the Service, NMFS, and the future maintainer, will develop long-term management plans for any mitigation that is developed as part of the project. Monitoring will occur for 8 consecutive years or as determined through the long-term management plan planning process. Annual monitoring reports will be submitted to the Service.

- Compensation areas will be protected in perpetuity and have a funding source for maintenance (endowment).

- Site access will be limited to the smallest area possible in order to minimize disturbance. Litter, debris, unused materials, equipment, and supplies will be removed from the project area daily. Such materials or waste will be deposited at an appropriate disposal or storage site.

- Designating a qualified biologist as a point-of-contact for any contractor who might incidentally take a living, or find a dead, injured, or entrapped threatened or endangered species. This representative shall be identified to the employees and contractors during an all employee education program conducted by the Corps. They shall have knowledge of the listed species that are discussed in this biological opinion.

- The Corps will provide an analysis of the launchable toe and buried rock trench, which shall evaluate the likelihood of the toe and trench launching. This analysis will also include the long-term durability of habitat which is established on the planting bench and the rock footprint of the launched buried rock trench. This analysis will be done by December 31, 2021. If long-term durability of the planting benches is diminished and the habitat will not be viable in perpetuity, then the Corps will work with the Service to offset effects to listed species due to this design feature.

- Stockpile all liquid chemicals and supplies at a designated impermeable membrane fuel and refueling station with a 100% containment system.

- Stockpile construction materials such as portable equipment, vehicles, and supplies, at designated construction staging areas and barges, exclusive of any riparian and wetland areas.

- Implement BMPs to prevent slurry from seeping out to the river and require piping systems on the landside of the levee.

- Immediately (within 24 hours) cleanup and report any spills of hazardous materials to the resource agencies. Any such spills, and the success of the efforts to clean them up, shall also be reported in post-construction compliance reports.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." For the proposed project, the action area encompasses the Sacramento River from the Sacramento Bypass downstream to River Mile 45, the lower American River from Arden Way to the confluence of the Sacramento River, Arcade Creek from Marysville Boulevard to the confluence of the NEMDC, the NEMDC from the south Dry Creek levee to just south of the NEMDC Arcade Creek confluence, the southern Dry Creek levee between Dry Creek Road and Rose Street, the borrow site along the NEMDC, and any borrow sites. Additionally, we are including a buffer of 300 feet from construction to account for effects to listed species due to dust and noise.

Analytical Framework for the Jeopardy Determination

Section 7(a)(2) of the Act requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR § 402.02).

The jeopardy analysis in this biological opinion considers the effects of the proposed federal action, and any cumulative effects, on the range wide survival and recovery of the listed species. It relies on four components: (1) the *Status of the Species*, which describes the current range wide condition of the species, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which analyzes the current condition of the species in the action area without the consequences to the listed species caused by the proposed action, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the *Effects of the Action*, which determines all consequences to listed species that are caused by the proposed federal action; and (4) the *Cumulative Effects*, which evaluates the effects of future, non-federal activities in the action area on the species. The *Effects of the Action* and *Cumulative Effects* are added to the *Environmental Baseline* and in light of the status of the species, the Service formulates its opinion as to whether the proposed action is likely to jeopardize the continued existence of the listed species.

Analytical Framework for the Adverse Modification Determination

Section 7(a)(2) of the Act requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to destroy or to adversely modify designated critical habitat. A final rule revising the regulatory definition of "destruction or adverse modification" (DAM) was published on August 27, 2019 (84 FR 44976). The final rule became effective on October 28, 2019. The revised definition states:

> "*Destruction or adverse modification* means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species."

The DAM analysis in this biological opinion relies on four components: (1) the *Status of Critical Habitat*, which describes the current range wide condition of the critical habitat in terms of the key components (i.e., essential habitat features, primary constituent elements, or physical and biological features) that provide for the conservation of the listed species, the factors responsible for that condition, and the intended value of the critical habitat overall for the conservation/recovery of the listed species; (2) the *Environmental Baseline*, which analyzes the current condition of the critical habitat in the action area without the consequences to designated critical habitat caused by the proposed action, the factors responsible for that condition, and the value of the critical habitat in the action area for the conservation/recovery of the listed species; (3) the *Effects of the Action*, which determines all consequences to designated critical habitat that are caused by the proposed federal action on the key components of critical habitat that provide for the conservation of the listed species, and how those impacts are likely to influence the conservation value of the affected critical habitat; and (4) *Cumulative Effects*, which evaluate the effects of future non-federal activities that are reasonably certain to occur in the action area on the key components of critical habitat that provide for the conservation of the listed species and how those impacts are likely to influence the conservation value of the affected critical habitat. The *Effects of the Action* and *Cumulative Effects* are added to the *Environmental Baseline* and considering the status of critical habitat, the Service formulates its opinion as to whether the action is likely to destroy or adversely modify designated critical habitat. The Service's opinion evaluates whether the action is likely to impair or preclude the capacity of critical habitat in the action area to serve its intended conservation function to an extent that appreciably diminishes the range wide value of critical habitat for the conservation of the listed species. The key to making that finding is understanding the value (i.e., the role) of the critical habitat in the action area for the conservation/recovery of the listed species based on the *Environmental Baseline* analysis.

Status of the Species

Valley Elderberry Longhorn Beetle

For the most recent comprehensive assessment of the species' range wide status please refer to the *Withdrawal of the Proposed Rule to Remove the Valley Elderberry Longhorn Beetle from the Federal List of Endangered and Threatened Wildlife* (Service 2014a). Threats discussed in the final document have continued to act on the species, with the loss of habitat being the most significant effect. While there have been continued losses of beetle habitat throughout the various recovery units, including the Sacramento River and Putah Creek Management Units identified in the *Revised Recovery Plan for the Valley Elderberry Longhorn Beetle (Desmocerus californicus dimorphus)* (VELB Recovery Plan) (Service 2019), to date no project has proposed a level of effect for which the Service has issued a biological opinion of jeopardy for the valley elderberry longhorn beetle. The Service is currently working on a 5-year review for this species.

Delta Smelt

Species Legal Status and Life Cycle Summary

The Service proposed to list the delta smelt as threatened with proposed critical habitat on October 3, 1991 (Service 1991). The Service listed the delta smelt as threatened on March 5, 1993 (Service 1993), and designated critical habitat for the species on December 19, 1994 (Service 1994). The delta smelt was one of eight fish species addressed in the *Recovery Plan for the Sacramento–San Joaquin Delta Native Fishes* (Service 1996). A 5-year status review of the delta smelt was completed on March 31, 2004 (Service 2004). The review concluded that delta smelt remained a threatened species. A subsequent 5-year status review recommended uplisting delta smelt from threatened to endangered (Service 2010a). A 12-month finding on a petition to reclassify the delta smelt as an endangered species was completed on April 7, 2010 (Service 2010b). After reviewing all available scientific and commercial information, the Service determined that re-classifying the delta smelt from a threatened to an endangered species was warranted but precluded by other higher priority listing actions (Service 2010c). The Service reviews the status and uplisting recommendation for delta smelt during its Candidate Notice of Review (CNOR) process. Each year it has been published, the CNOR has recommended the uplisting from threatened to endangered. Electronic copies of these documents are available at https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=321.

The delta smelt is a small fish of the family Osmeridae. In the wild, very few individuals reach lengths over 3.5 inches (90 mm; Damon *et al.* 2016). At the time of its listing, only the basics of the species' life history were known (Moyle *et al.* 1992). In the intervening 26 years, it has become one of the most studied fishes in the United States. Enough has been learned about the delta smelt to support its propagation in captivity over multiple generations (Lindberg *et al.* 2013), to support the development of complex conceptual models of the species life history (Interagency Ecological Program (IEP) 2015), and mathematical simulation models of its life cycle (Rose *et al.* 2013a). Any synthesis of the now extensive literature on the delta smelt requires drawing conclusions across studies that had disparate objectives, but several syntheses have been compiled from existing information (Moyle *et al.* 1992; Bennett 2005; IEP 2015; Moyle *et al.* 2016). In this biological opinion, the Service relied on these previous syntheses where it remains appropriate to do so. We also relied on source study results and analyses of our own to synthesize across a rapidly growing body of scientific information.

The delta smelt has a fairly simple life history because a large majority of individuals live only one year (Bennett 2005; Moyle *et al.* 2016) and because it is an endemic species (Moyle 2002), comprising only one genetic population (Fisch *et al.* 2011), that completes its full life cycle in the northern reaches of the San Francisco Bay-Delta (Merz *et al.* 2011; Figure 1). The schematic of this simple life cycle developed by Moyle *et al.* (2016) and published again by Moyle *et al.* (2018) is shown in Figure 2. Most spawning occurs from February through May in various places from the Napa River and locations to the east including much of the Sacramento-San Joaquin Delta. Larvae hatch and enter the plankton primarily from March through May, and most individuals have metamorphosed into the juvenile life stage by June or early July. Most of the juvenile fish continue to rear in habitats from Suisun Bay and marsh and locations east principally along the Sacramento River-Cache Slough corridor (recently dubbed the 'North Delta Arc'; Moyle *et al.* 2010). The juvenile fish (or 'sub-adults') begin to develop into maturing adults in the late fall. Thereafter, the population spatial distribution expands with the onset of early winter storms and the first individuals begin to reach sexual maturity by January in some years, but most often in February (Damon *et al.* 2016; Kurobe *et al.* 2016). Delta smelt do not reach sexual maturity until they grow to at least 55 mm in length (~ 2 inches) and 50% of individuals are sexually mature at 60 to 65 mm in length (Rose *et al.* 2013b). In captivity delta smelt can survive to spawn at two years of age (Lindberg *et al.* 2013), but this appears to be rare in the wild (Bennett 2005; Damon *et al.* 2016; Figure 2). The spawning microhabitats of the delta smelt are unknown, but based on adult distribution data (Damon *et al.* 2016; Polansky *et al.* 2018) and the evaluation of otolith microchemistry (Hobbs *et al.* 2007a; Bush 2017), most delta smelt spawn in freshwater to slightly brackish-water habitats under tidal influence. Most individuals die after spawning, but as is typical for annual fishes, when conditions allow, some individuals can spawn more than once during their single spawning season (Damon *et al.* 2016). In a recent study spanning 2 to 3 months, captive males held at a constant water temperature of

12°C (54°F) spawned an average of 2.8 times and females spawned an average of 1.7 times (LaCava *et al.* 2015).

Figure 1. Delta smelt range map. Waterways colored in purple depict the delta smelt distribution described by Merz *et al.* (2011). The Service has used newer information to expand the transient range of delta smelt further up the Napa and Sacramento rivers than indicated by Merz *et al.* (2011). The red polygon depicts the boundary of delta smelt's designated critical habitat. The inset map shows the region known as the North Delta Arc shaded light green.

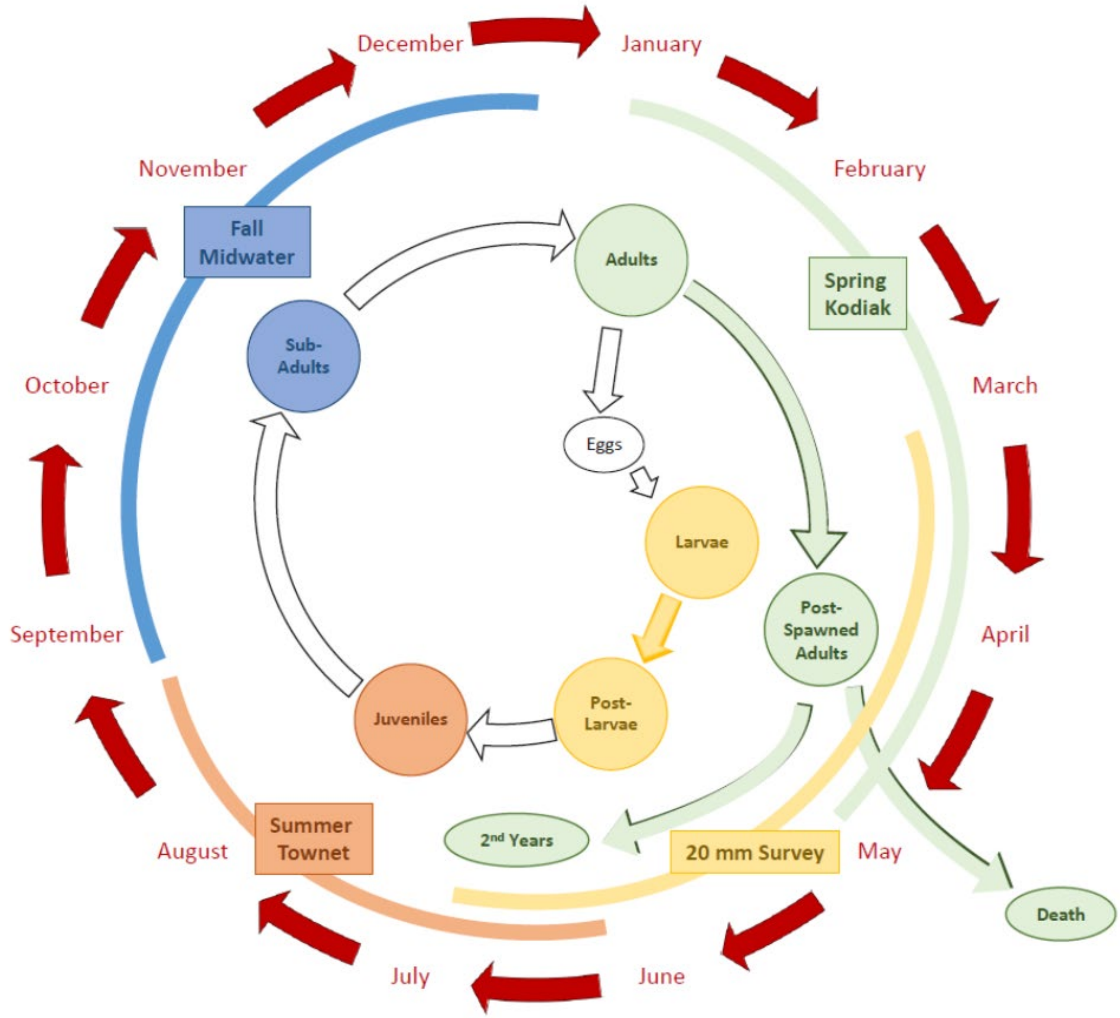

Figure 2. Schematic representation of the delta smelt life cycle. This conceptual model crosswalks delta smelt life stages with calendar months and current monitoring programs (prior to Enhanced Delta Smelt Monitoring) used to evaluate the species' status. Source: Moyle *et al.* 2016

Detailed Review of the Reproductive Biology of Delta Smelt

Delta smelt spawn in the estuary and have one spawning season for each generation, which makes the timing and duration of the spawning season important every year. Delta smelt are believed to spawn in fresh and low-salinity water (Hobbs *et al.* 2007a; Bush 2017). Therefore, freshwater flow affects how much of the estuary is available for delta smelt to spawn (Hobbs *et al.* 2007a). This is one mechanism in which interannual variation in Delta outflow could play a role in the population dynamics of delta smelt. Given the timing of delta smelt reproduction, Delta outflow during February through May would be most important for this mechanism. During this time of year, variation in Delta outflow is largely driven by weather variation and regulated by the California State Water Resources Control Board (SWRCB) Decision-1641 (D-1641).

The locations of delta smelt spawning are thought to be influenced by salinity (Hobbs *et al.* 2007a), but the duration of the spawning season is thought to be driven mainly by water temperature (Bennett 2005; Damon *et al.* 2016), which is largely a function of regional air temperature (Wagner *et al.* 2011). Thus, the spawning season duration does not appear to be a freshwater flow mechanism, but rather, a climate-driven mechanism (Brown *et al.* 2016a). Delta smelt can start spawning when water temperatures reach about 10°C (50°F) and can continue until temperatures reach about 20°C (68°F; Bennett 2005; Damon *et al.* 2016). The ideal spawning condition occurs when water temperatures remain between 10°C and 20°C throughout February through May. Few delta smelt ≤ 55 mm in length are sexually mature and 50% of delta smelt reach sexual maturity at 60 to 65 mm in length (Rose *et al.* 2013b). During January and February, many delta smelt are still smaller than these size thresholds (Damon *et al.* 2016). Thus, if water temperatures rise much above 10°C in January, the "spawning season" can start before many individuals are mature enough to actually spawn. If temperatures continue to warm rapidly toward 20°C in early spring, that can end the spawning season with only a small fraction of 'adult' fish having had an opportunity to spawn, and perhaps only one opportunity to do so. Delta smelt were initially believed to spawn only once before dying (Moyle *et al.* 1992). It has since been confirmed that delta smelt can spawn more than once if water temperatures remain suitable for a long enough time, and if the adults find enough food to support the production of another batch of eggs (Lindberg *et al.* 2013; Damon *et al.* 2016; Kurobe *et al.* 2016). In a recent study spanning 2 to 3 months, captive males held at a constant water temperature of 12°C (54°F) spawned an average of 2.8 times and females spawned an average of 1.7 times (LaCava *et al.* 2015). As a result, the longer water temperatures remain cool, the more fish have time to mature and the more times individual fish can spawn. Most adults disappear from monitoring programs by May, suggesting they have died (Damon *et al.* 2016; Polansky *et al.* 2018).

The reproductive behavior of delta smelt is only known from captive specimens spawned in artificial environments and most of the information has never been published, but is currently being revisited in new research. Spawning likely occurs mainly at night with several males attending a female that broadcasts her eggs onto bottom substrate (Bennett 2005). Although preferred spawning substrate is unknown, spawning habits of delta smelt's closest relative, the Surf smelt (*Hypomesus pretiosus*), are sand or small gravel (Hirose and Kawaguchi 1998; Quinn *et al.* 2012).

The duration of the egg stage is temperature-dependent and averages about 10 days before the embryos hatch into larvae (Bennett 2005). It takes the fish about 30-70 days to reach 20-mm in length (Bennett 2005; Hobbs *et al.* 2007b). Similarly, Rose *et al.* (2013b) estimated that it takes delta smelt an average of slightly over 60 days to reach the juvenile life stage. Metamorphosing "post-larvae" appear in monitoring surveys from April into July of most years. By July, most delta smelt have reached the juvenile life stage. Thus, subtracting 60 days from April and July indicates that most spawning occurs from February-May.

Hatching success is highest at temperatures of 15-16°C (59-61°F) and lower at cooler and warmer temperatures and hatching success nears zero percent as water temperatures exceed 20°C (Bennett 2005). Water temperatures suitable for spawning occur most frequently during the months of February-May, but ripe female delta smelt have been observed as early as January and larvae have been collected as late as July, suggesting that spawning itself may extend into June in years with exceptionally cool spring weather.

<u>Detailed Review of the Habitat Use and Distribution of Delta Smelt</u>

Because the delta smelt only lives in one part of one comprehensively monitored estuary, its general distribution and habitat use are well understood (Moyle et al. 1992; Bennett 2005; Hobbs et al. 2006; 2007b; Feyrer et al. 2007; Nobriga et al. 2008; Kimmerer et al. 2009; Merz et al. 2011; Murphy and Hamilton 2013; Sommer and Mejia 2013; Mahardja et al. 2017a; Simonis and

Merz 2019). The delta smelt has been characterized as a semi-anadromous species (Bennett 2005; Hammock et al. 2017) and Sommer et al. (2011) characterized the species as a partial diadromous migrant, recognizing individual variation in its life-history. However, both terms emphasize a life cycle in which delta smelt spawn in freshwater and volitionally move 'downstream' into brackish water habitat, which is only one endpoint among several individual life cycle strategies that have recently been confirmed through the use of otolith microchemical analyses (Bush 2017). In addition, semi-anadromy and partial diadromy are scale-dependent terms which have caused confusion among researchers and managers alike. For instance, some individual delta smelt clearly migrate between fresh and brackish water during their lives (Bush 2017). Other individuals could appear to have done so based on otolith microchemistry but in reality have moved very little and simply experienced annual salinity variation, which can be very high in much of the range of delta smelt (see Hammock et al. 2019). Other individual delta smelt are clearly freshwater and brackish-water resident throughout their lives (Bush 2017). As a result, there are both location-based (e.g., Sacramento River around Decker Island) and conditions-based (low-salinity zone) habitats that delta smelt permanently occupy. There are habitats that some delta smelt occupy seasonally (*e.g.*, for spawning), and there are habitats that a few delta smelt occupy transiently, which we define here as occasional use. Transient habitats include distribution extremes from which delta smelt have occasionally been collected, but were not historically collected every year or even in most years. Thus, the Service suggests the delta smelt may be best characterized as an upper estuary resident species with a population-scale distribution that expands and contracts as freshwater flow seasonally (and interannually) decreases and increases, respectively. This influence of freshwater flow inputs on delta smelt distribution could in turn influence mechanisms that affect the species' population dynamics when those mechanisms are linked to where the fish reside or how they are distributed in the estuary. We note that water temperature, turbidity, water diversion rates, prey availability, and possibly other factors would also affect these spatial recruitment and survival mechanisms.

Delta smelt have been observed as far west as San Francisco Bay near the City of Berkeley, as far north as Knight's Landing on the Sacramento River, as far east as Woodbridge on the Mokelumne River and Stockton on the Calaveras River, and as far south as Mossdale on the San Joaquin River (Merz *et al.* 2011; Figure 1). These extremes of the species' distribution extend beyond the geographic boundaries specified in the critical habitat rule. However, most delta smelt have been collected from locations within the critical habitat boundaries. In other words, observations of delta smelt outside of the critical habitat boundaries reflect transient habitat use rather than permanent or seasonal habitat use. The Napa River is the only location outside of the critical habitat boundaries that may be used often enough to be considered a seasonal habitat rather than a transient one.

The fixed-location habitats that delta smelt permanently occupy span from the Cache Slough complex down into Suisun Bay and Suisun Marsh (Figure 3). The reasons delta smelt are believed to permanently occupy this part of the estuary are the presence of fresh- to low-salinity water year-round that is comparatively turbid and of a tolerable water temperature. These appropriate water quality conditions overlap an underwater landscape featuring variation in depth, tidal current velocities, edge habitats, and food production (Nobriga *et al.* 2008; Feyrer *et al.* 2011; Murphy and Hamilton 2013; Sommer and Mejia 2013; Hammock *et al.* 2015; 2017; 2019; Bever *et al.* 2016; Mahardja *et al.* 2019; Simonis and Merz 2019). Field observations are increasingly being supported by laboratory research that explains how delta smelt respond physiologically and behaviorally to variation in water quality that can vary with changes in climate, freshwater flow and estuarine bathymetry (e.g., Hasenbein *et al.* 2013; 2016b; Komoroske *et al.* 2014; 2016).

The principal variable-location habitat that delta smelt permanently occupy is the low-salinity zone (LSZ) (Moyle *et al.* 1992; Bennett 2005). The LSZ is a dynamic habitat with size and location that respond to changes in tidal and river flows (Jassby *et al.* 1995; Kimmerer *et al.* 2013; MacWilliams *et al.* 2015; 2016; Bever *et al.* 2016). The LSZ generally expands and moves downstream as river flows into the estuary increase, placing low-salinity water over a larger and more diverse set of nominal habitat types than occurs under lower flow conditions. As river flows decrease, the LSZ contracts and moves upstream. This is perhaps the most frequently assumed freshwater flow mechanism in discussions about X2 regulations, but as shown by Kimmerer *et al.* (2009; 2013), it does not appear to be a major explanatory mechanism for most fishes including the delta smelt.

The LSZ often encompasses many of the permanently occupied fixed locations discussed above. It is treated separately here because delta smelt distribution tracks the movement of the LSZ somewhat (Moyle *et al.* 1992; Dege and Brown 2004; Feyrer *et al.* 2007; 2011; Nobriga *et al.* 2008; Sommer *et al.* 2011; Bever *et al.* 2016; Manly *et al.* 2015; Polansky *et al.* 2018; Simonis and Merz 2019). Due to its historical importance as a fish nursery habitat, there is a long research history into the physics and biology of the LSZ. The LSZ is frequently defined as waters with a salinity range of about 0.5 to 6 ppt (Kimmerer 2004). This and similar salinity ranges reported by different authors were chosen based on analyses of historical peaks in chlorophyll concentration and zooplankton abundance. Most delta smelt collected in California Department of Fish and Wildlife's (CDFW) 20-mm Survey and Summer Townet Survey (TNS) have been collected at salinities of near 0 ppt to 2 ppt and most of the (older) delta smelt in the Fall Midwater Trawl (FMWT) have been collected from a salinity range of about 1 to 5 ppt (Kimmerer *et al.* 2013). These fish of different life stages do not tend to be in dramatically different places (Murphy and Hamilton 2013; Figure 3), suggesting that some of the change in occupied salinity with age is due to the seasonal increases in salinity that accompany lower outflow in the summer and fall.

Each year, the distribution of delta smelt seasonally expands when adults disperse in response to winter flow increases that also coincide with seasonal increases in turbidity and decreases in water temperature (Sommer *et al.* 2011; Figure 3). The annual range expansion of adult delta smelt extends up the Sacramento River to about Garcia Bend in the Pocket neighborhood of Sacramento, up the San Joaquin River from Antioch to areas near Stockton, up the lower Mokelumne River system, and west throughout Suisun Bay and the larger sloughs of Suisun Marsh. Some delta smelt seasonally and transiently occupy Old and Middle rivers in the south Delta each year, but face a high risk of entrainment when they do (Kimmerer 2008; Grimaldo *et al.* 2009). The expanded adult distribution initially affects the distribution of the next generation because delta smelt eggs are adhesive and not believed to be highly mobile once they are spawned (Mager *et al.* 2004). Thus, the distribution of larvae reflects a combination of where spawning occurred and freshwater flow when the eggs hatch.

In summary, the delta smelt population spreads out in the winter and then retracts by summer into what is presently a bi-modal spatial distribution with a peak in the LSZ and a separate peak in the Cache Slough complex. Most individuals occur in the LSZ at some point in their life cycle and the use of the Cache Slough complex diminishes in years with warm summers (Bush 2017).

Microhabitat Use: The delta smelt has been historically characterized as a pelagic fish, meaning one with a spatial distribution that is skewed away from shorelines (Moyle *et al.* 1992; Sommer *et al.* 2007). This has led to some confusion among researchers and managers alike – usually perpetuating a strawman argument that delta smelt either occupy deep-water habitats or shallow-water habitats. Then, catch data from shallow habitats get used to refute the pelagic characterization, but catches in shallow-water say nothing more about a pelagic tendency than catches in deep water would say about a nearshore habitat tendency. The long-term monitoring programs used to characterize delta smelt status and trend are offshore sampling programs – meaning pelagic sampling programs, and surface-trawling appears to be particularly effective at capturing delta smelt away from shorelines (Mitchell *et al.* 2017). However, numerous studies have reported collecting delta smelt from nearshore environments using fishing gear like beach seines and fyke nets from locations that often had a water depth less than or equal to 1 meter (just over three feet) (e.g., Matern *et al.* 2002; Nobriga *et al.* 2005; Gewant and Bollens 2012; Mahardja *et al.* 2017b). Further, it has been established that onshore-offshore movements are one behavior option delta smelt and other fishes can use to maintain position or move upstream in a tidal-flow influenced estuary (Bennett *et al.* 2002; Feyrer *et al.* 2013; Bennett and Burau 2015). Captive delta smelt have been shown to avoid in-water structure like submerged aquatic vegetation (SAV) (Ferrari *et al.* 2014). SAV tends to grow where tidal current velocities are low, which is a habitat attribute that has also been associated with wild delta smelt (Hobbs *et al.* 2006; Bever *et al.* 2016). Thus, the proliferation of SAV in areas that might otherwise be attractive to delta smelt represents a significant habitat degradation, not only because it creates structure in the water column, but also because it is associated with higher water transparency (Hestir *et al.* 2016), and a fish fauna that delta smelt does not seem to be able to coexist with (Nobriga *et al.* 2005; Conrad *et al.* 2016). Based on our review, the Service suggests that the characterization of delta smelt as an open-water fish appears to be accurate and does not imply occupation of a particular water column depth. The species does appear to have some affinity for surface waters (Bennett and Burau 2015; Mitchell *et al.* 2017), but like any microhabitat descriptor, this is not intended to reflect the location of all individuals because delta smelt are not limited to surface waters (Feyrer *et al.* 2013).

Although the delta smelt is generally an open-water fish, depth variation of open-water habitats is an important habitat attribute (Moyle *et al.* 1992; Hobbs *et al.* 2006; Bever *et al.* 2016). In the wild, delta smelt are most frequently collected in water that is somewhat shallow (4-15 ft deep) where turbidity is often elevated and tidal currents exist, but are not excessive (Moyle *et al.* 1992; Bever *et al.* 2016). For instance, in Suisun Bay, the deep shipping channels are poor quality habitat because tidal velocity is very high (Hobbs *et al*. 2006; Bever *et al.* 2016), but in the Delta where tidal velocity is slower, offshore habitat in Cache Slough and the Sacramento Deepwater Shipping Channel is used to a greater extent (Feyrer *et al.* 2013; CDFW unpublished data).

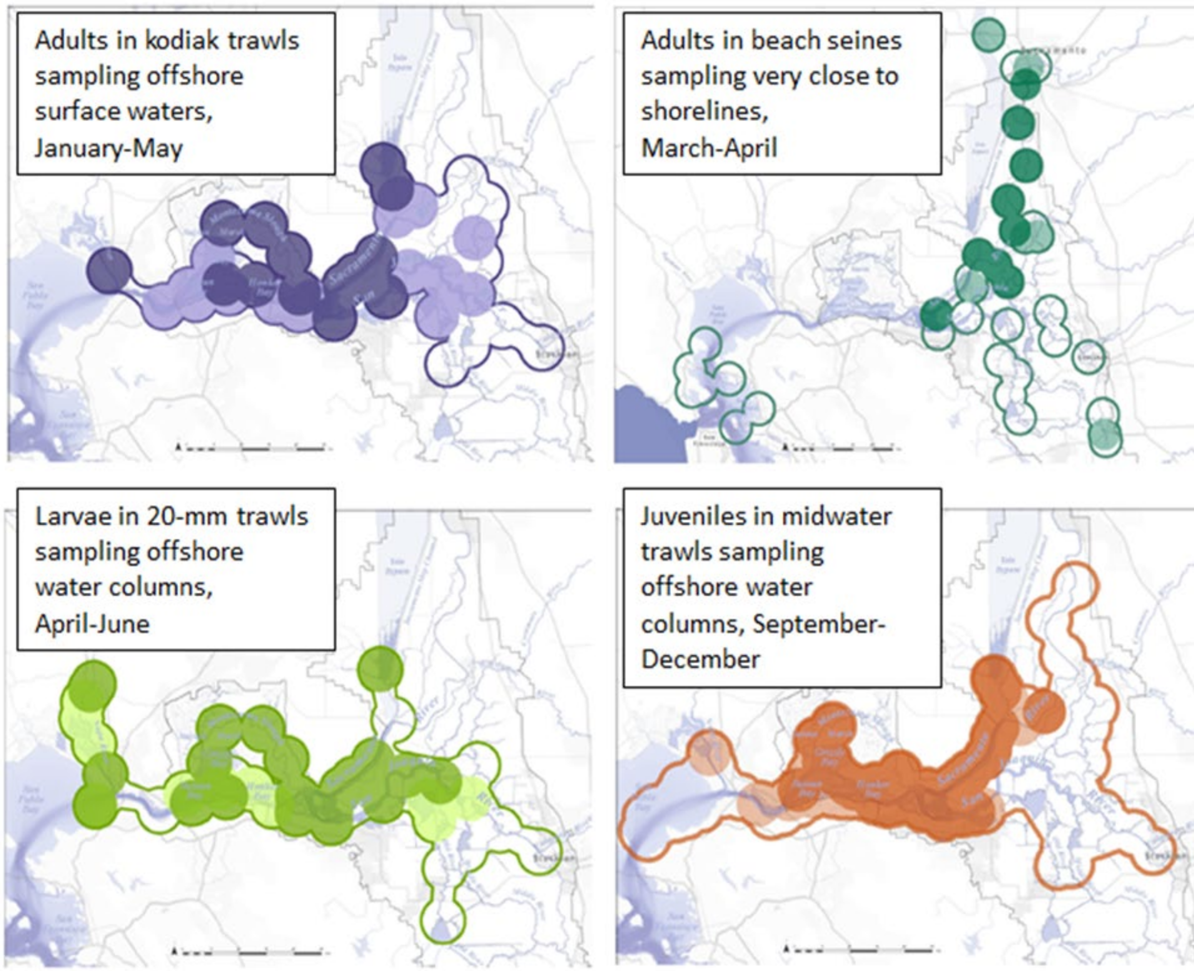

Figure 3. Maps of multi-year average distributions of delta smelt collected in four monitoring programs. The sampling regions covered by each survey are outlined. The areas with dark shading surround sampling stations in which 90 percent of the delta smelt collections occurred, the areas with light shading surround sampling stations in which the next 9 percent of delta smelt collections occurred. Note the lack of sampling sites in Suisun Bay and marsh for the beach seine (upper right panel). Source: Murphy and Hamilton (2013).

<u>Environmental Setting and History of Ecological Change in the Bay-Delta</u>
This section briefly reviews environmental changes that have occurred since 1850; i.e., the California Gold Rush to the present. This section is subdivided into three parts. The first describes the condition that is believed to have existed in 1850. The second covers a period from about 1920 to 1967, which is the year prior to the initiation of State Water Project (SWP) water exports from the Delta. The third sub-section covers 1968, the first year of Central Valley Project (CVP) and SWP dual operations, to the present.

Over the past few years, the scientific information developed to understand pre- and post-water project changes to the estuary's landscape and flow regime has grown substantially. However, as with most scientific endeavors, there are some discrepancies that may affect some conclusions. For instance, Whipple *et al.* (2012) showed the difference between contemporary estimates of unimpaired Delta outflow that were used in the modeling studies reviewed below and measured data from the latter 19th century. These discrepancies can affect the conclusions about the natural hydrograph of the Bay-Delta ecosystem and should be kept in mind when reviewing what follows. The information on ecosystem changes that have accrued through time provides context for the current status of the delta smelt.

The 1850 Bay-Delta estuary: The historical Delta ecosystem was a large tidal marsh at the confluence of two floodplain river systems (Whipple *et al.* 2012; Andrews *et al.* 2017; Gross *et al.* 2018; Figure 4). The Delta itself experienced flooding over spring-neap tidal time scales and seasonal river runoff time scales. This variability in freshwater input to the estuary was likely important to seasonal and interannual variability in the productivity of the ecosystem for the same reasons that smaller-scale tidal marsh plain and floodplain inundation are today. Specifically, these flood cycles deliver organic carbon, but also increase the production of lower trophic levels due to lengthened water residence times and greater shallow, wetted surface areas (Sommer *et al*. 2004; Grosholz and Gallo 2006; Howe and Simenstad 2011; Enright *et al*. 2013). When freshwater flows out of the Delta and into the estuary, it can generate currents that aggregate particulate matter like sediment and phytoplankton (Monismith *et al*. 1996; 2002; MacWilliams *et al*. 2015) – and presumably also did so in the pre-development ecosystem. Prior to the invasion of the overbite clam, these sediment and phytoplankton aggregations, which occurred near the 2 ppt isohaline, demarcated an important fish nursery region (Turner and Chadwick 1972; Jassby *et al*. 1995; Bennett *et al*. 2002).

The estuary's natural hydrograph reached its annual base flows (annual minimum inputs of fresh water) in August or September toward the end of California's dry summers (Figure 5). Freshwater inputs would generally increase during the fall as precipitation in the watershed resumed. Delta outflow reached a broad winter through spring peak fueled first by precipitation followed by additional contributions from melting snow. The annual peak of Delta outflow often spanned January through May before declining back to base flow conditions by the late summer. The year-to-year variation in Delta outflow was considerable, often varying by about an order of magnitude during each month of the year. Water flowing from the Delta mixed into larger open-water habitats in Suisun and San Pablo bays, which themselves were fringed with marshes and tidal creeks. This pre-development ecosystem was shallower than the modern system. As a result, salinity responded more rapidly to changes in freshwater flow than it does now and less freshwater flow was needed to move salinity isohalines than is presently the case (Andrews *et al.* 2017; Gross *et al.* 2018). Like most native fish, the delta smelt evolved its life history to take advantage of this flow regime (Moyle 2002). In particular, its spawning period and early life stages overlap the months in which historical marsh-floodplain inundation and freshwater inputs to the estuary were highest, and water temperatures were cool, but not as cold as they are in the winter before spawning commences (see above for details of what is known about spawning and early life stages of delta smelt).

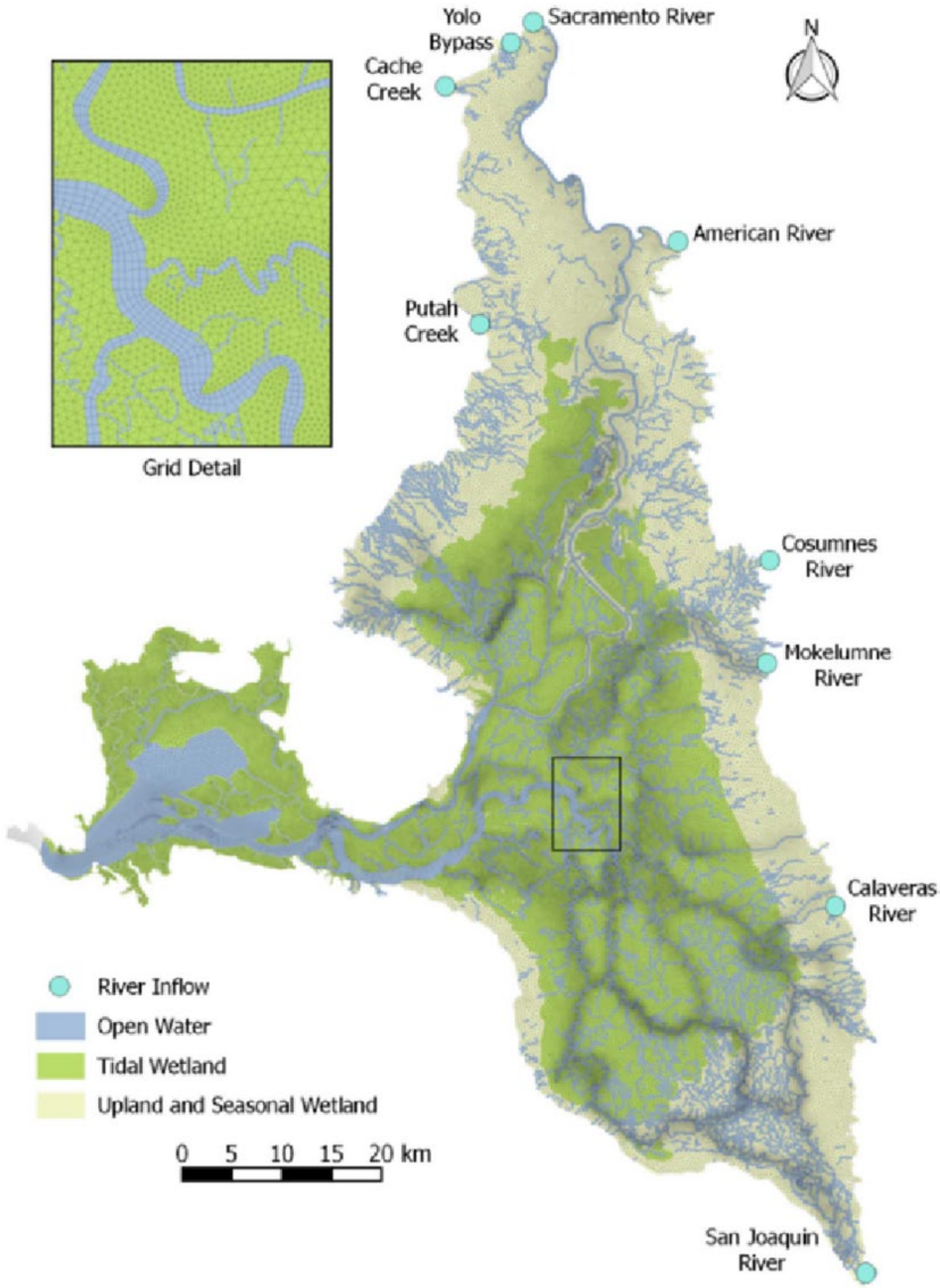

Figure 4. The circa 1850 Delta as depicted in the version of the UnTRIM 3-D hydrodynamic model described by Andrews *et al.* (2017). The model depicts an expansive tidal marsh area of approximately 2,200 square kilometers (km) or 850 square miles. Source: Andrews *et al.* (2017).

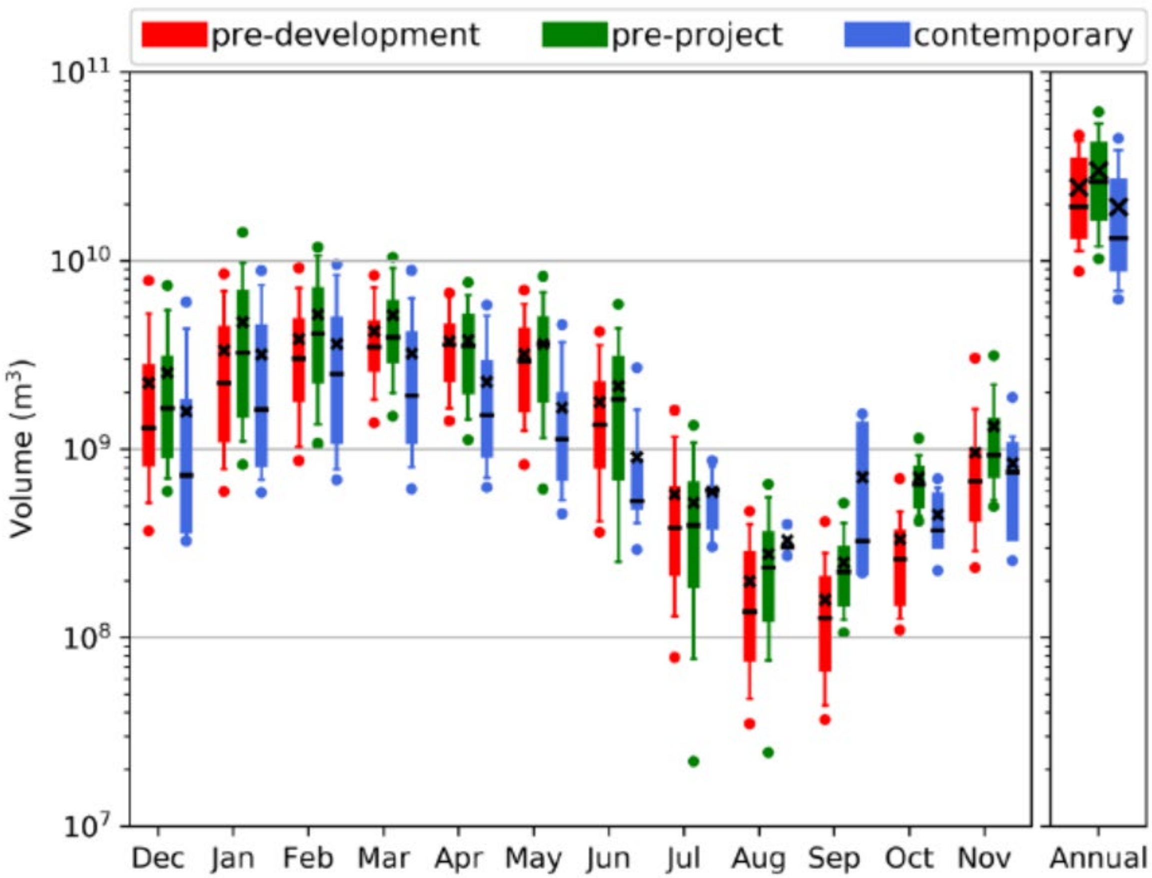

Figure 5. Boxplots of estimated Delta outflow by month for a pre-development Bay-Delta (circa 1850; red boxes), a pre-CVP and SWP Bay-Delta (circa 1920; green boxes), and a contemporary Bay-Delta (blue boxes; precise year not stated by the authors). Source: Gross *et al.* (2018). The inset labeled "Annual" on the x-axis is the boxplot summary of the sum of monthly outflows. Gross *et al.* (2018) attributed the higher outflow in the pre-project era relative to the pre-development era to the levees that had been constructed in the system by 1920.

Many tidal river estuaries form frontal zones where inflowing fresh water begins mixing with seawater (Peterson 2003). In the Bay-Delta, a frontal zone of biological importance is the LSZ (Jassby *et al.* 1995). The LSZ is a mobile and variable habitat region that frequently overlaps the parts of the estuary where many delta smelt reside (as described above). In the Bay-Delta the location and associated function of the LSZ have historically been indexed using a statistic called X2, which is the geographic location of 2 ppt salinity near the bottom of the water column measured as a distance from the Golden Gate Bridge (Jassby *et al.* 1995; MacWilliams *et al.* 2015; Figure 6). When Delta outflow is high, saline water is pushed closer to the Golden Gate, resulting in a smaller distance from the Golden Gate Bridge to X2. Conversely, when Delta outflow is low, salinity intrudes further into the estuary resulting in a larger distance from the Golden Gate Bridge to X2. These changes in how salinity is distributed affect numerous physical and biological processes in the estuary (Jassby *et al.* 1995; Kimmerer 2002a,b; Kimmerer 2004; MacWilliams *et al.* 2015).

X2, rather than another salinity isohaline, was chosen as the low-salinity zone habitat metric because it is a frontal zone or boundary upstream of which, salinity tends to be the same from the surface of the water to the bottom, and downstream of which, salinity varies from top to bottom (Jassby *et al.* 1995). That variability in the vertical distribution of salinity is indicative of currents that help to aggregate sinking particles like sediment and phytoplankton, and as recently modeled, zooplankton (Kimmerer *et al.* 2014a), near X2.

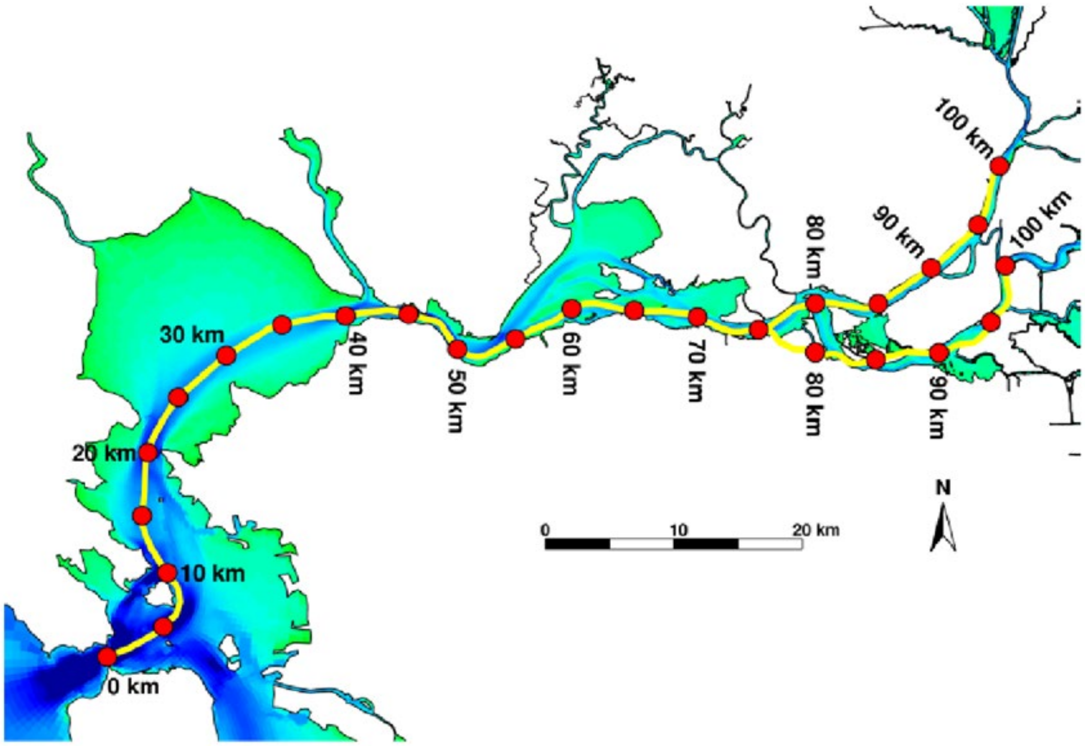

Figure 6. The northern reach of the Bay-Delta as depicted in the UnTRIM 3-D contemporary Bay-Delta model; greener colors represent shallower water and bluer colors represent deeper areas. The yellow lines depict the transect along which the location of X2 is estimated in the model and the associated red circles depict selected km distances from the Golden Gate Bridge along the northern axis of the estuary into the Sacramento and San Joaquin rivers for use in interpreting the variable locations of X2. Source: MacWilliams *et al.* (2015).

Pre-development outflows from the Delta were higher in the winter and spring than they are now while summer and fall outflows may have been lower (Andrews *et al.* 2017; Gross *et al.* 2018; Figure 5). Thus, X2 also varied more within years in the circa 1850 estuary than it now does. In the pre-development estuary, X2 would remain in San Pablo Bay for months at a time in the winter-spring of Above Normal and wetter water year types before retreating landward (upstream) in the summer-fall. In the contemporary estuary, X2 spends nearly all of its wet season time in Suisun Bay (landward or 'upstream' of historical) and dry season time between Collinsville and Rio Vista (~ 80 to 95 km; Figure 6). These contemporary dry season locations of X2 may be seaward or 'downstream' of historical locations (Gross *et al.* 2018).

There are no data on the timing and magnitude of biological productivity in the circa 1850 Bay-Delta, nor are we aware of any information on how delta smelt used the estuary at the time.

However, inferences can be made based on general ecosystem function in the northern hemisphere temperate zone and contemporary information. The input of basal food web materials like nutrients and detritus likely co-varied with the timing, duration, and magnitude of freshwater flows (e.g., Delta inflow; Jassby and Cloern 2000), which would likewise have affected the timing, magnitude, and duration of inundation of the system's expansive floodplains (e.g., Whipple *et al.* 2012; Figure 4). The production of planktonic and epibenthic invertebrates from floodplains, tidal wetlands, and open-water habitats that fuel the production of juvenile fishes that feed in open waters may have generally increased during the spring and peaked during the summer in concert with seasonal variation in water temperature (e.g., Heubach 1969; Orsi and Mecum 1986; Merz *et al.* 2016). The summer months are the warmest months in the Bay-Delta region and thus, they support the highest *average* metabolic rates of invertebrates and fish, which rely on water temperature to control their body temperature and metabolic rates. However, there was likely to have been considerable species-specificity to this generalization (e.g., Ambler *et al.* 1985; Gewant and Bollens 2005) because the Bay-Delta's native biotic community includes numerous cold-water adapted species.

The seasonal timing of delta smelt reproduction (February-May; detailed below) would have more broadly coincided with the general timing of peak freshwater flow into the Bay-Delta (Figure 5). The higher outflow and shallower average depth of the system resulted in frequent occurrence of the LSZ in San Pablo Bay during the wet season. Thus, it is likely that delta smelt reared in San Pablo Bay, taking advantage of its greatly expanded low-salinity habitat area (see MacWilliams *et al*. 2015), to much greater extent prior to development of the system than they are able to now. Lower flows in the summer-fall likely caused delta smelt distribution to seasonally retract back into Suisun Bay/marsh and the Delta; ecosystems which were likely much more productive at the time due to the expansive tidal marshes and greater connection between land and water (Whipple *et al*. 2012). Delta smelt's population-level demand for prey annually peaks at some combination of water temperature and growth of the population's biomass. This timing could be estimated from the model developed by Rose *et al.* (2013a), but we are not aware that such a calculation exists.

1920-1967: By 1920, most of the Delta's tidal wetlands had been reclaimed (Whipple *et al.* 2012; Figure 7). The data provided by Gross *et al.* (2018; Figure 4) suggest that Delta outflow may have been a little higher circa 1920 than it had been circa 1850 due to levee construction. However, this may (Hutton and Roy 2019) or may not be consistent with historical observations (Whipple *et al.* 2012). Regardless, Delta outflow and several other net flow metrics from within the Delta did begin to decline between the early 1920s and 1967 (Hutton *et al.* 2017a; 2019). These changes occurred because of four factors: (1) water storage in the Bay-Delta watershed increased from about 4 million acre feet (MAF) to about 40 MAF because of the construction of dams upstream of the Delta, (2) the CVP began exporting water from the Delta in 1951, (3) non-project water diversions within and upstream of the Delta increased, and (4) shipping channels were dredged through the estuary and into the Sacramento and San Joaquin rivers. These changes facilitated a general water management strategy in California to store water during the wet season and re-distribute it during the dry season to provide a more reliable supply than was available naturally. In addition, the CVP and SWP have had to offset a considerable summertime water deficit to protect the quality of their exported water and to protect water quality for senior water rights holders in the Delta. These uses would be highly impaired without water released from CVP and SWP reservoirs during the summer and fall (Hutton *et al.* 2017b).

During the 1930s to 1960s, the navigation channels were dredged deeper (~12 meters) to accommodate shipping traffic from the Pacific Ocean and San Francisco Bay to ports in Sacramento and Stockton and to increase the capacity of the Delta to convey floodwaters. Channel deepening interacted with the simultaneously increasing water storage to change the Bay-Delta ecosystem into one in which Suisun Bay and the Sacramento-San Joaquin River confluence region became the largest and most depth-varying places in the typical range of the LSZ. Even with these changes, the LSZ remained a highly productive fish nursery habitat for many decades (Stevens and Miller 1983; Moyle *et al.* 1992; Jassby *et al.* 1995).

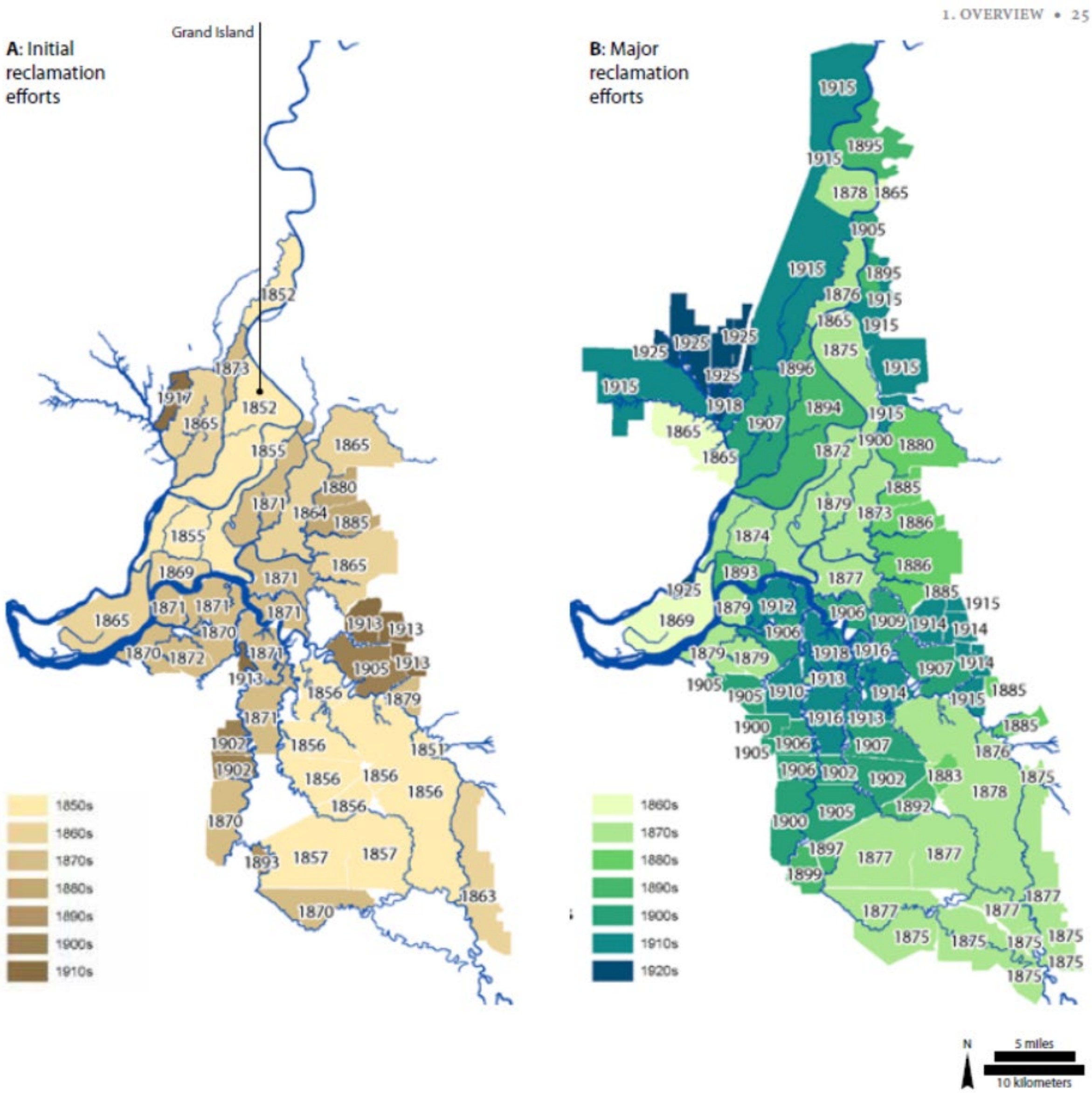

Figure 7. Maps of the Delta showing years of initial land reclamation attempts on the left and major land reclamation efforts on the right. Note that a large majority of the major reclamation efforts were underway by 1915 and the last efforts in the vicinity of Liberty Island began in 1925. Source: Whipple *et al.* (2012).

1968-present: The SWP began exporting water from the Delta in 1968 and its exports generally increased until about 1989 (Figure 8). CVP exports reached present-day levels by the end of the 1970s. During the 1980s water storage capacity in the Bay-Delta watershed reached its present-day level of a little over 50 MAF (Cloern and Jassby 2012; Hutton *et al.* 2017a). Thereafter, combined CVP-SWP exports began to increase in year-to-year variability, which increased the uncertainty about how much water would be supplied south of the Delta annually. This has combined with the increasing human demand for fresh water to result in a conflict between human water demand and environmental water uses, including the maintenance of the hydraulic salinity barrier needed to protect exported water and other in-Delta water users from salinity intrusion (Hutton *et al.* 2017b; Reis *et al.* 2019).

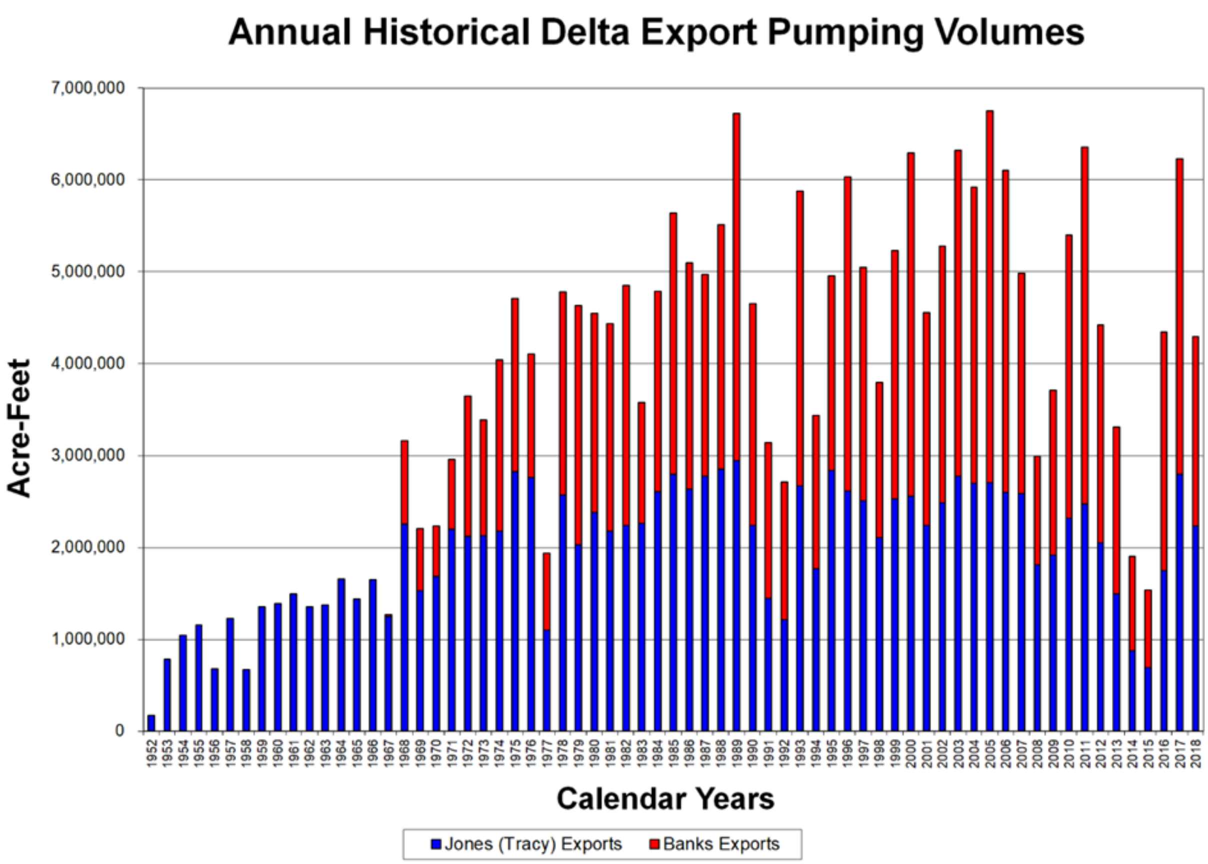

Figure 8. Time series of Central Valley Project and State Water Project exports from the Delta for 1952 through 2018. State Water Project exports began in water year 1968. Source: DAYFLOW data base.

The changes discussed above have continued to lower Delta outflow (Hutton *et al.* 2017a,b; Reis *et al.* 2019; Figures 9 and 10), though D-1641 appears to have halted the trend for years in which the eight river index is lower than 20 MAF (middle panel of Figure 9). In Figure 9, exports were modeled as depletions of water from the system, so the more negative the number on the y-axis of the middle panel, the higher the exports. Thus, the graphic shows that in years when the eight river index is more than 20 MAF, exports continue to increase, but in years when the eight river index is lower than 20 MAF, exports have been trending lower. Both of these trends cause the higher year-to-year variability in water exports shown in Figure 8.

In general, major changes to the flow regime of an aquatic ecosystem are expected to be accompanied by ecological change (Benson 1981; Bunn and Arthington 2002; Poff and Zimmerman 2010; Gillson 2011), and that is what has been observed over time in the Bay and Delta (e.g., Matern *et al.* 2002; Moyle and Bennett 2008; Winder *et al.* 2011; Feyrer *et al.* 2015; Conrad *et al.* 2016). Delta outflow is a driver of many ecological mechanisms in the Bay-Delta and an indicator of several others (Kimmerer 2002a). Thus, the changes to the estuary's freshwater flow regime have likely interacted with the changes to the estuary's landscape, specifically its deeper channels and greatly reduced land-water connections (Andrews *et al.* 2017), to lower the total biological productivity of the estuary. In addition, changes to the freshwater flow regime detailed above appear to have affected the reproductive success of fishes that use the Delta and Suisun Bay as rearing habitats. The evidence for this is that the native fish assemblage had reproductive seasons timed to winter-spring peak flows, whereas currently dominant non-native species generally spawn later in the spring and into the summer when inflows to the Delta are generally high to support human water use, but outflow from the Delta is generally low (Moyle 2002; Moyle and Bennett 2008). Reis *et al.* (2019) recently described super-critical water years with respect to Delta outflow. Several studies have indicated that low flow years and droughts in particular result in low native fish production in the Bay-Delta (Meng *et al.* 1994; Jassby *et al.* 1995; Kimmerer 2002b; Feyrer *et al.* 2015). Droughts recur and may contribute to cumulative impacts to native fishes like delta smelt. For instance, recent droughts have been particularly problematic for delta smelt (Moyle *et al.* 2018). Thus, the frequency of these super-critical water years, which has been much higher since 1968 than it was from 1920-1967 (Figure 10), is a conservation challenge that the Service and its partners have to contend with.

There are several fish species in the Bay-Delta that have historically been shown to have demonstrable positive population responses to freshwater flows into or out of the Delta. These include the well-described relationships for the survival of emigrating Sacramento basin Chinook salmon (*Oncorhynchus tschawytscha)* smolts with Sacramento River inflows (Kjelson and Brandes 1989; Perry *et al.* 2010), the relationship of Sacramento splittail (*Pogonichthys macrolepidotus*) production to Yolo Bypass flow (Moyle *et al.* 2004; Feyrer *et al.* 2006), and the 'fish-X2' relationships for striped bass (*Morone saxatilis*), longfin smelt (*Spirinchus thaleichthys*), and starry flounder (*Platichthys stellatus*) (Turner and Chadwick 1972; Jassby *et al.* 1995; Kimmerer 2002b). The life-history of delta smelt with its affinity for fresh and low-salinity waters seems consistent with that of a fish one could expect to respond similarly to variation in Delta outflow or X2. Researchers searched for some form of analogous relationship for the delta smelt for several decades, but no persistent relationship was found (Stevens and Miller 1983; Moyle *et al.* 1992; Jassby *et al.* 1995; Kimmerer 2002b; Bennett 2005; Mac Nally *et al.* 2010; Thomson *et al.* 2010; Miller *et al.* 2012). Further, Rose *et al.* (2013a,b) did not find salinity variation *per se* to have much impact on predictions of delta smelt population growth rate. The larger predicted impact in their individual-based model related to flow was due to simulated entrainment in exported water (Rose *et al.* 2013b; Kimmerer and Rose 2018). Although entrainment was predicted to lower the population growth rate, in and of itself, it could not convert a strongly positive growing population into a declining one without at least one additional factor impacting survival at the same time.

The IEP (2015) reported a correlation between February-May X2 and ratios of the 20-mm Survey index for delta smelt and either the Spring Kodiak Trawl (SKT) or FMWT indices of the parental stock that produced the 20-mm fish. This relationship emerged in data beginning at the time of the pelagic organism decline (POD) in 2002. This relationship is stronger when considered in terms of salinity at Chipps Island (He and Nobriga 2018), possibly because salinity can be measured more accurately than Delta outflow when net freshwater flow is very low (Monismith 2016). Castillo *et al.* (2018) used a simulation based on SKT data to suggest a link between Delta outflow and adult delta smelt abundance. In addition, several teams have reported statistical associations of delta smelt spatial distribution and salinity that imply the population spatial distribution co-varies with Delta outflow, X2, or similar indices of freshwater input to the estuary (Feyrer *et al.* 2007; 2011; Nobriga *et al.* 2008; Kimmerer *et al.* 2009; 2013; Bever *et al.* 2016; Polanksy *et al.* 2018; Simonis and Merz 2019). The strength of this covariation and its management utility have been contested (e.g., Murphy and Hamilton 2013; Manly *et al.* 2015; Latour 2016; Polanksy *et al.* 2018) and supported (Sommer *et al.* 2011; Bever *et al.* 2016; Feyrer *et al.* 2016; Mahardja *et al.* 2017a) in several recently published papers.

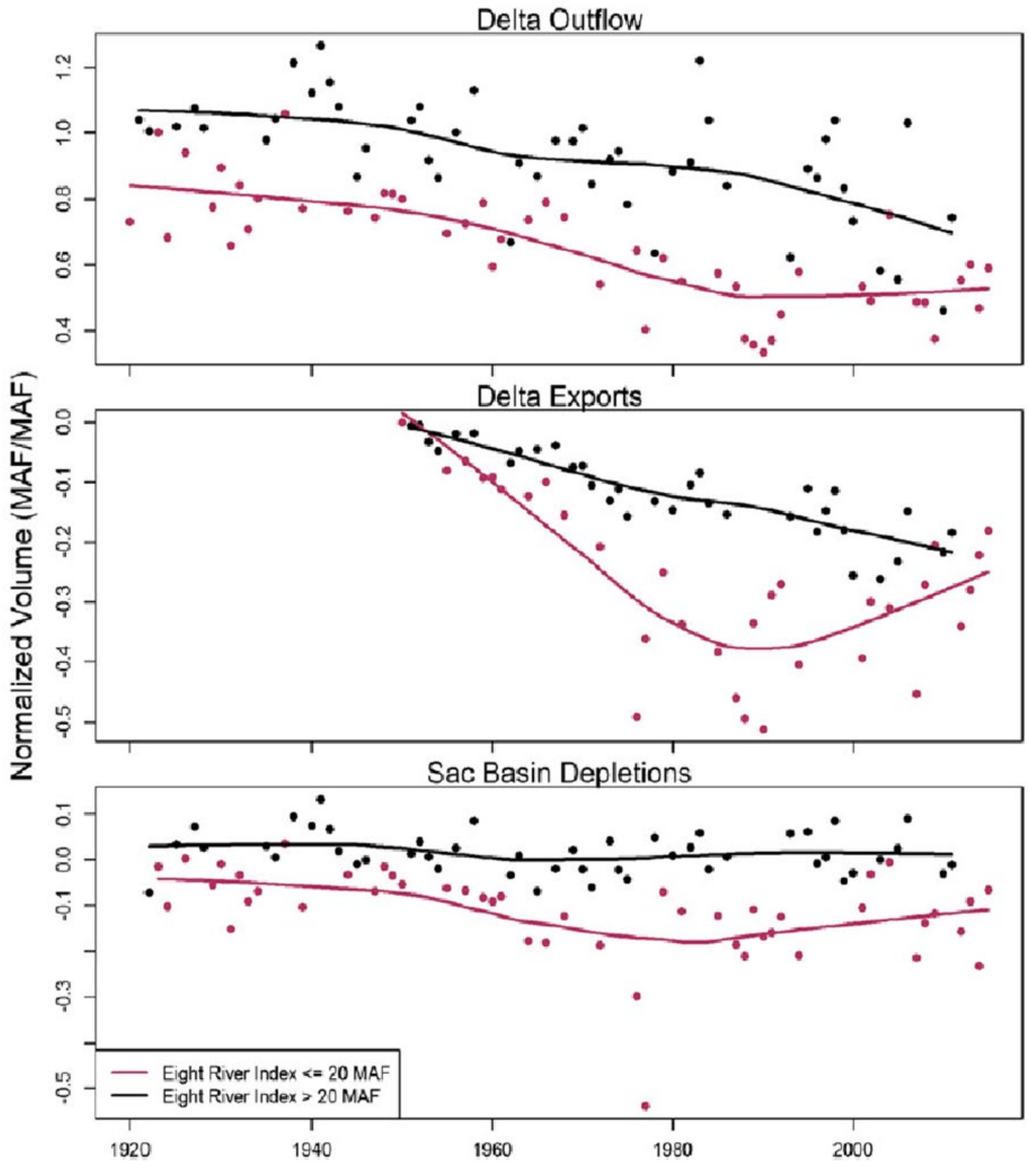

Figure 9. Time series (1922-2015) of statistical trend outputs of annual Delta outflow (top panel), Delta exports treated as depletions so increasing exports are represented by more negative values (middle panel), and water diversions from the Sacramento River basin upstream of the Delta (bottom panel). Black symbols and lines are for years in which the eight river index, a measure of water availability in the Bay-Delta watershed, was greater than 20 MAF. Red symbols and lines are for years in which the eight river index was less than or equal to 20 MAF. Source: Hutton *et al.* (2017b).

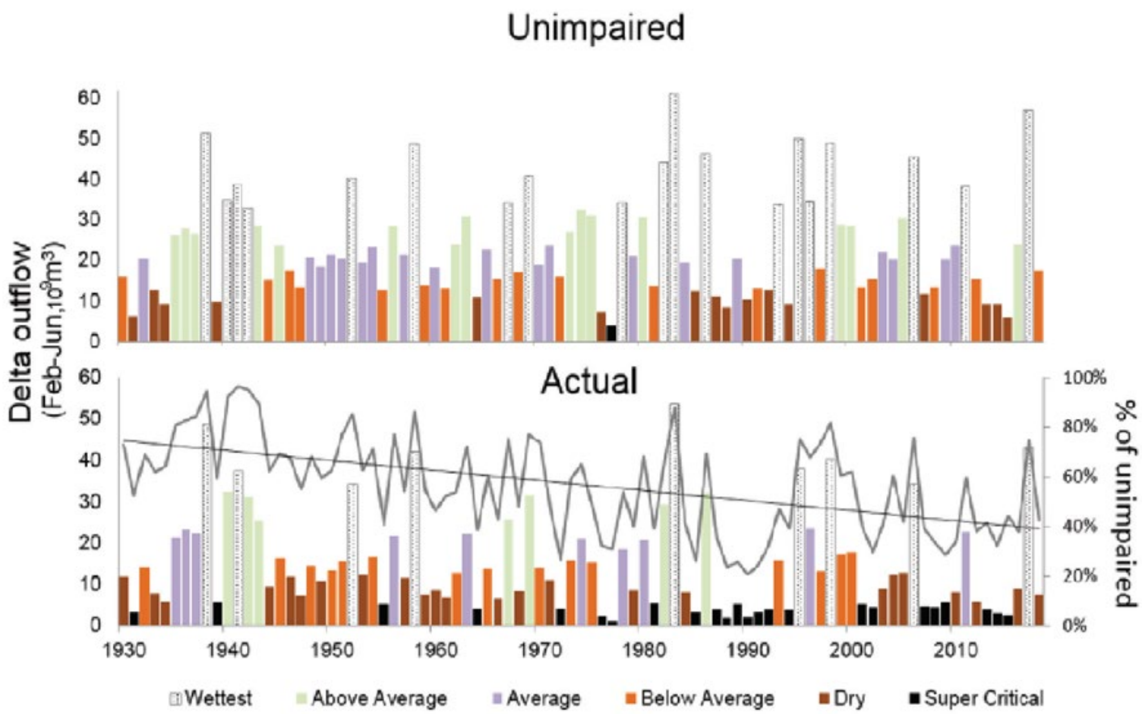

Figure 10. Time series of estimates of unimpaired (upper panel) and actual (lower panel) Delta outflow (February-June) color-coded according to six water year types, 1930-2018. The water year types based on basin precipitation are shown in the upper panel. In the lower panel, the water year types were re-assessed based on their fraction of the estimated unimpaired outflow. The long-term trend in this fraction as "% of unimpaired" is shown on the second y-axis of the bottom panel. Source: Reis *et al.* (2019).

<u>Delta Smelt Population Trend</u>

The CDFW's TNS (http://www.dfg.ca.gov/delta/data/townet/indices.asp?species=3) and FMWT Survey (http://www.dfg.ca.gov/delta/data/fmwt/indices.asp) are the two longest running indicators of the delta smelt's abundance trend. Indices of delta smelt relative abundance from these surveys date to 1959 and 1967, respectively (Figures 11 and 12). The FMWT index has traditionally been the primary indicator of delta smelt trend because it samples later in the life cycle, providing a better indicator of annual recruitment than the TNS (Service 1996). It has also sampled more consistently and more intensively than the TNS. The FMWT deploys more than 400 net tows per year over its four-month sampling season (September through December). The highest FMWT index for delta smelt (1,673) was recorded in 1970 and a comparably high index (1,654) was reported in 1980 (Figure 12). The last FMWT index exceeding 1,000 was reported in 1993. The last FMWT indices exceeding 100 were reported in 2003 and 2011. In 2018, the FMWT index was zero for the first time. The TNS index for delta smelt has been zero four times since 2015. Thus, the TNS and FMWT have recorded a 40-50 year decline in which delta smelt went from a minor (but common) species to essentially undetectable by these long-term surveys (Figures 11 and 12).

Following the listing of the delta smelt, the CDFW launched a 20-mm Survey (1995) and a SKT Survey (SKT; 2002) to monitor the distribution and relative abundance of late larval stage and adult delta smelt, respectively. These newer indices have generally corroborated the trends implied by the TNS and the FMWT (Figures 11 and 12). The CDFW methods generate abundance indices from each survey but each index is on a different numeric scale. This means the index number generated by a given survey only has quantitative meaning relative to other indices generated by the same survey. Further, the CDFW indices lack estimates of uncertainty (variability) which limits interpretation of abundance changes from year to year even within each sampling program. The Service recently completed a new delta smelt abundance indexing procedure using data from all four of these surveys (Polansky *et al.* 2019). The Service method improves upon the CDFW method because it generates abundance indices in units of numbers of fish, including attempts to correct for different sampling efficiencies among surveys, and the method includes measures of uncertainty. Service indices of spawner abundance based on combined January and February SKT sampling are listed with their confidence intervals in Table 9. The estimates show the most recent 19 years of the delta smelt's longer-term decline in numbers of fish as best as they can be approximated with currently available information. The 2020 abundance estimate of 5,213 is the lowest on record, though the upper confidence limit for the 2020 estimate overlaps the lower confidence limits from 2016 and 2018. This indicates there is more than a five percent chance that the 2020 abundance index is not different from 2016 and 2018. Regardless of this recent year uncertainty, the 2020 abundance index is much lower than peak abundance estimates in Table 9 which themselves are all based on data streams that started after the species had already declined considerably (Figures 11 and 12).

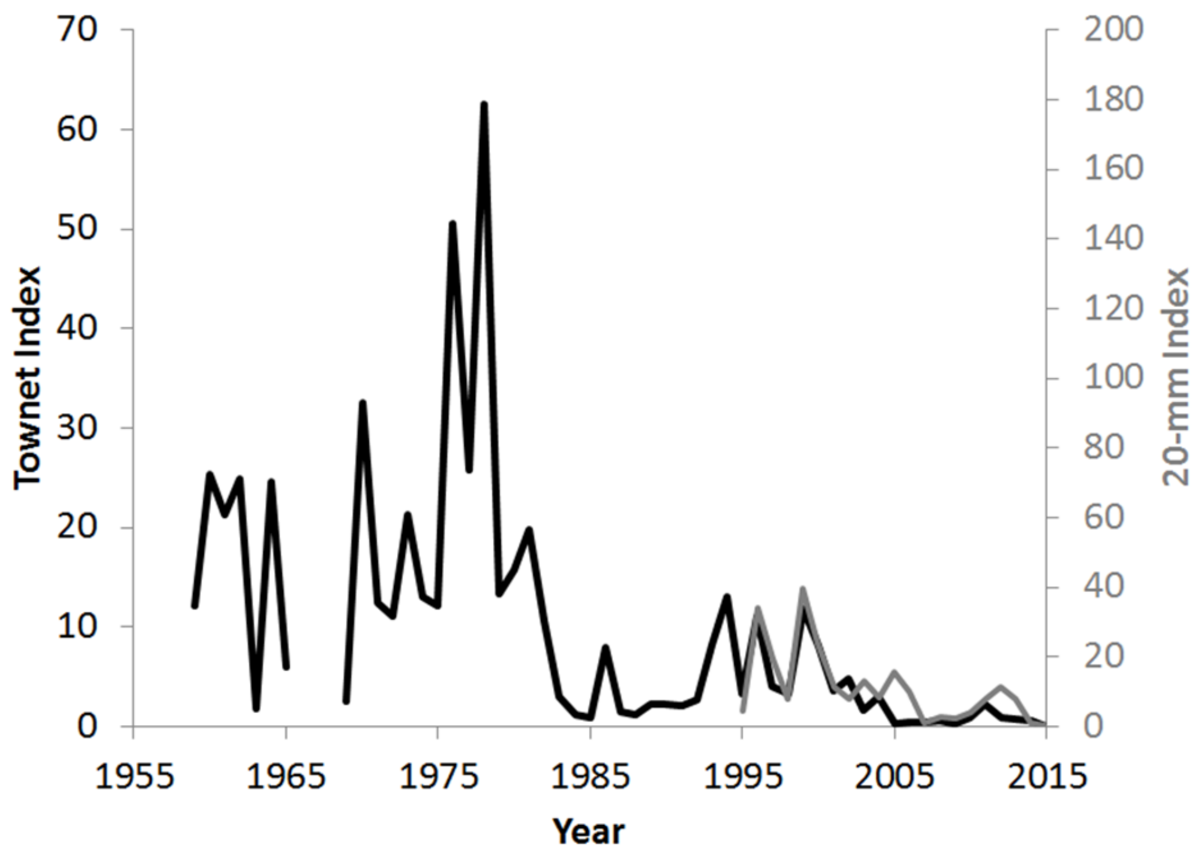

Figure 11. Time series of juvenile and larval delta smelt relative abundance as depicted by the California Department of Fish and Wildlife's TNS and 20-mm Survey, respectively. The TNS began in 1959 and the 20-mm Survey began in 1995. The second y-axis was scaled to better align the indices which are calculated on different numeric scales.

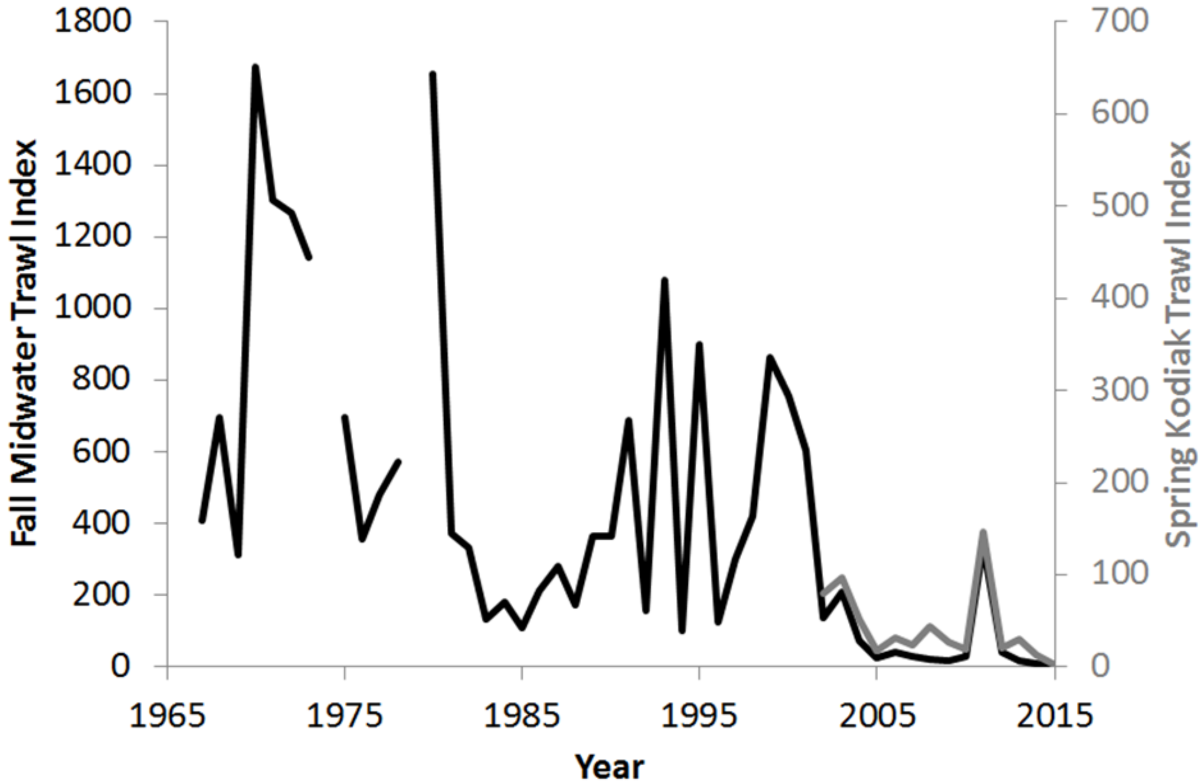

Figure 12. Time series of juvenile and larval delta smelt relative abundance as depicted by the California Department of Fish and Wildlife's FMWT and SKT Survey, respectively. The FMWT survey began in 1967 and the SKT trawl survey began in 2002. The second y-axis was scaled to better align the indices which are calculated on different numeric scales.

Table 9. Estimates of adult delta smelt population size during January-February of 2002 through 2020 with 95% confidence intervals.

			95% Confidence Interval			Number of Delta Smelt Caught in the SKT Survey		
Year	Abundance Estimate	Standard Error	Lower Bound	Upper Bound		January	February	Year-to-Year Ratio
2002	1,093,244	195,329	760,332	1,523,294		262	394	NA
2003	996,055	261,205	581,197	1,597,198		NA	232	0.91
2004	966,981	262,190	553,729	1,573,002		380	300	0.97
2005	715,858	147,190	470,572	1,044,828		220	218	0.74
2006	272,327	42,400	198,681	364,438		44	84	0.38
2007	449,466	128,731	249,216	749,168		109	107	1.65
2008	509,428	188,396	236,859	963,839		132	36	1.13
2009	1,166,145	523,856	459,083	2,464,804		579	61	2.29
2010	251,863	54,580	161,753	374,582		88	57	0.22
2011	461,599	202,547	185,712	962,088		177	128	1.83
2012	1,177,201	328,682	662,728	1,939,836		320	287	2.55
2013	333,682	89,809	191,886	541,064		100	125	0.28
2014	308,972	91,474	167,858	522,884		148	55	0.93
2015	213,345	76,639	101,434	397,439		21	68	0.69
2016	25,445	9,584	11,661	48,622		7	6	0.12
2017	73,331	23,342	38,010	128,459		18	8	2.88
2018	26,649	21,397	5,215	82,805		10	4	0.36
2019	5,610	4,395	1,138	17,135		1	1	0.21
2020	5,213	3,644	1,241	14,710		1	1	0.93

Climate Change

Climate projections for the San Francisco Bay-Delta and its watershed indicate that changes will be substantial by mid-century and considerable by the year 2100. Climate models broadly agree that average annual air temperatures will rise by about 2°C at mid-century and about 4°C by 2100 if current atmospheric carbon emissions accelerate as currently forecasted (Dettinger *et al.* 2016). It remains highly uncertain whether annual precipitation in the Bay-Delta watershed will trend wetter or drier (Dettinger 2005; Dettinger *et al.* 2016). The warmer air temperature projections suggest more precipitation will fall as rain rather than snow and that storms may increase in intensity, but will have more dry weather in between them (Knowles and Cayan 2002; Dettinger 2005; Dettinger *et al.* 2016). The expected consequences are less water stored in spring snowpacks, increased flooding and an associated decrease in runoff for the remainder of the year (Hayhoe *et al.* 2004). Changes in storm tracks may lead to increased frequency of flood and drought cycles during the 21st century (Dettinger *et al.* 2015).

As of 2009, sea level rise had not had much effect on X2 (Hutton *et al.* 2017b). However, additional sea level rise is another anticipated consequence of a warming global climate and if it is not mitigated, sea level rise will likely increase saltwater intrusion into the Bay-Delta (Rath *et al.* 2017). During the summer of 2015, variation in sea level interacted with very low Delta inflows to cause frequent recurrence of net negative Delta outflow (Monismith 2016).

Since the early 1980s, climate change is thought to have increased wind speed along the central California coast, resulting in a more frequent and longer lasting upwelling season (Garcia-Reyes and Largier 2010). Coastal upwelling causes colder deep water to rise to the ocean surface, bringing with it nutrients that stimulate the coastal food web. One effect of wind blowing over the estuary is that it resuspends sediment deposited in shallow areas like San Pablo Bay, Grizzly Bay, and Honker Bay (Ruhl *et al*. 2001). Thus, higher wind speeds blowing onto the coast might be expected to result in higher turbidity of the water in parts of the estuary. In contrast to this expectation, Bever *et al*. (2018) reported a recent reduction in wind speed over the Bay-Delta during 1995-2015, which these authors associated with lower turbidity in Suisun Bay. The Service notes these contrasting results for completeness but we cannot reconcile these opposing trends in wind speed at this time. We show below that Secchi disk depths (an indicator of water turbidity) have not increased since the mid-1980s near the (mobile) location of X2 even though suspended sediment concentrations in Suisun Bay have decreased since about 2000 (Schoellhamer 2011; Bever *et al*. 2018).

Central California's warm summers are already a source of energetic stress for delta smelt and warm springs can already severely compress the duration of their spawning season (Rose *et al.* 2013a,b). We expect warmer estuary temperatures to present a significant conservation challenge for delta smelt in the coming decades (Brown *et al.* 2013; 2016a; Figure 13). Feyrer *et al.* (2011) and Brown *et al.* (2013; 2016a) have evaluated the anticipated effects of projected climate change on several delta smelt habitat metrics. Collectively, these studies indicate the future will bring chronically compressed fall habitat, fewer 'good' turbidity days (defined by the authors as a mean turbidity greater than or equal to 18 Nephelometric Turbidity Units (NTU)), a spawning window of similar duration but that is shifted 2 to 3 weeks earlier in the year, and a substantial increase in the number of days delta smelt will need to endure lethal or near lethal summer water temperatures.

The delta smelt lives at the southern limit of the inland distribution of the family Osmeridae along the Pacific coast of North America. The anticipated effects of a warming climate are expected to create increasing temperature related challenges for delta smelt at some future point. The amount of anticipated change to the regional climate expected in the near term is lower than it is for the latter half of the century (Figure 13). Therefore, it is less certain that any measurable change from current conditions will occur in the next approximately 10 years than by 2050 or

2100. For the time being, water temperatures are stressful to delta smelt, but not of themselves lethal in most of the upper estuary (Komoroske *et al.* 2015).

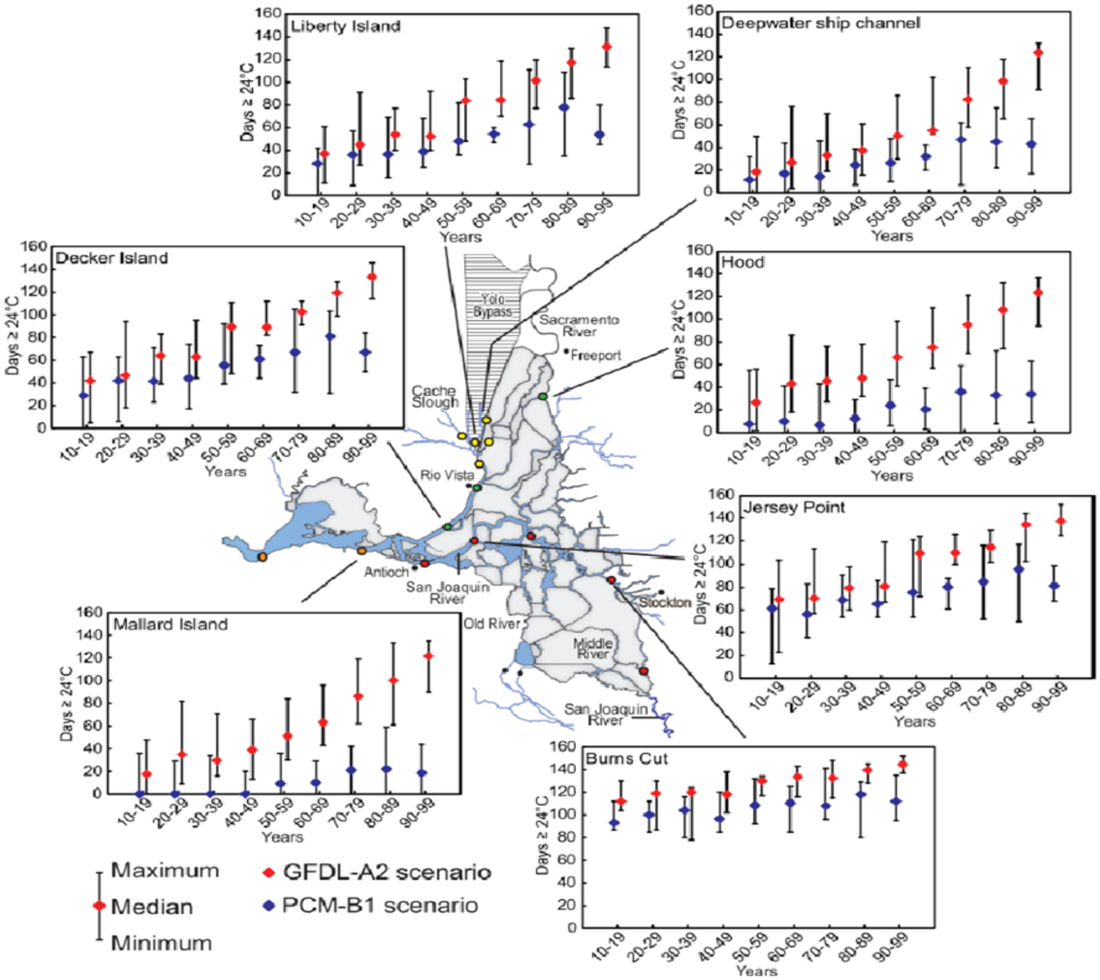

Figure 13. Plots of median, maximum, and minimum number of days each year with an estimated average daily water temperature greater than or equal to 24°C (75°F) at selected sites in the Delta by decade for the 21st century. The water temperature threshold reflects one chosen by the authors to represent near lethal conditions for delta smelt. Source: Brown *et al.* (2016a).

<u>Recovery and Management</u>

Following Moyle *et al.* (1992), the Service (1993) indicated that SWP and CVP exports were the primary factors contributing to the decline of delta smelt due to entrainment of larvae and juveniles and the effects of low flow on the location and function of the estuary mixing zone (now called the low-salinity zone). In addition, prolonged drought during 1987-1992, in-Delta water diversions, reduction in food supplies by nonindigenous aquatic species (specifically overbite clam and nonnative copepods), and toxicity due to agricultural and industrial chemicals were also factors considered to be threatening the delta smelt. In the Service's December 15, 2008 *Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP)* (2008 BO), the Reasonable and Prudent Alternative (RPA) required protection of all life stages from entrainment and augmentation of Delta outflow during the fall of Wet and Above-Normal years as classified by the State of California (Service 2008). The expansion of entrainment protection for delta smelt in the 2008 BO was in response to large increases in juvenile and adult salvage in the early 2000s (Kimmerer 2008; Brown *et al.* 2009). The fall X2 requirement in the 2008 RPA was in response to increased fall exports that had reduced variability in Delta outflow and lowered habitat suitability during the fall months and the 2008 proposed action was anticipated to reduce it further (Feyrer *et al.* 2011).

The Service's (2010c) recommendation to uplist delta smelt from threatened to endangered included a discussion of threats related to reservoir operations and water diversions upstream of the estuary as additional water operations mechanisms interacting with exports from the Delta to restrict the LSZ and concentrate delta smelt with competing and predatory fish species. In addition, Brazilian waterweed (*Egeria densa*) and increasing water transparency were considered new detrimental habitat changes. Predation was considered a low-level threat linked to increasing waterweed abundance and increasing water transparency. Additional threats considered potentially significant by the Service in 2010 were entrainment into power plant diversions, contaminants, and reproductive problems that can stem from small population sizes. Conservation recommendations included: establish Delta outflows proportionate to unimpaired flows to set outflow targets as fractions of runoff in the Central Valley watersheds; minimize reverse flows in Old and Middle rivers; and, establish a genetic management plan for captive-reared delta smelt with the goals of minimizing the loss of genetic diversity and limiting risk of extinction caused by unpredictable catastrophic events. The Service (2012) recently added climate change to the list of threats to the delta smelt.

Maintaining protection of the delta smelt from excessive entrainment, improving the estuary's flow regime, suppression of nonnative species, increasing zooplankton abundance, and improving water quality are among the actions the Service has previously indicated are needed to recover the delta smelt.

There have been several recent papers suggesting it is time to consider supplementation of the wild delta smelt population with captive-bred fish as part of a broad-based conservation strategy to avoid extinction in the wild, also known as extirpation (Moyle *et al.* 2016; 2018; Hobbs *et al.* 2017; Lessard *et al.* 2018). In 2019, pilot research conducted by the California Department of Water Resources (DWR) has demonstrated that captive-bred delta smelt held within steel enclosures can survive in the Delta for at least 30 days. This is long enough to show that the fish can feed themselves and did not die from acute water toxicity in either of two locations tested thus far. The fish will be evaluated for chronic toxic exposure, but that work is not finished. These results are promising and similar research is planned this year.

The status of the delta smelt is poor. The current estimated delta smelt population sizes are so low that it seems unlikely the species can be habitat- or food-limited even though both physical and food web-related habitat attributes have degraded over time. It is more likely that delta smelt have been marginalized by non-native fishes and invertebrates that compete with and prey on them. When fish populations reach very low levels, they can fall victim to demographic problems (often termed Allee effects in the scientific literature). These include problems concentrating enough individuals in particular locations for successful spawning, successful feeding, or maintaining large enough egg supplies, or shoals and schools of juvenile and adult fish to provide effective protection from predators (Liermann and Hilborn 2001; Keith and Hutchings 2012).

Summary of the Status of Delta Smelt - The relative abundance of delta smelt has reached very low numbers for a small forage fish in an ecosystem the size of the Bay-Delta and the species is approaching extinction in the wild (Moyle *et al.* 2016; 2018; Hobbs *et al.* 2017). The extremely low 2018-2020 abundance indices reflect decades of habitat change and marginalization by non-native species that prey on and out-compete delta smelt. The anticipated effects of climate change on the Bay-Delta and its watershed such as warmer water temperatures, greater salinity intrusion, lower snowpack contribution to spring outflow, and the potential for frequent extreme drought, indicate challenges to delta smelt survival will increase.

Delta Smelt Critical Habitat

Legal Status

The Service designated critical habitat for the delta smelt on December 19, 1994 (Service 1994). The geographic area encompassed by the designation includes all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the existing contiguous waters contained within the legal Delta (as defined in section 12220 of the California Water Code) (Service 1994).

Conservation Role of Delta Smelt Critical Habitat

The Service's primary objective in designating critical habitat was to identify the key components of delta smelt habitat that support successful completion of the life cycle, including spawning, larval and juvenile transport, rearing, and adult migration back to spawning sites. Delta smelt are endemic to the Bay-Delta and the vast majority only live one year. Thus, regardless of annual hydrology, the Bay-Delta estuary must provide suitable habitat all year, every year. The primary constituent elements considered essential to the conservation of the delta smelt as they were characterized in 1994 are physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (Service 1994). The Service recommended in its designation of critical habitat for the delta smelt that salinity in Suisun Bay should vary according to water year type, which it does. For the months of February through June, this element was codified by the SWRCB "X2 standard" described in D-1641 and the SWRCB's current Water Quality Control Plan.

See the Detailed Review of the Habitat Use and Distribution of Delta Smelt above in the Status of the Species section.

Description of the Primary Constituent Elements

PCE #1: "Physical habitat" is defined as the structural components of habitat (Service 1994). As reviewed above, physical habitat in the Bay-Delta has been substantially changed with many of the changes having occurred many decades ago (Andrews *et al.* 2017; Gross *et al.* 2018). Physical habitat attributes are important in terms of spawning substrate, rearing habitat in terms of how geographic location and bathymetry affect tidal current velocities (Bever *et al.* 2016), and possibly, foraging opportunities near the edges of emergent marshes (Whitley and Bollens 2014; Hammock *et al.* 2019). Information on spawning habitat is incomplete and it is difficult to protect spawning habitat without knowing what it is.

PCE #2: "Water" is defined as water of suitable quality to support various delta smelt life stages that allow for survival and reproduction (Service 1994). Certain conditions of turbidity, water temperature, and food availability characterize suitable habitat for delta smelt and are discussed in detail below. Contaminant exposure can degrade this primary constituent element even when the basic habitat components of water quality are otherwise suitable (Hammock *et al.* 2015).

Turbidity: Turbidity is the measure of relative clarity of a liquid. It is an optical characteristic of water and is a measurement of the amount of light scattered by material in the water when a light is shined through the water sample. The higher the intensity of scattered light, the higher the turbidity. Material that causes water to be turbid can include clay, silt, particulate organic matter, algae, dissolved colored organic compounds, and other microscopic organisms. In the Bay-Delta, turbidity results mainly from sediment suspended in the water column and to a lesser degree phytoplankton (Cloern and Jassby 2012). Turbidity can play an important role in structuring fish communities; one mechanism by which this can occur is the scale dependence in how fish of different sizes can have their prey detection enhanced or impaired (Utne-Palm 2002). Turbidity typically lowers the reactive distance of fishes feeding on zooplankton or each other. However, if the turbidity increases prey contrast (which it often does for fish larvae and planktivorous species), then it can enhance the feeding of these small fishes while still impairing the ability of their predators to see them.

The delivery of suspended sediment to the estuary increased substantially following the era of hydraulic gold mining in the watershed (Schoellhamer 2011). It increased again during rapid regional population growth and development after World War II. Since then, the delivery of new sediment to the estuary has declined (Wright and Schoellhamer 2004; Schoellhamer 2011). In addition, summertime phytoplankton production has been greatly diminished (Cloern and Jassby 2012). These changes have resulted in a general clearing of the estuary's waters (Figure 14); however, the clearing trend has been strongest in the Delta where expansive beds of SAV further filter fine sediment from the water (Kimmerer 2004; Feyrer *et al*. 2007; Nobriga *et al*. 2008; Hestir *et al*. 2016). Water exports from the south Delta may also have contributed to the trend toward clearer estuary water by removing suspended sediment in exported water (Arthur *et al.* 1996); however, the contribution of exports to the total suspended sediment budget in the estuary is small (Schoellhamer 2012).

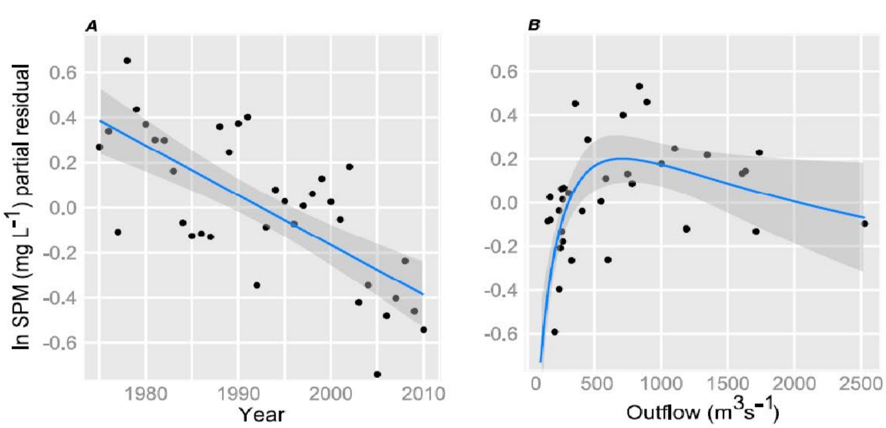

Figure 14. Partial residual plots for a regression model that accounts for variability in annual average concentration of suspended particulate matter at IEP station D8 in Suisun Bay as a result of its long-term trend (left panel) and its relationship to annual average Delta outflow (right panel). The blue lines are loess smoothers and the gray shading is the 95% confidence interval around the line. Source: Cloern and Jassby (2012).

The available catch data for delta smelt imply the species has an affinity for turbid water throughout most, if not all, of its free-swimming life (e.g., Nobriga *et al.* 2005; 2008; Feyrer *et al.* 2007; 2011; Grimaldo *et al.* 2009; Kimmerer *et al.* 2009; Mahardja *et al.* 2017a; Polansky *et al.* 2018; Simonis and Merz 2019), but there have been some recent suggestions that turbidity in the water affects the ability of fishing gears to catch delta smelt perhaps more than it is an actual habitat attribute (Latour 2016). The aquaculture techniques developed for delta smelt include rearing in black tanks under low light conditions because the fish are sensitive to highly lit circumstances (Lindberg *et al.* 2013; Hasenbein *et al.* 2016a). In addition, the tanks are circular and kept free of in-water structures. These captive rearing techniques are consistent with inhabitation of low visibility environments in the wild such as maintaining a spatial association with turbid water.

Below, we review process-based laboratory research that supports the 'turbidity as habitat' hypothesis. Then, we summarize long-term data on Secchi disk depths to demonstrate how water has remained relatively turbid where estuarine physics (Monismith *et al*. 1996; 2002) interacting with shallow water wind wave mixing (Ruhl *et al*. 2001; Bever *et al*. 2016) may contribute to an important refuge for delta smelt even though the biological productivity of this region has been substantially diminished (i.e., that phytoplankton currently contributes less to the turbidity than it once did). This turbid-water refuge occurs in the LSZ and is one of only two remaining in the range of the delta smelt. Turbid water may be a needed present-day habitat attribute because it provides cover for foraging delta smelt (Ferrari *et al*. 2014). By extension, it may be a factor modulating feeding success; one recent study found histopathologic evidence of elevated delta smelt feeding success in the turbid Cache Slough Complex and Suisun Marsh (Hammock *et al*. 2015); a follow-up study found elevated stomach fullness of delta smelt inhabiting the LSZ even though they were spatially disconnected from where zooplankton density was highest (Hammock *et al*. 2017). These findings are also qualitatively consistent with a more macroscopic study of the Delta's fish assemblages that found most native fishes, including delta smelt, to be more common in lower productivity turbid habitats than higher productivity SAV habitats (Nobriga *et al*. 2005). For these reasons, the Service believes delta smelt's association with turbid water, which in the present state of the Bay-Delta system is mainly caused by sediment suspended in the water, is a true habitat association.

It has been shown experimentally that delta smelt larvae require particles in the water to see their transparent prey (Baskerville-Bridges *et al.* 2004). Thus, without some kind of turbidity in the water, delta smelt larvae will starve to death. Another recent laboratory study using late larval stage delta smelt found that feeding success and survival varied across a gradient of turbidity (Hasenbein *et al.* 2016a). The results implied bell-shaped response curves in which both survival and feeding success were highest at intermediate values, though the results among treatment levels were only significantly different in a few cases. A similar experiment using 120-day-old juvenile delta smelt produced different results (Hasenbein *et al.* 2013). In this experiment, the authors reported that feeding success decreased as turbidity was increased; however, their results indicate that statistically speaking, turbidity had no effect except at the highest treatment level. The highest treatment level was 250 NTU which is exceptionally turbid water. It is worth noting two things about these studies. First, the turbidity in the tanks was created using algae, which is not the dominant source of water turbidity in the estuary. Second, in the studies described by Hasenbein *et al.* (2013; 2016b), the experiments were conducted under low light conditions even when turbidity was low (~ 1 lux). In the wild, a surface-oriented fish might have the benefit of both turbidity and high light conditions similar to those that experimentally optimized successful first feeding (Baskerville-Bridges *et al.* 2004).

In another laboratory experiment, the vulnerability of delta smelt to predation by largemouth bass was lower in a circa 3 NTU treatment (again, using algae) than a clear-water treatment (Ferrari *et al.* 2014). In a DNA-based diet study of field-caught predators, the predation of delta smelt larvae was strongly affected by water turbidity (Schreier *et al.* 2016). Thus, the available evidence suggests that delta smelt require turbid water to succeed in the contemporary Bay-Delta food web.

In fish survey data, the longest-term indicator of water turbidity is Secchi disk depth measurements that for several decades have accompanied most individual net tows. Secchi disk depths are basically inverses of turbidity because the less turbid the water is, the deeper into the water column a Secchi disk remains visible. The FMWT Secchi disk depth data set summarized below dates to 1967 (Figure 15).

The Secchi disk depth information suggests the increasing water clarity trends discussed above are not uniform across the upper estuary (Figure 15). From a regional perspective, they have been most pronounced in the San Joaquin River half of the Delta where SAV proliferation has been most expansive (Feyrer *et al.* 2007; Nobriga *et al.* 2008; Hestir *et al.* 2016). Consistent with this, boxplots depicting the time series of Secchi disk depth measurements from the FMWT show the previously reported increasing trend is most pronounced when and where the Secchi disk depths were taken in fresh water (upper left panel of Figure 15). In this upper left panel for which the Secchi disk depth data were summarized only when and where salinity was lower than 1.25 ppt, the previously reported trend of increasing water transparency is apparent; median Secchi disk depths have increased from about 0.5 meters with extreme values seldom exceeding 1 meter early in the time series to medians typically exceeding 1 meter and extreme values near 4 meters in recent years. When data summaries include these freshwater samples along with samples from the LSZ, the trend and extreme data points remain (upper right panel of Figure 15). This could lead to the erroneous conclusion that Secchi disk depths have been similarly increasing in the LSZ.

However, it is also important to consider the hydrodynamic aspect of water turbidity in the estuary. As mentioned above, X2 is a boundary upstream of which salinity tends to be the same from the surface of the water to the bottom, and downstream of which salinity varies from top to bottom (Jassby *et al.* 1995). That variability in salinity from surface to bottom waters is indicative of a front that helps to aggregate turbidity near X2. This does not mean it all aggregates precisely at X2; tidal dispersion results in a spatially complex distribution of sinking particles widely distributed in the LSZ (Kimmerer *et al.* 2014a). Thus, when the FMWT Secchi disk depth data set are constrained to brackish water samples, the long-term trend looks very different (lower panels of Figure 15). There is still an increasing trend over time, but it is much more modest. In particular, at a salinity near 2 to 5 ppt, Secchi disk depths have not consistently increased since the mid-1980s and observations exceeding 1 meter are still rare. Thus, there is a turbid water refuge for delta smelt that persists in the LSZ similar to the one that persists in the Cache Slough Complex.

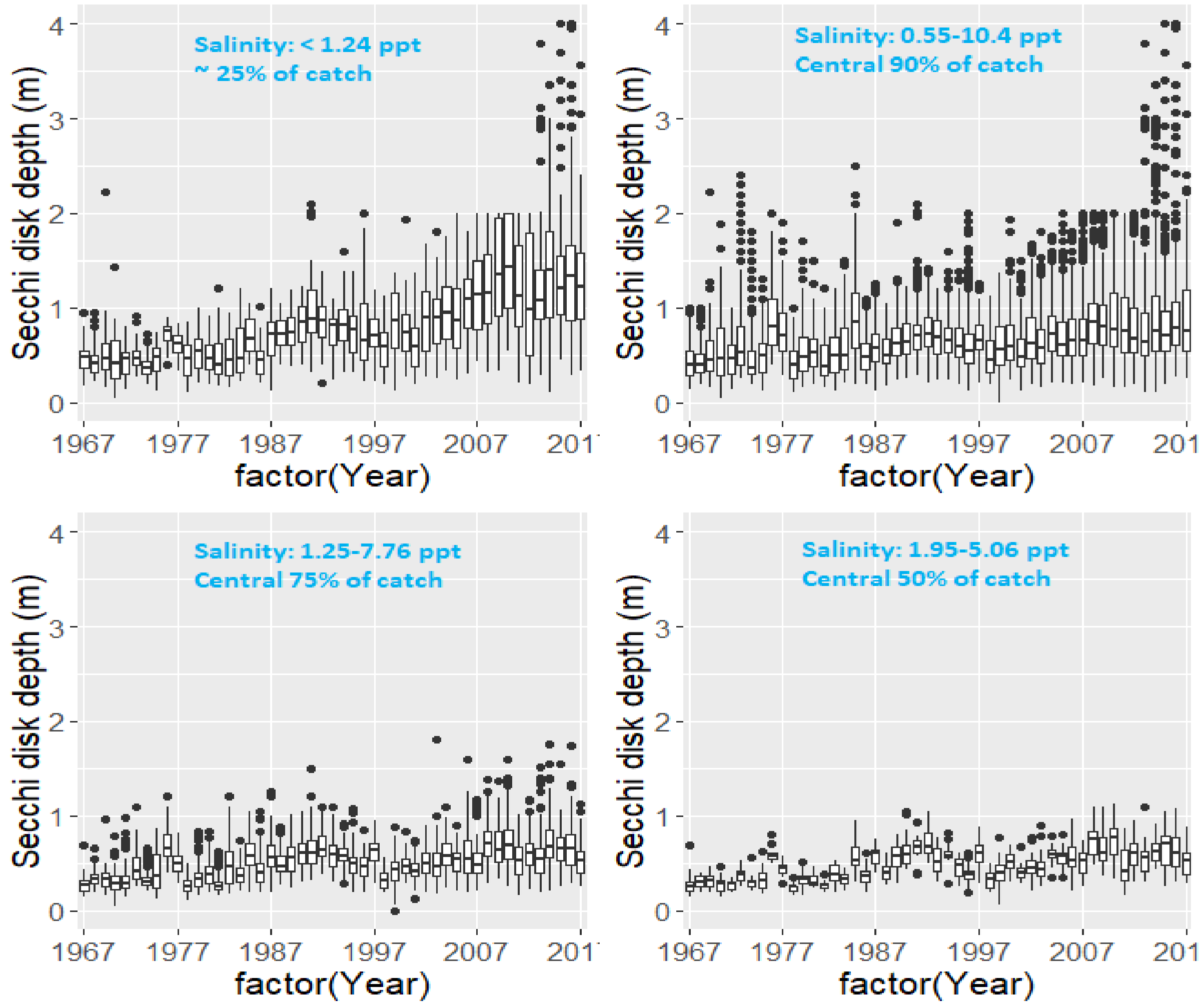

Figure 15. Boxplot time series of Secchi disk depth measurements taken during the California Department of Fish and Wildlife Fall Midwater Trawl Survey, 1967-2017. The boxes depict the central 50% of observations; the line through each box is the median. The black circles are observations outside the central 95% of observations. The data have been grouped into four salinity bins based on statistical summaries of delta smelt data (Kimmerer *et al.* 2013). The salinity range graphed is reported on each panel as is the predicted fraction of FMWT delta smelt catch. Source: Service unpublished data analysis using a specific conductance to salinity conversion described by Schemel (2001) and generalized additive model results provided by W. Kimmerer.

Water temperature: Water temperature is the primary driver of the timing and duration of the delta smelt spawning season (Bennett 2005). Water temperature also affects delta smelt's metabolic and growth rates which in turn can affect their susceptibility to contaminants (Fong *et al*. 2016), food limitation (Rose *et al*. 2013a), and readiness to spawn (Hobbs *et al.* 2007b). Water temperature is not strongly affected by variation in Delta inflows or outflows except at the margins of the Delta where these inflows enter (Kimmerer 2004). The primary driver of water temperature variation in the delta smelt critical habitat is air temperature (Wagner *et al.* 2011). Very high flows can transiently cool the upper estuary (*e.g.,* flows in the upper 10^{th} percentile, Kimmerer 2004), but the system rapidly re-equilibrates once air temperatures begin to warm. Thus, like duration of the spawning season, other water temperature-driven mechanisms affecting recruitment and survival are not freshwater flow mechanisms.

Research initially suggested an upper water temperature limit for delta smelt of about 25°C, or 77°F (Swanson *et al.* 2000). Newer research suggests delta smelt temperature tolerance decreases as the fish get older, but is a little higher than previously reported, ranging from nearly 30°C or 86°F in the larval life stage down to about 25°C in post-spawn adults (Komoroske *et al.* 2014). These are upper *acute* water temperature limits meaning these temperatures will kill, on average, one of every two fish. Subsequent research into delta smelt's thermal tolerances indicated that molecular stress response begins to occur at temperatures at least 4°C cooler than the acute thermal maxima (Komoroske *et al.* 2015).

In the laboratory and the wild, delta smelt appear to have a physiological optimum at temperatures of about 16-20°C or 61-68°F (Nobriga *et al.* 2008; Rose *et al.* 2013a; Eder *et al.* 2014; Jeffries *et al.* 2016). Most of the upper estuary exceeds this water temperature from May or June through September (Komoroske *et al.* 2015). Thus, during summer, many parts of the estuary are energetically costly and physiologically stressful to delta smelt (Komoroske *et al.* 2014). Generally speaking, spring and summer water temperatures are cooler to the west and warmer to the east due to the differences in overlying air temperatures between the Bay Area and the warmer Central Valley (Kimmerer 2004). In addition, there is a strong water temperature gradient across the Delta with cooler water in the north and warmer water in the south. The much higher summer inflows from the Sacramento River probably explain this north-south gradient. Note that water temperatures in the north Delta near Liberty Island and the lower Yolo Bypass where summer inflows are low to non-existent, are also typically warmer than they are along the Sacramento River. This may have consequences for the survival of freshwater-resident delta smelt during comparatively warm summers (Bush 2017).

Food: Food and water temperature are strongly interacting components of the "Water" element of delta smelt critical habitat because the warmer the water, the more food delta smelt require (Rose *et al.* 2013a). If the water gets too warm, then no amount of food is sufficient. The more food delta smelt eat (or must try to eat) the more they will be exposed to predators and contaminants.

The open-water habitat use of delta smelt is reflected in their diet composition, which is largely made up of planktonic and epibenthic crustaceans (Moyle *et al.* 1992; Nobriga 2002; Hobbs *et al.* 2006; Slater and Baxter 2014). Some of the epibenthic crustaceans discussed below (e.g., amphipods and mysids) ascend into the water column at times (Kimmerer *et al.* 2002) and are therefore available to predators foraging in the open water. A large majority of the identifiable prey of delta smelt larvae is copepods, particularly the early life stages of copepods (Nobriga 2002; Hobbs *et al.* 2006; Slater and Baxter 2014). Juvenile delta smelt feeding in the summer months also have copepod-dominated diets, but these larger individuals tend to eat adult copepods and also begin to include prey taxa in their diets that grow larger than copepods (Slater and Baxter 2014; Figure 16). The older juveniles and adults continue to prey on copepods, but have less reliance on them and greater diet diversity (Moyle *et al.* 1992; Slater and Baxter 2014; Whitley and Bollens 2014; Figures 17 and 18). All of the delta smelt's major prey taxa (e.g., copepods, amphipods) are ubiquitously distributed, but which prey species are present at particular times and locations changes from early morning to mid-day, season to season, and has changed dramatically over time (Kimmerer *et al.* 2002; Winder and Jassby 2011; Kratina *et al.* 2014). The latter two have likely affected delta smelt feeding success (Kimmerer and Rose 2018).

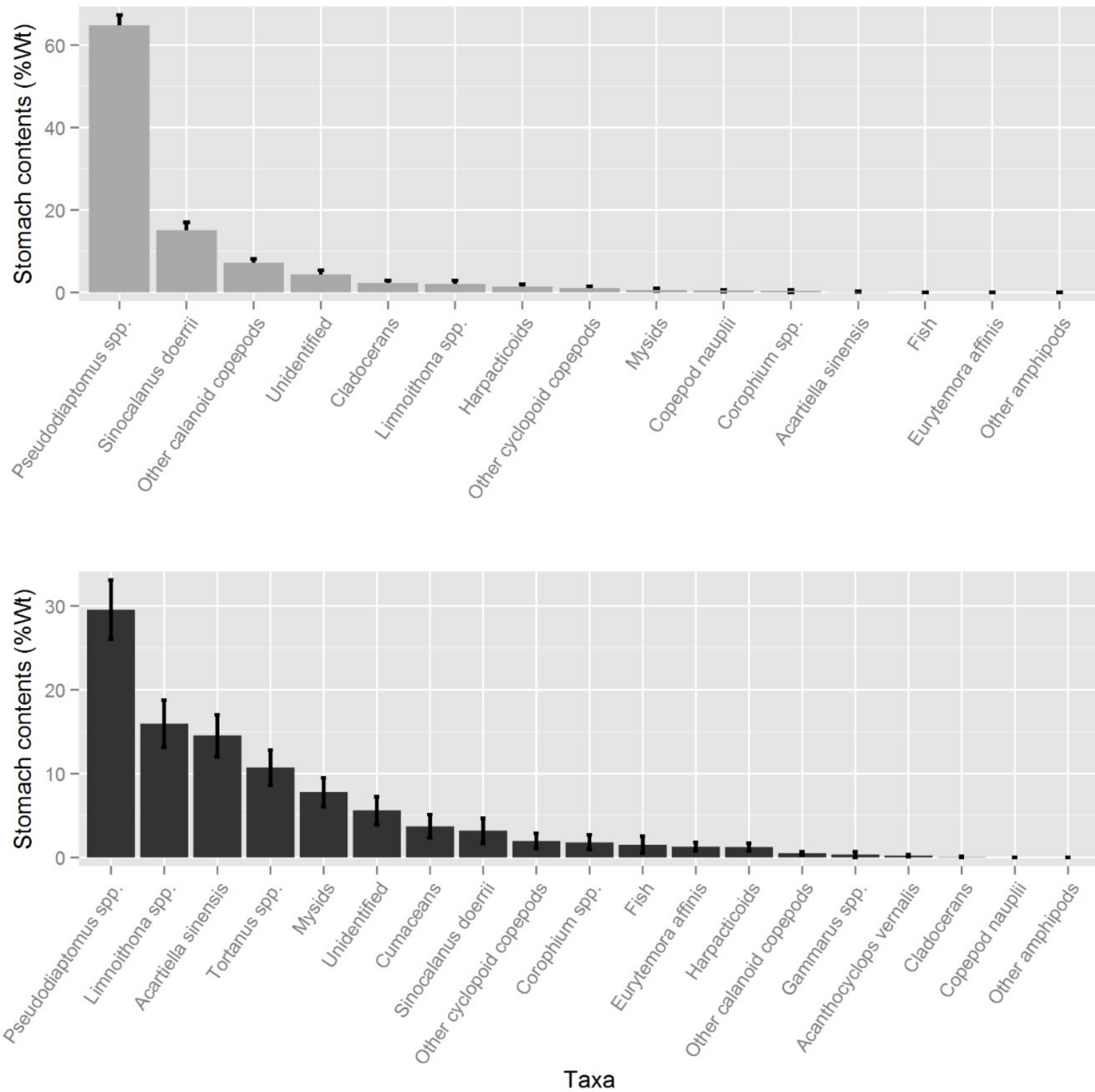

Figure 16. Diet compositions of delta smelt collected by the TNS upper panel for stations with a salinity lower than 0.55 ppt and lower panel for stations with a salinity greater than or equal to 0.55 ppt. Of the prey taxa listed on the x-axis, the ones that are *not* copepods are Cladocerans, Mysids, Corophium spp., Fish, Other Amphipods, Cumaceans, and Gammarus spp. Source: supplemental material for Hammock *et al.* (2017).

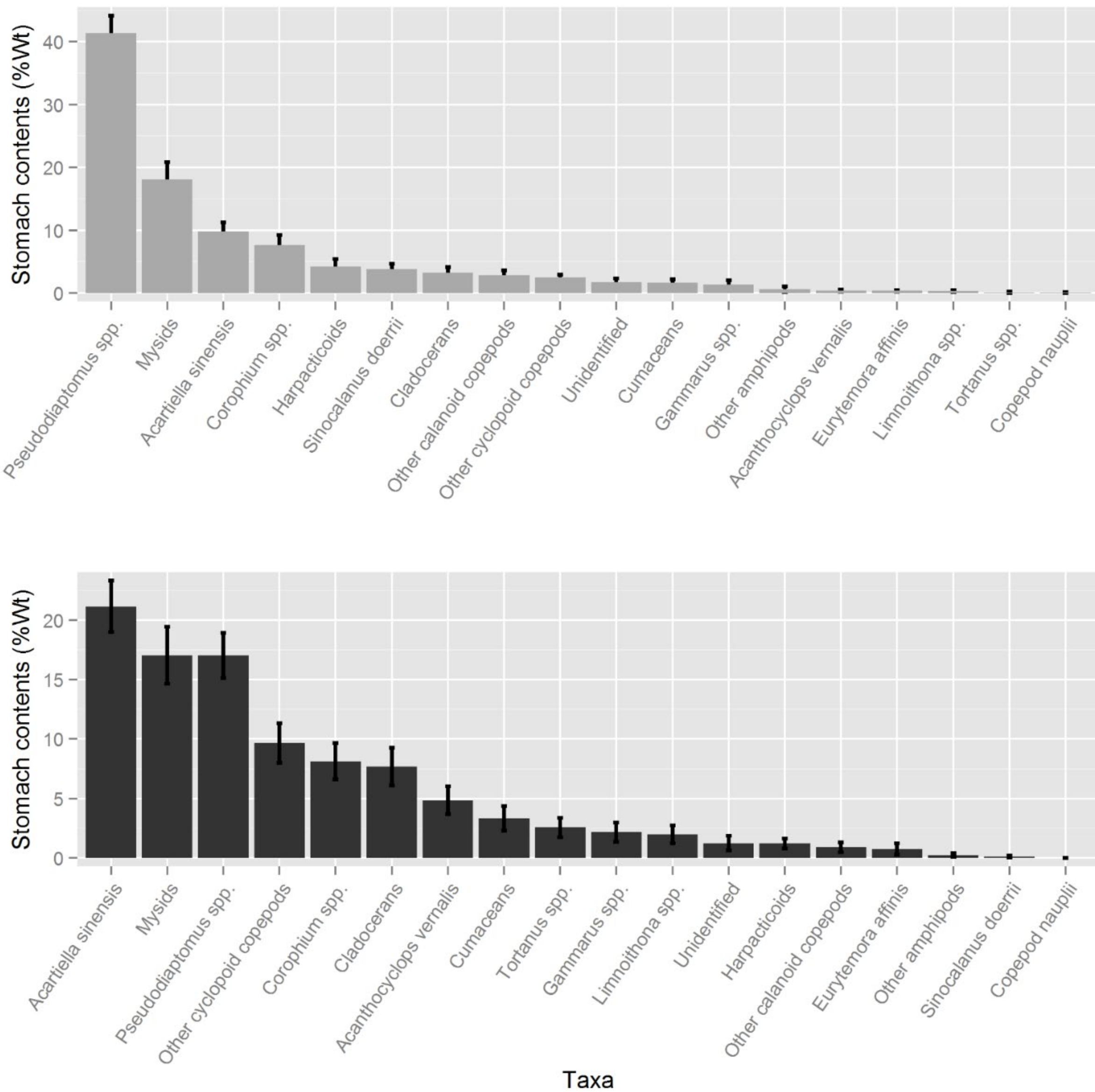

Figure 17. Diet compositions of delta smelt collected by the FMWT upper panel for stations with a salinity lower than 0.55 ppt and lower panel for stations with a salinity greater than or equal to 0.55 ppt. Of the prey taxa listed on the x-axis, the ones that are *not* copepods are Cladocerans, Mysids, Corophium spp., Other Amphipods, Cumaceans, and Gammarus spp. Source: supplemental material for Hammock *et al.* (2017).

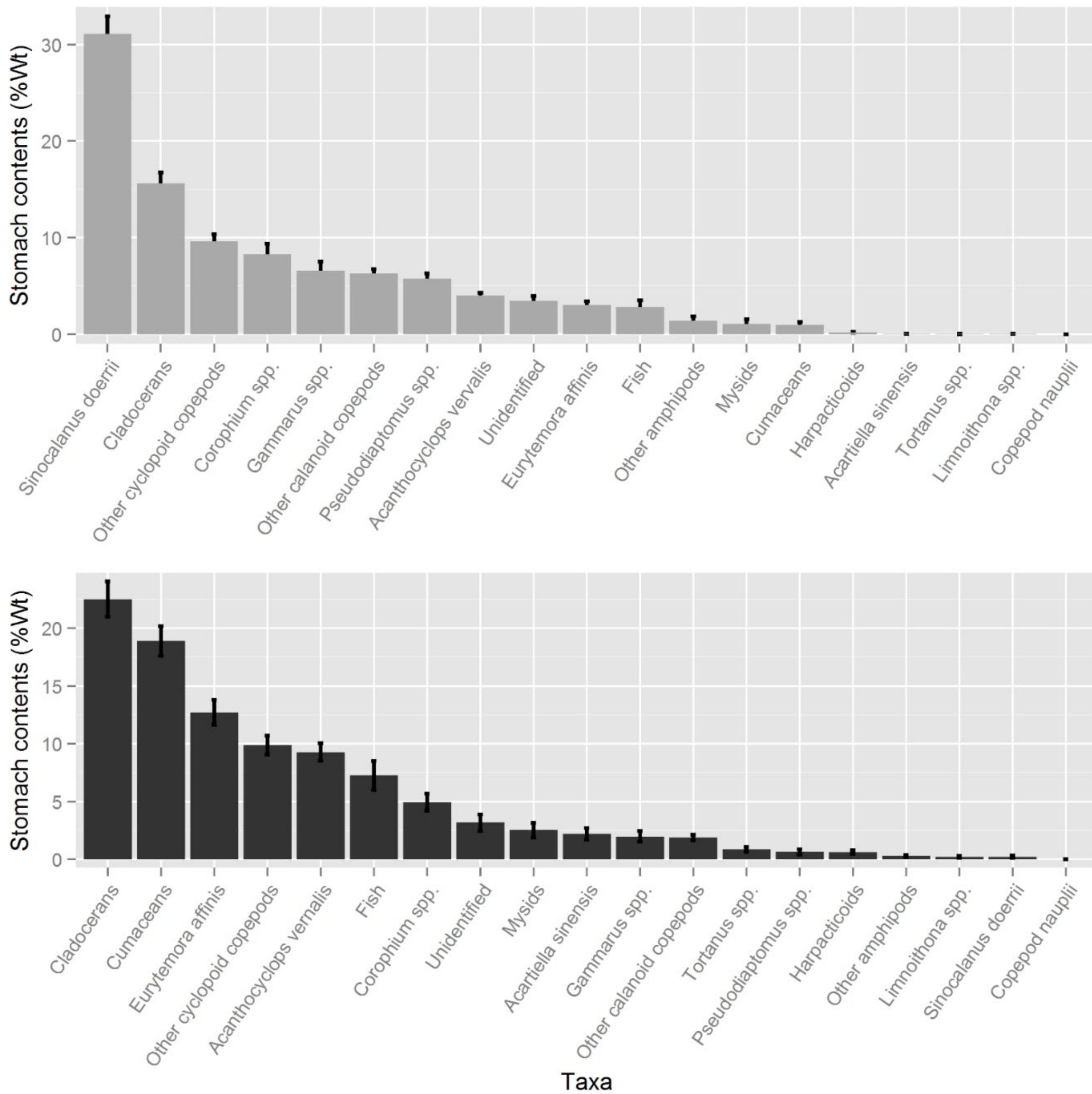

Figure 18. Diet compositions of delta smelt collected by the SKT upper panel for stations with a salinity lower than 0.55 ppt and lower panel for stations with a salinity greater than or equal to 0.55 ppt. Of the prey taxa listed on the x-axis, the ones that are *not* copepods are Cladocerans, Mysids, Corophium spp., Fish, Other Amphipods, Cumaceans, and Gammarus spp. Source: supplemental material for Hammock *et al.* (2017).

An influence of copepod production on the production of delta smelt has been a common finding in quantitative modeling research on delta smelt's population dynamics (Mac Nally *et al.* 2010; Maunder and Deriso 2011; Miller *et al.* 2012; Rose *et al.* 2013a; Hamilton and Murphy 2018; Kimmerer and Rose 2018).

The earliest published paper on a freshwater flow influence on fish production in the Bay-Delta posited that the mechanisms producing striped bass worked primarily through the LSZ food web (Turner and Chadwick 1972). Specifically, these authors suggested that higher Delta inflow stimulated the food web that supported striped bass and increased turbidity which hid them from their predators. Because IEP monitoring was originally set up to better understand striped bass recruitment, the IEP has monitored the pelagic food web extensively since the 1970s (Brown *et al.* 2016b).

The varied sources of primary productivity that fuel estuarine fish production are an area of active research in the Bay-Delta (Sobczak *et al.* 2002; 2005; Grimaldo *et al.* 2009; Howe and Simenstad 2011; Schroeter *et al.* 2015). As is the general case in open-water food webs of estuaries and coastal marine systems, diatoms are the dominant source of primary productivity supporting open-water fish production (Sobczak *et al.* 2002; 2005; Grimaldo *et al.* 2009). Phytoplankton-based and submerged aquatic vegetation-based food webs can be separated on the basis of stable isotopes of carbon and nitrogen, but phytoplankton-based food web paths cannot be clearly separated from pathways based on terrestrial vegetation using these isotopes (Grimaldo *et al.* 2009; Schroeter *et al.* 2015). Sulfur isotopes may provide greater ability to discern among sources within and near tidal marsh environments, but to date, have not been extensively evaluated in the Bay-Delta (Howe and Simenstad 2011). The production of littoral and bottom-feeding fishes is supported by a greater fraction of non-planktonic primary producer sources (Grimaldo *et al.* 2009; Schroeter *et al.* 2015). These non-planktonic food web pathways likely have some importance to delta smelt (Whitley and Bollens 2014; Hammock *et al.* 2019).

There may be tremendous potential for benthic and epiphytic processes to periodically subsidize delta smelt's food supply, and these subsidies may occur at critical times of need, yet such pathways remain underemphasized and understudied. It is common for estuarine amphipods to rise into the water column to relocate to newly formed depositional areas, where they feed on deposited detritus and other organic materials; their successive landward movements via repeated use of selective tidal stream transport (STST, or "tidal surfing") diminish in terms of distance of upstream travel, but ultimately place them within depositional habitats (Hough and Naylor 1992; Forward and Tankersley 2001; Naylor 2006). This behavior results in the amphipods spending a great deal of time in the water column, especially when the water is dimly lit. Being in the water column may make the amphipods more available as prey for delta smelt, but the amphipods are nevertheless energetically tied to benthic basal resources, despite their spending a great deal of time in the water column (i.e., they are still energetically tied to primary production that is bottom-associated: vascular plant detritus, phytodetritus, or benthic microalgae, as opposed to phytoplankton). Mysids, on the other hand, are harder to generalize, as some species are herbivorous, some are predatory, and some are omnivorous. They also use STST, which likely increases their availability to (adult) delta smelt (Wooldridge and Erasmus 1980; Orsi 1986). Thus, depending on mysid species, they may or may not link delta smelt to benthically driven energy pathways.

Jassby *et al*. (1993) estimated benthic microalgae to be responsible for nearly 30% of the primary production in upper San Francisco Bay, inclusive of delta smelt habitat. Light penetration has since improved as turbidity has decreased (Parker *et al*. 2012a), and so this ~30% contribution may have increased dramatically. Jassby *et al*. (1993) provided no estimate for epiphytic microalgae associated with SAV and the zones of emergent grass stems (in marshes) that are near the surface and within the photic zone. Even if the photic zone is just a few centimeters deep, these substrates, when added together, can provide very large surface areas for epiphytic production.

There are two clam species that affect phyto- and zooplankton biomass within the distribution of the delta smelt population. The freshwater *Corbicula fluminea*, which has been in the Delta and its tributary rivers since the 1940s, and the estuarine overbite clam *Potamocorbula amurensis*, which started invading the estuary in 1986 and was well-established within a year (Alpine and Cloern 1992). The freshwater clam can suppress diatom production in shallow freshwater habitats (Lucas *et al.* 2002; Lopez *et al.* 2006). However, the overbite clam appears to have a larger impact on the food web than the freshwater clam (Alpine and Cloern 1992; Jassby *et al.* 2002; Kimmerer and Thompson 2014), so the focus of this review will be on the overbite clam.

In the 1970s and early 1980s, scientists had learned that year-to-year variation in Delta inflow (or salinity at Chipps Island) - especially during the spring and summer - drove the year-to-year variation in the productivity of the low-salinity zone food web (Cloern *et al.* 1983; Knutson and Orsi 1983). In wet years, the flow brought a lot of nutrients and organic carbon into the low-salinity zone (Jassby and Cloern 2000) where it fueled food web production as Delta outflow seasonally decreased into an optimal range estimated by Cloern *et al.* (1983) to be about 100 to 350 cubic meters per second (about 3,500 to 12,400 cubic feet per second (cfs)). In dry years, elevated salinity allowed a marine clam (*Mya arenaria*) to colonize Suisun Bay and graze the diatoms down to low levels. This in turn lowered the production of the mysid shrimp (*Neomysis mercedis*), which was a key food source for several fish species, particularly striped bass (Knutson and Orsi 1983; Orsi and Mecum 1996; Feyrer *et al.* 2003). This stimulation of mysid shrimp production was one of the food web mechanisms that Turner and Chadwick (1972) had hypothesized led to higher striped bass production in higher flow years. Similar 'fish-flow' relationships were later established for longfin smelt (*Spirinchus thaleichthys*) and starry flounder (*Platyichthys stellatus*); both of these fish are also mysid shrimp predators and were shown to have step-declines in their abundance indices associated with the overbite clam invasion (Kimmerer 2002b).

The overbite clam, once established (~ 1987), resulted in a permanent source of loss to diatoms and copepods in the LSZ that resulted in rapid step-declines in the abundance of the most important historical food web components: diatoms, mysid shrimp, and *Eurytemora affinis*; the latter is a copepod that was a major prey for both the opossum shrimp (Knutson and Orsi 1983) and delta smelt (Moyle *et al.* 1992). Unlike striped bass, longfin smelt, and starry flounder, no change in delta smelt abundance occurred coincident with the establishment of the overbite clam (Stevens and Miller 1983; Jassby *et al.* 1995; Kimmerer 2002b; Mac Nally *et al.* 2010; Thomson *et al.* 2010). However, the average size of delta smelt declined somewhat (Sweetnam 1999; Bennett 2005).

Some scientists have hypothesized that the diatom decline was caused by wastewater treatment plant inputs of ammonium or changes in the ratios of dissolved forms of nitrogen that support aquatic plant growth more than by overbite clams (Glibert *et al.* 2011; Dugdale *et al.* 2012; Parker *et al.* 2012b; Wilkerson *et al.* 2015). One piece of evidence used to support this hypothesis is an observation that ammonium was frequently crossing a critical 4 micro-molar threshold concentration for diatom growth at about the same time the overbite clam became established. These researchers have established that uptake of dissolved ammonium inhibits the growth rate of diatoms in the Bay-Delta. However, diatoms can still grow on ammonium, and actually take it into their cells preferentially over nitrate; they just grow more slowly using ammonium as their cellular nitrogen source (Glibert *et al.* 2015). This means that 'but for' the overbite clam, the diatom population in the LSZ would eventually build up enough biomass each year to metabolize ambient ammonium concentrations to levels below the 4 micro-molar threshold and then increase their growth rate using the nitrate that is also in the water. Thus, although nitrogen chemistry could be a problem, a more fundamental one is that as Delta outflow declines during the spring into early summer to levels that could enable diatom blooms, the water temperature is rising and that supports reproduction of the overbite clam. With help from a few other abundant grazers (Kimmerer and Thompson 2014), the growing overbite clam population depletes diatoms faster than they can metabolize the ammonium in the water. Thus, clam grazing is the fundamental reason that summer-fall diatom blooms no longer occur (Cloern and Jassby

2012; Kimmerer and Thompson 2014; Cloern 2019). During spring when Delta outflow is higher, outflow can interact with other factors to limit diatom accumulation as well (Dugdale *et al.* 2012; 2016). Note that Dugdale *et al.* (2016) suggested that available estimates of the overbite clam grazing rate were over-estimates, but this assertion has been contested (Kimmerer and Thompson 2014; Cloern 2019).

The largest source of dissolved ammonium is the Sacramento Regional Wastewater Treatment Plant. Upgrades to the facility are expected to occur in 2021-2023, which will result in reductions in dissolved ammonium concentrations in the Delta. It is scheduled to significantly reduce its nitrogen effluent concentrations beginning in 2023. Once that happens, it should become apparent within a few years how important ammonium ratios are in limiting diatom production in the Bay-Delta.

Because the overbite clam repressed the production of historically dominant diatoms and zooplankton, there were numerous successful invertebrate species invasions and changes in plant communities that followed for a decade or so thereafter (Kimmerer and Orsi 1996; Bouley and Kimmerer 2006; Winder and Jassby 2011). Changing nutrient ratios (including the forms of nitrogen and the ratios of nitrogen and phosphorus) necessary for plant growth may also have contributed to changing phytoplankton and plant communities (Glibert *et al.* 2015; Dahm *et al.* 2016). In addition, extreme drought and propagule pressure are also thought to have directly contributed to the zooplankton species changes (Winder *et al.* 2011). The most important changes for delta smelt have been changes to the copepod community. The copepod invasions of the late 1980s and early 1990s actually helped stem (but not recover the system from) what had been a major decline in copepod abundance (Winder and Jassby 2011). Prior to the overbite clam, delta smelt had diets dominated by *E. affinis* from the time the larvae started feeding in the spring until at least the following fall (Moyle *et al.* 1992). The overbite clam suppressed the production of *E. affinis* (Kimmerer *et al.* 1994; Kimmerer and Orsi 1996) and that seems to have opened the door for several non-native copepods including *Pseudodiaptomus forbesi*, which became the new main prey of delta smelt from late spring into the fall (Moyle *et al.* 1992; Nobriga 2002; Hobbs *et al.* 2006; Slater and Baxter 2014; Hammock *et al.* 2017; Figures 16 and 17).

There is general agreement among quantitative delta smelt models that the production of copepods including *P. forbesi* are important to recruitment and survival (Kimmerer 2008; Maunder and Deriso 2011; Miller *et al.* 2012; Hamilton and Murphy 2018; Kimmerer and Rose 2018; Simonis and Merz 2019). Recognition of *P. forbesi*'s importance to delta smelt led to substantial research into this non-native copepod's population dynamics (Kimmerer and Gould 2010; Sullivan *et al.* 2013; Kimmerer *et al.* 2014b; Kayfetz and Kimmerer 2017; Kimmerer *et al.* 2018a,b). The delta smelt's primary historical prey (*E. affinis*) bloomed from within the LSZ and had peak abundance near X2 (Orsi and Mecum 1986). This copepod still blooms each spring, but disappears by summer due to overbite clam grazing (Kimmerer *et al.* 1994). The same thing happens to *P. forbesi* in the LSZ (Kayfetz and Kimmerer 2017). However, the *P. forbesi* population survives the summer because its center of reproduction is in freshwater habitats landward of the LSZ. It would disappear from the LSZ altogether were it not for a constant replenishment (or subsidy) from upstream where the overbite clam and a predatory non-native copepod are less abundant. It is the combination of tidal mixing and Delta outflow that seems to provide this subsidy (Kimmerer *et al.* 2018a,b). Thus, this subsidy of *P. forbesi* to delta smelt inhabiting the turbid water refuge of the LSZ appears to be of substantial importance – particularly during the summer and fall.

The most obvious test of whether the overbite clam affected delta smelt is a before-after comparison. As mentioned above, this has been tested several times and no obvious effect like the ones reported for striped bass, longfin smelt, and starry flounder has been established. Rather, the first big decline in delta smelt abundance occurred prior to the overbite clam invasion and the second one about 15 years afterward. Thus, if copepod production limits delta smelt production, it is either a part-time limit (e.g., Hamilton and Murphy 2018), or (a) it was a limiting factor prior to the overbite clam, and (b) it did not become a further limit until sometime thereafter. These are not mutually exclusive hypotheses.

Contaminants: Research conducted over the past 10 years suggests that delta smelt are fairly susceptible to contaminants (e.g., Connon *et al.* 2009; 2011a,b; Hasenbein *et al.* 2014; Jeffries *et al.* 2015; Jin *et al.* 2018). The effects of ambient Sacramento River water, pyrethroid pesticides, several herbicides, copper, and ammonium have all been examined and all of these compounds have shown at least sub-lethal effects represented by changes in gene expression. In some cases, delta smelt were exposed to higher than observed concentrations of some compounds in order to estimate their LC_{50}, the estimated concentration that kills half of the test fish over the study duration. Exposure durations have varied widely among studies (4 hour to 1 week), which limits the ability to quantitatively compare toxicity among studies. The loading of some contaminants into the habitats occupied by delta smelt can be functions of freshwater flow inputs (e.g., Kuivila and Moon 2004; Weston *et al.* 2014; 2015) so in some instances, the impacts of contaminants can be freshwater flow mechanisms. However, the impacts of others may be related to where individuals are located (Hammock *et al.* 2015), what delta smelt eat, or water temperature-based demand for prey, all of which could affect the quantities of biomagnifying substances that get ingested over the life span of the fish.

PCE #3: “River flow” was originally believed to be critical as transport flow to facilitate an extended spawning migration by adult fish and the transport of offspring to LSZ rearing habitats (Service 1994). However, it has since been shown that although some individual fish may embark on what could be considered a short spawning migration, there is no population-scale spawning migration *per se*, and that most transport and retention mechanisms for delta smelt (and their prey) involve the selective use of tidal currents rather than net flows (Kimmerer *et al.* 1998; 2002; Bennett *et al.* 2002; Kimmerer *et al.* 2014a; Bennett and Burau 2015). River flow includes both inflow to and outflow from the Delta, both of which influence the net movements of water through the Delta and further into the estuary (Kimmerer and Nobriga 2008). As mentioned above, these variations in freshwater flow affect the spatial distribution of salinity including X2, which in turn exert some influence on the distribution of delta smelt (Sweetnam 1999; Dege and Brown 2004; Feyrer *et al.* 2007; Nobriga *et al.* 2008; Sommer *et al.* 2011; Manly *et al.* 2015; Polansky *et al.* 2018; Simonis and Merz 2019).

Net water movements in the Delta have recently been reconstructed and analyzed for long-term trend attribution (Hutton *et al.* 2019; Figure 19). This analysis demonstrated several net flow variables have experienced strong time trends since water exports from the Delta began. In particular, cross-Delta flows have increased during the summer and fall, Rio Vista flows have decreased in the winter and spring and increased in the summer, Jersey Point flow and Old and Middle river flow (OMR) have decreased year-around. The change attribution indicated that CVP and SWP operations were predominantly the source of these net flow changes except for Jersey Point flow in the spring, which is also strongly influenced by in-Delta irrigation demand. The net flow changes ultimately influence Delta outflow, which as discussed above, has been trending downward for more than 100 years.

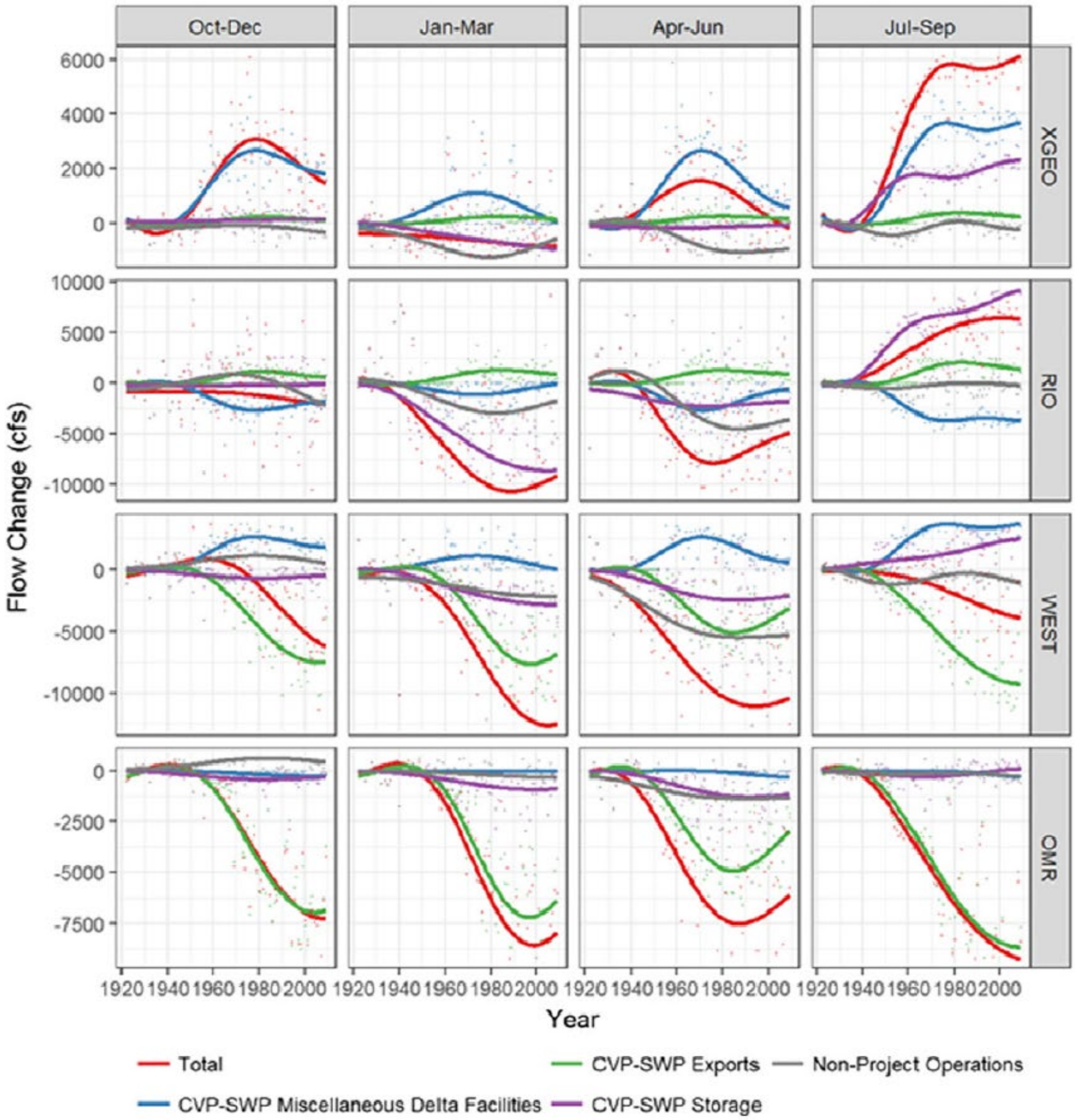

Figure 19. Time series (1922-2009) of statistical trend outputs of annual cross Delta flows (XGEO), net flow at Rio Vista (RIO), net flow at Jersey Point on the San Joaquin River (WEST), and net flow in Old and Middle rivers (OMR). For XGEO net north to south flows have positive values. For RIO and WEST, net seaward (downstream) flows have positive values. For OMR, which seldom has positive values, net north to south flows are depicted as negative values. The colored lines reflect the statistical trend in the time series with the different colors reflecting the relative contributions of the sources listed in the legend. Source Hutton *et al.* (2019).

A concise summary of the contemporary Delta outflow hydrograph is shown in Figure 20. A value on the y-axis of 0.5 suggests that an outflow on a given day has had an equal chance of being at least as high as one or in some cases all three of the chosen thresholds. Delta outflow at least as high as the Roe Island standard freshens the estuary enough for delta smelt to spawn in typically brackish regions like the Napa River and western Suisun Marsh, and tends to reduce the likelihood of entrainment. Delta outflows at least as high as the Chipps Island standard tend to generate LSZ coverage throughout much or all of Suisun Bay. Outflows near the Collinsville standard are associated with a typical X2 slightly upstream of the confluence of the Sacramento and San Joaquin rivers with low-salinity conditions extending into, but not throughout Suisun Bay and marsh. The water management response to D-1641 has been to increase the intra-annual variability in outflows. The greater intra-annual variability is related to the more frequent meeting of these flow thresholds in the winter and spring as required by D-1641, with lower frequency in the fall. This pattern is especially pronounced for outflows greater than or equal to 7,100 cfs ("Collinsville") and 11,400 cfs (Chipps Island; Figure 20). The same pattern is visible for 27,200 cfs ("Roe Island"; Figure 20), but with less change (mainly days 100-150 and 325-350, which correspond to April and the November-December transition). This does more closely mimic the timing and duration of the natural Delta outflow hydrograph than occurred during the 1968-1994 period, though the magnitude is considerably lower as discussed above (Figures 5, 9, and 10). Note that the DAYFLOW calculations used to make Figure 20 can be highly uncertain at values lower than about 10,000 cfs (Monismith 2016).

The tidal and net flow of water toward the south Delta pumping plants is frequently indexed using OMR (Grimaldo *et al.* 2009; Andrews *et al.* 2017; Figure 19). The tidal and net flows in Old and Middle rivers influence the vulnerability of delta smelt larvae, juveniles, and adults to entrainment at the Banks and Jones facilities (Kimmerer 2008; 2011; Grimaldo *et al.* 2009). Currently available information indicates that OMR is a very good indicator of larval delta smelt entrainment risk (Kimmerer 2008; 2011). When the fish reach the juvenile stage, they can leave the south Delta to avoid adverse water temperatures (Kimmerer 2008). When maturing adults disperse the following winter, their advection into the south Delta can be affected by OMR flow, but turbidity is also an important mediator of their entrainment risk (Grimaldo *et al.* 2009). The Service's experience, particularly since 2008, is that the risk of seeing entrained fish in CVP or SWP fish salvage is low if south Delta turbidity remains less than 12 NTU.

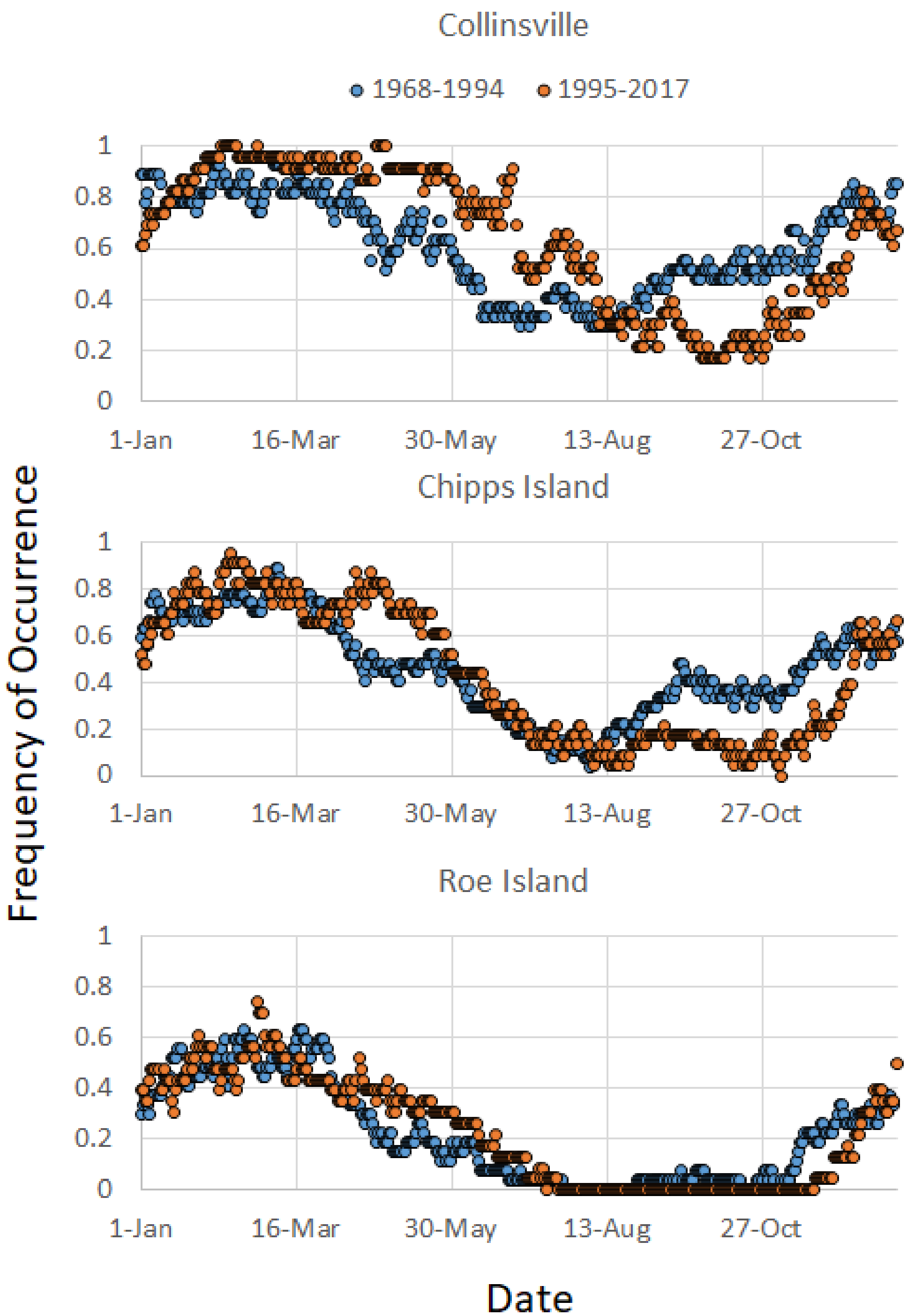

Figure 20. Daily frequency that the Net Delta Outflow Index (NDOI) was at least as high as the steady-state thresholds for the D-1641 'X2 standard' for January 1 to December 31, 1968-1994 (pre-Bay Delta Accord; blue symbols) and 1995-2017 (post Bay Delta Accord; orange symbols). The X2 standards outlined in the Bay Delta Accord were adopted into D-1641. The steady-state NDOI thresholds used to calculate the frequencies were Roe Island ≥ 27,200 cfs, Chipps Island ≥ 11,400 cfs, and Collinsville ≥ 7,100 cfs. For reference, a frequency of 0.5 means an NDOI at least as high as the threshold occurred half of the time on a given day. Note that this plot is intended to provide a concise view of the seasonality of Delta outflow. It is not intended to reflect anything about compliance or non-compliance with D-1641, which can be based on Delta outflow, salinity, or X2. Source: Service unpublished analysis of the DAYFLOW database.

PCE # 4: "Salinity". Fish assemblages are able to lessen competition among species and life stages by partitioning habitats. For instance, some fish species and life stages are more shoreline oriented whereas others are more offshore oriented. Some species are better adapted to midwater or surface waters, while others are more adapted to stay close to the substrate. Some fish are tolerant of turbidity, while others are not. In estuaries, salinity is often a dominant factor separating different groups of fishes (e.g., Bulger *et al.* 1993; Edgar *et al.* 1999). Similarly, in the Bay-Delta, dominant fishes replace one another at several places along the salinity gradient (Feyrer *et al.* 2015).

Delta smelt is part of the fish assemblage that uses the low-salinity waters of the estuary (Kimmerer *et al.* 2009; 2013). Thus, the Primary Constituent Element "Salinity" helps define its nursery habitat (Service 1994). Freshwater flow into the estuary, and Delta outflow in particular, is the most significant mechanism affecting the salinity distribution of the estuary (Jassby *et al.* 1995; MacWilliams *et al.* 2015). Thus any recruitment or survival mechanisms that change in intensity as functions of salinity, or where particular ranges of salinity are distributed, are ultimately freshwater flow mechanisms (see Kimmerer 2002a). As discussed above, these may include the spatial extent of spawning habitat (Hobbs *et al.* 2007a), the availability of low velocity water refuges that remain turbid (Bever *et al.* 2016), and population-scale entrainment in water diversions (Kimmerer and Nobriga 2008; Kimmerer 2008). Some contaminant exposure and dilution mechanisms are also related to changes in freshwater flow inputs. For instance, the toxicity of water in creeks flowing into Suisun Marsh and the Delta can increase when storms increase flows that mobilize contaminated sediment (Weston *et al.* 2014; 2015). At a larger spatial-temporal scale, water toxicity varies regionally and seasonally, and may on average, be higher in years with low winter-spring inflows (Werner *et al.* 2010).

Initial research indicated that delta smelt have an upper acute salinity tolerance of about 20 ppt (Swanson *et al.* 2000) which is about 60% of seawater's salt concentration of 32-34 ppt. Newer research suggests that some individual delta smelt can acclimate to seawater, but that about one in three juveniles and one in four adults die within a few days if they are rapidly transitioned from low-salinity water to marine salinity water (Komoroske *et al.* 2014). The survivors can live for at least several weeks in seawater, but lose weight (Komoroske *et al.* 2014; 2016). This clear evidence of physiological stress for delta smelt exposed to seawater has not been observed at lower salinity challenges – including salinities as high as 18-19 ppt. Different molecular responses have been observed, particularly at salinities higher than 6 ppt (Komoroske *et al.* 2016). These different molecular responses may reflect physiological stress, but this is not certain. There are currently several published studies that have examined aspects of delta smelt physiology at salinities in the 12-19 ppt range; none have found obvious evidence of an inability of the delta smelt to adjust its physiology to handle salinity in this range (Komoroske *et al.* 2014; 2016; Kammerer *et al.* 2016; Davis *et al.* 2019).

These findings are interesting because peak catches of early life stage wild delta smelt have occurred in fresh- or very low-salinity water and peak catches of juvenile and sub-adult fish have occurred at salinities that typify the LSZ. This contrast between where most wild delta smelt have been collected and what laboratory research indicates they can tolerate suggests one of three things. One possibility is there is a persistent laboratory artifact, though we are not aware of what such an artifact would be. A second possibility is that the analyses that have been done to date may not have accounted for change through time that has covaried with declining catches. For instance, in a recent analysis of the SKT Survey, Castillo *et al.* (2018) found that when salinity was higher during sampling (i.e., during periods of low outflow) delta smelt and other fishes were collected from a higher mean salinity. The third possibility is that a discrepancy between field salinity distribution and laboratory results may be evidence that delta smelt's distribution along the estuary salinity gradient is due to a factor or factors other than salinity *per se*. Historically, delta smelt's prey were most abundant in the LSZ, but that has not been the case for more than 30 years. One explanation that may better align with recent laboratory research is that turbidity is the more important physical habitat attribute. Relatively turbid waters occur as a mobile front within the LSZ (Figure 15), occur regularly in Grizzly and Honker bays (Bever *et al.* 2016), and the Cache Slough complex (Sommer and Mejia 2013), all of which are places delta smelt have frequently been collected. This could mean that hiding from predators or minimizing competition are the more relevant drivers of delta smelt distribution. The Service has permitted the use of cultured fish enclosures placed along the estuary salinity gradient to explore this possibility.

The Service used the FMWT data to re-evaluate delta smelt salinity distribution and included equivalent data for five other open-water species to provide context. We analyzed the data separately for pre- and post-overbite clam eras given the large changes in food web function and fish distribution that occurred following its invasion (e.g., Kimmerer 2002b; Kimmerer 2006). To generate Figure 21, we converted the specific conductance data recorded during FMWT sampling to salinity using the equation provided by Schemel (2001) and created salinity bins spanning 1 ppt. We normalized the catch of each species each year relative to salinity so that years of high abundance would not contribute to the results more than years of low abundance. We did this by setting each year's maximum catch of each species to one, and converting smaller catches to fractions of these annual maxima. We then summarized the results with boxplots that show the interannual variability in normalized catch relative to the salinity gradient. Note that catch data were converted to biomass estimates before normalizing.

Of the species summarized in Figure 21, the delta smelt showed the smallest change in distribution relative to salinity after the overbite clam invasion. This is partly because delta smelt is the only one that has never been recorded at a salinity higher than about 20 ppt, which is consistent with previous field data summaries and the laboratory results reviewed above. There are small modes in delta smelt biomass in the LSZ and a general tapering off (with occasional exceptions in particular 1 ppt bins) out to 20 ppt. The northern anchovy data show the skew toward more marine waters that was described by Kimmerer (2006). Longfin smelt and age-0 striped bass had a more even distribution relative to salinity after the overbite clam than they did before. In contrast, American shad had a relatively even distribution across the salinity gradient before the overbite clam, but its distribution has been skewed into somewhat fresher water since. Threadfin shad appear to have greater relative use of the LSZ since the overbite clam, and perhaps higher salinity water more generally. Collectively, these data suggest some re-distribution of the upper estuary fish assemblage has occurred since the 1980s. We note that because mean salinity of the FMWT sampling grid has increased as well (Feyrer *et al.* 2007; 2011) some of these changes may also reflect that trend (e.g., northern anchovy, longfin smelt, striped bass, and threadfin shad). In contrast, the shift toward fresher water by American shad and the lack of major change by delta smelt suggest these species' spatial distribution has changed – if it had not, they would be distributed in more saline water like the other four species. For delta smelt, this distribution shift to the east is consistent with what has been reported previously (Feyrer *et al.* 2007; 2011; Sommer *et al.* 2011; Sommer and Mejia 2013).

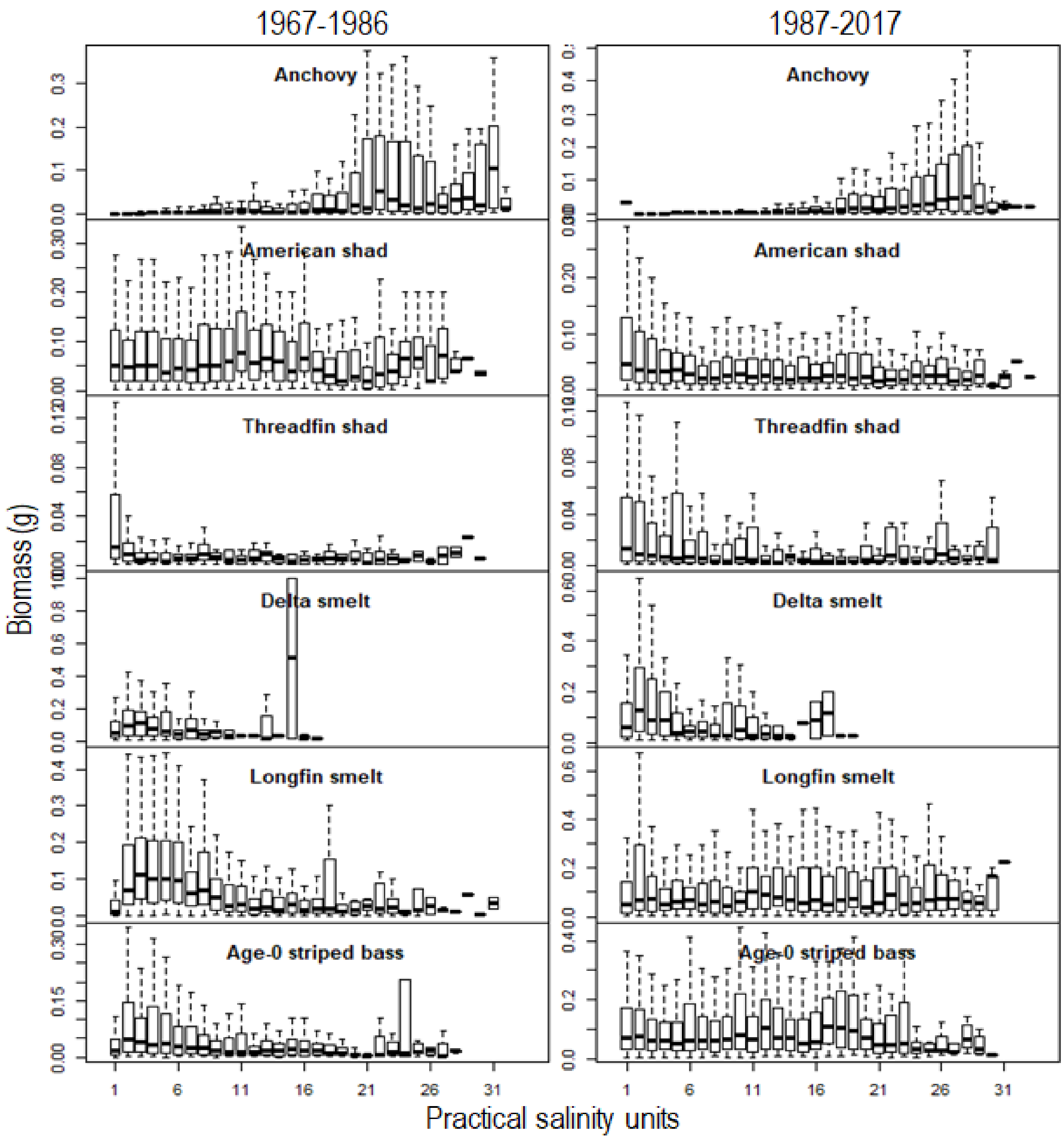

Figure 21. Salinity distributions of Fall Midwater Trawl catch for six pelagic San Francisco Estuary fishes, summarized by pre-overbite clam invasion years (1967-1986) and post-invasion years (1987-2017). Each Fall Midwater Trawl sample was associated with a specific conductance measurement, which was converted to practical salinity units. Annual frequencies of positive catches for each species, binned into one salinity unit increments, were divided by the total positive catch for each year-species combination, to yield proportional positive catch by salinity. Proportions represented annual distributions along the salinity gradient. Within each salinity bin and across years, the distributions of proportional catches were summarized with boxplots.

Summary of Status of Delta Smelt Critical Habitat

The Service's primary objective in designating critical habitat was to identify the key components of delta smelt habitat that support successful completion of the life cycle.

The delta smelt's critical habitat is currently not adequately serving its intended conservation role and function because there are very few locations that consistently provide all the needed habitat attributes for larval and juvenile rearing at the same times and in the same places (Table 10). The Service's review indicates it is rearing habitat that remains most impacted by ecological changes in the estuary, both before and since the delta smelt's listing under the Act. As described above, those changes have stemmed from chronic low outflow, changes in the seasonal timing of Delta inflow, and lower flow variability, species invasions and associated changes in how the upper estuary food web functions, declining prey availability, high water temperatures, declining water turbidity, and localized contaminant exposure and accumulation by delta smelt.

Table 10. Summary of habitat attribute conditions for delta smelt in six regions of the estuary that are permanently or seasonally occupied in most years.

	Landscape	Turbidity	Salinity	Temperature	Food
Montezuma Slough	Appropriate	Appropriate	Appropriate *when outflow is sufficient, or when the Suisun Marsh Salinity Control Gates are operated to lower salinity*	Usually appropriate	Appropriate
Suisun Bay (including Honker and Grizzly bays)	Appropriate except in shipping channel	Usually appropriate	Appropriate *when outflow is sufficient*	Usually appropriate	Depleted
West Delta	Limited area 4 to 15 feet deep	Marginal, declining	Appropriate	Can be too high during summer	Depleted
North Delta (Cache Slough region)	Appropriate	Appropriate	Appropriate	Can be too high during summer	Appropriate, but associated with elevated contaminant impacts
Sacramento River above Cache Slough confluence	Limited area 4 to 15 feet deep; swift currents	Marginal except during high flows, declining	Appropriate, but possibly lower than optimal	Usually appropriate	Likely low due to swift currents and wastewater inputs
South Delta	Appropriate except too much coverage by submerged plants	Too low	Appropriate	Too high in the summer	Appropriate

Giant Garter Snake

For the most recent comprehensive assessment of the species' range-wide status, please refer to the *Giant Garter Snake (Thamnophis gigas) 5-year Review: Summary and Evaluation* (Service 2020). No change in the species listing status was recommended in this 5-year review. Threats evaluated during that review and discussed in the final document have continued to act on the species since the 2020 5-year review was finalized, with loss of habitat being the most significant effect. While there have been continued losses of snake habitat throughout the various recovery units, to date, no project has proposed a level of effects for which the Service has issued a biological opinion of jeopardy for the species.

Western Yellow-Billed Cuckoo

For the most recent assessment of the species range-wide status please refer to the October 3, 2014, *Determination of Threatened Status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (Coccyzus americanus occidentalis)* (Service 2014b). Ongoing threats to the yellow-billed cuckoo include habitat loss from flood control projects and maintenance, alterations to hydrology, climate change, and invasive species. While these threats continue to affect the yellow-billed cuckoo throughout its range, no project, to date, has proposed a level of effect for which the Service has issued a biological opinion of jeopardy for the yellow-billed cuckoo.

Environmental Baseline

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

The proposed project occurs along the mainstem Sacramento River from river mile (RM) 46 upstream to the American River confluence (RM 60), along the Sacramento north of the existing Sacramento Weir (RM 63), the lower American River from RM 0 to RM 11, and portions of the NEMDC, Arcade Creek, and Magpie Creek.

The Sacramento River in this part of the Sacramento Valley is moderately sinuous with the channel confined on both sides by man-made levees. The channel is a fairly uniform width and is not able to migrate due to the levees. Portions of the bank along the Sacramento River have had rock revetment placed to halt erosion of the bank and levees. Narrow bands of riparian habitat occur along the Sacramento River and tends to be comprised of cottonwoods, willows, buttonbush and box elder. Activities in this area consist mostly of maintenance of the levees and recreation consisting of walking, biking, and fishing. Wave wash erosion occurs from boaters in the Sacramento River.

The lower American River is not as constrained as the Sacramento River with portions of the levees set back from the river channel. This results in wider bands of riparian habitat, though there are sections where it is not continuous due to the levee being close to the river or to other land use such as golf courses which preclude native habitats. Non-native species such as black locust (*Robinia pseudoacacia*), tree of heaven (*Ailanthus altissima*), and red sesbania (*Sesbania punicea*) occur throughout the area. Recreation impacts the lower American River, particularly in the form of unauthorized camping which can result in the loss of vegetation and fires, which remove riparian vegetation.

The NEMDC, Arcade Creek, and Magpie Creek are all smaller waterways with levees adjacent to them. Riparian habitat is sporadic and, in some areas, completely missing. These creeks interface between urbanized areas and the open space of Sacramento County.

Valley Elderberry Longhorn Beetle

Habitat for the valley elderberry longhorn beetle occurs within riparian habitat along the Sacramento River, the American River, Arcade Creek and Sacramento Weir expansion footprint.

Sacramento River - Riparian habitat along the Sacramento River, south of the city of Sacramento, occurs in narrow bands along the riverbank and levee. Generally, an overstory layer is present, composed of cottonwood, sycamore, and oak trees. Shrubs occur as a mid-story layer including buttonbush, blue elderberry, white alder, and Oregon ash. Elderberry shrubs occur randomly along the reach of river proposed for improvements. The Corps has documented at 2.82 acres of valley elderberry longhorn beetle habitat and 40 individual shrubs that occur within the action area for erosion and seepage and stability work along the Sacramento River. Natural river processes of erosion and accretion effect elderberry shrubs which is the host plant of the valley elderberry longhorn beetle by eroding away bank and potentially elderberry shrubs. Levee maintenance can adversely affect elderberries within this stretch of the Sacramento River either by pruning or drift of herbicides used along the levee slope.

American River – Valley elderberry longhorn beetles have been identified along the lower American River Parkway in the CNDDB (2021). The Corps has designed and built six sites along the lower American River as habitat for the valley elderberry longhorn beetle. These sites extend from RM 0.9 up to RM 21. Bank protection along the lower American River has 37.23 acres of habitat for the valley elderberry longhorn beetle. Levee maintenance can adversely affect elderberry shrubs, though the largest threat to valley elderberry longhorn beetle is fires that have been started in the parkway and burned habitat that supports valley elderberry longhorn beetles.

Arcade Creek – Arcade Creek is dominated by grassland, with some areas of oak woodland and cottonwood forest. Two elderberry clusters of elderberry shrubs are located along Arcade Creek. Similar to elderberry shrubs along the Sacramento and American Rivers, these shrubs are subject to flood maintenance activities.

Sacramento Weir – At the Sacramento Weir expansion 2.82 acres of valley elderberry longhorn beetle occurs within riparian habitat, along a railroad embankment. The Sacramento River is to the east of the embankment with a continuous canopy of trees extending to the river, but with very little understory and a walnut orchard to the west.

Delta Smelt

The portions of the Action Area that fall within the range of delta smelt include the Sacramento River east levee, south of Sacramento and the Sacramento Weir. Delta smelt typically migrate up into this area as early as December and move out in the spring and summer. The proposed project contains habitat components that can be used for feeding, spawning, rearing, and movement. According to a 2007 riprap database done for the Corps rock erosion protection currently exists between RMs 46 and 60 for a total of 19 miles, this includes both sides of the river. This section of the river is highly constrained with levees close to the river channel, which results in a good portion of the Sacramento River's bank is also in the levee template. The Corps' project will occur within 30 acres of delta smelt shallow water habitat.

Delta Smelt Critical Habitat

The erosion work along the Sacramento River will occur within critical habitat for delta smelt. These sites contain Primary Constituent Element #1, described above. The proposed project is occurring in the upper limits of the designated critical habitat, which includes potential spawning habitat. Sediment load in this portion of the Sacramento River is high and depending on the water year, sediment can drop out and cover areas with large amounts of cobble creating potential spawning habitat, or flush out accredited sediment and expose areas that are less suitable for spawning.

Giant Garter Snake

The proposed project is located within both the American Basin Recovery Unit (NEMDC borrow area) and the Yolo Basin Recovery Unit (ditch in the Sacramento Bypass) both are identified in the *Recovery Plan for the Giant Garter Snake* (Service 2017). Habitat within the proposed project occurs within the NEMDC and in the enlarged Sacramento Bypass. A borrow site located adjacent to the NEMDC in the southern part of the Natomas basin is upland giant garter snake habitat. The borrow site is on the southern edge of the agricultural lands and developed land interface. The NEMDC near this borrow site is an aquatic feature with large open areas of grassland that can serve as upland habitat for the giant garter snake. A snake observed 0.5 mile to the west of the NEMDC along Elkhorn Boulevard in 1996 (CNDDB 2021). Borrow site 2's northern boundary is Elkhorn Boulevard on the east side of the NEMDC. Giant garter snakes could be using the NEMDC for aquatic habitat and the surrounding grasslands for uplands.

Snakes have been located within the Yolo Bypass within 2 miles of the Sacramento Bypass. Numerous irrigation and drainage canals exist which provide connectivity from the Sacramento Bypass and areas that are known to support snakes in the Yolo Bypass. The canal segment between the southern cross canal and the Tule Canal that will be modified as a result of construction of the Bypass Transport Channel contains about 38.4 acres of giant garter snake habitat (3.4 acres of aquatic habitat and 35 acres of upland habitat).

Western Yellow-Billed Cuckoo

Riparian habitat along the Sacramento River is narrow and linear. This habitat is not wide enough to support a nesting pair of cuckoos. Yellow-billed cuckoos use riparian habitat for foraging and nesting. Larger habitat patches exist within the lower American River. There are 65 acres of riparian habitat along the Lower American River that yellow-billed cuckoos could be using in the project area. The Corps will remove 110 acres of riparian habitat along the Sacramento River and disturb an additional 50 acres of riparian habitat by removing the understory and placing rock around the large trees. Riparian habitat exists landside of the levee at the Sacramento Weir extension. There are 13.74 acres of riparian that the cuckoo could use during migration at the Sacramento Weir extension.

Effects of the Action

Valley Elderberry Longhorn Beetle

Vegetation removal, including elderberry shrubs can cause mortality of any beetle larvae within the elderberry shrub. Transplanting the shrubs between November 1 and February 15, when the shrubs are dormant, will minimize the likelihood of killing larvae within the shrub. However, with transplantation there is no guarantee that the shrub will live which would result in both the death of any larvae in the shrub and the loss of habitat for the beetle. Proper care of the transplants through watering in the initial years can minimize this loss and increase the likelihood that the shrub will survive and provide habitat for the valley elderberry longhorn beetle.

The Corps is avoiding a large number of elderberries along the lower American River and Sacramento River. Elderberry shrubs along the Sacramento River are being avoided with at least a 20 foot buffer from the dripline. On the lower American River 8.34 acres of valley elderberry longhorn beetle riparian habitat will have construction occurring within 20 feet of the dripline of elderberry shrubs, but the shrubs will be protected in place. Construction and geotechnical studies that occur near elderberry shrubs that will be protected in place can kill adult beetles if construction equipment is operating between the months of March and July when valley elderberry longhorn beetles have emerged from the elderberry shrubs, are locating mates for reproduction, and laying eggs on the elderberry shrubs. Fencing the area which contains riparian habitat, specifically elderberry shrubs, will minimize the likelihood of killing an adult beetle, but given the large amount of construction that will be occurring, the project will cause mortality to adult beetles.

The linear nature of this project could result in a loss of habitat connectivity for the valley elderberry longhorn beetle, which will affect the long-term viability of the beetle in the lower American River and along the Sacramento River because the beetle is a poor disperser. A large number of elderberry shrubs are being transplanted out of the construction footprint. Because final designs have not been completed for all of the bank protection work, the Corps is including the Service in the design process as well as in the selection and design of mitigation sites. Sites will be selected that increase both habitat connectivity as well as habitat patch size. Fulfilling recovery actions in the VELB Recovery Plan will be considered when selecting mitigation sites.

Overall, the Corps is transplanting the following amounts of elderberry shrubs: 7.11 acres along the lower American River; 0.12 acre along the Sacramento River for bank protection; 0.69 acre at Sacramento Weir; and 40 individual shrubs along the Sacramento River for seepage and stability. The 7.92 acres of elderberry shrubs are within a total of 27.21 acres of riparian that the beetle could be using to disperse from elderberry shrub to elderberry shrub. The 40 individual elderberry shrubs were not associated with riparian habitat and the Corps is proposing to offset adverse effects through the creation of 3.31 acres of valley elderberry longhorn beetle habitat. The Corps is proposing to offset the loss of this habitat through the creation of 84.94 acres of valley elderberry longhorn beetle habitat primarily along the lower American River and at the

Stone Lakes Conservation site, with up to 8.22 acres protected at a valley elderberry longhorn beetle conservation bank.

These components of the action (the creation and protection of valley elderberry longhorn beetle habitat and the purchase of bank credits) will have the effect of protecting and managing lands for the species' conservation in perpetuity. The compensatory lands will provide suitable habitat for breeding, feeding, or sheltering commensurate with or better than habitat lost as a result of the proposed project. Providing this compensatory habitat in a way that provides relatively large, contiguous blocks of conserved land may contribute to recovery efforts for the valley elderberry longhorn beetle.

Operations and Maintenance - Trimming of elderberry shrubs can result in the loss of some habitat for the valley elderberry longhorn beetle. Unlike transplantation however, the shrub remains within the riparian corridor and can provide habitat for the beetle during dispersal. There is potential for one of the pruned stems to contain the larvae of the valley elderberry longhorn beetle. While elderberry shrubs do resprout readily, there is a temporal loss of habitat for the beetle and as part of the maintenance, any resprouted stems will be removed in order to provide maintenance equipment access. To offset these effects, the local maintaining agencies have proposed to create a 40-acre conservation area for the valley elderberry longhorn beetle. This area will be selected as described in the preceding paragraph. This will ensure habitat connectivity and help with long-term maintenance and monitoring of these lands.

Delta Smelt

Construction along the Sacramento River will place bank protection along a total of 43,000 non-contiguous linear feet (total of 8.14 miles) sections of the left bank of the Sacramento River. This will result in the majority of this section of river having rock bank protection placed on it. Delta smelt are a pelagic species typically associated with open water. However, as described in the status of the species they do spawn on sandy beaches in shallow water habitat. Suitable spawning habitat in this portion of the Sacramento River is present along the riverine edge of the left bank where proposed activities will occur. The rock footprint and other construction related activities below the mean high-water mark will change the substrate up to 43,000 linear feet (30 acres of shallow water habitat).

In-water construction activities (July 1 through October 31) will avoid the adult migration season and exposure to the adult spawning, incubation *(i.e.*, eggs/embryos), and larval transport from heavy equipment such as barges and cranes. Infrequent detection of larger juveniles in beach surveys suggests that the Sacramento River serves as a spawning ground and not as a nursery ground (Service 2020). Therefore, the early start of construction of July 1 in this section of the Sacramento River, while has the potential to effect individuals, this will be a small number of individuals. The bulk of the work will be completed during the August 1 to November 30 work window that typically avoids effecting individual delta smelt.

Effects due to increasing sediment downstream of the work area will be minimized through the conservation measures involving monitoring water quality during construction to ensure that effects do not extend into the portion of the Delta that delta smelt occupies during the late summer/fall period.

Construction to widen the Sacramento Weir will involve excavation of 5.56 acres of riverine habitat and roughly 2 acres of excavation of the upper bank. Once completed there will be 7.5 of riverine habitat with natural substrate. Only 1 acre of riprap will be used in this area immediately around the fish passage channel to limit erosion. The 7.5 acres of riverine habitat will be available to delta smelt the following year, resulting in no loss of habitat available to the delta smelt.

The primary adverse effect of the project is on potential spawning habitat is the modification of substrate within the shallow water zone (*e.g.*, sand to riprap). Rock used for bank protection is large enough to retard erosional forces of the river and therefore has interstitial spaces. Should delta smelt spawn over this riprap substrate, it is very likely that any eggs will fall into these interstitial spaces resulting in the loss of eggs and potentially causing fertilization to not occur if the eggs fall into the interstitial spaces. Rock slope protection limits the lateral mobility of a river channel, increases flow velocities (Sedell et al. 1990), limit sediment transport, and eliminates bankside refugia areas (Gregory et al. 1991). Rock placement can also affect primary productivity through the loss of vegetation. The Corps will protect large trees in place and plant riparian benches at the conclusion of the rock placement to replace some of the loss of vegetation. Planting benches and vegetation planting will help to offset the increased velocities that the bank protection sites will experience due to the smoother rock surface. Current designs of the sites have a launchable toe, which is designed to provide protection against toe erosion. Because this is a feature that could move in the future, the Corps has committed to analyzing the likelihood and effects to the on-site planting bench if the toe rock launches. If it is found that the launch of the toe rock will affect the long-term viability of the on-site mitigation, the Corps will consult with the Service to determine how the launchable toe could affect the delta smelt and its critical habitat and reintitiate consultation if necessary.

To offset the loss spawning potential and the loss of riverine edge habitat the Corps has proposed to purchase or create up to 90 acres of credits at a Service-approved delta smelt conservation bank or through other Service-approved mitigation actions for the effects to up to 30 acres of shallow water habitat. From a temporal perspective it is assumed that mitigation will be in place and available to the species by the end of construction, assuming construction will be done by 2025. The Corps is coordinating with the Service on the development of mitigation. If they find that mitigation will not be completed by the anticipated time they will work with the Service to determine what the effects to delta smelt will be if mitigation is not completed by 2025 and reinitiate consultation as appropriate.

The proposed conservation plan of the action will have the effect of protecting and managing lands for the species' conservation in perpetuity. The compensatory lands will provide suitable habitat for breeding, feeding, or sheltering commensurate with or better than habitat lost as a result of the proposed project. Providing this compensatory habitat in a way that provides relatively large, contiguous blocks of conserved land may contribute to recovery efforts for the delta smelt.

Operations and Maintenance - The Corps has proposed to evaluate effects to listed species including delta smelt when long-term maintenance activities for the Sacramento River can be described. Therefore, this biological opinion does not address effects to the delta smelt from any long-term levee maintenance activities.

Delta Smelt Critical Habitat

Implementation of the proposed project will affect PCE #1 Physical Habitat as described under the environmental baseline section above. The placement of rock or other construction activities under the mean high-water mark will change the substrate of shallow water habitat for 30 acres. Any loss of shallow water habitat will be compensated through the purchase of credits at a delta smelt conservation bank, creation of on-site shallow water planting benches, or a Service-approved mitigation site. Creation of on-site benches can minimize and mitigate effects to delta smelt critical habitat if they are in the shallow water habitat zone and accessible to delta smelt during the spawning season. Previous erosion repair sites have accreted sandy soils on the benches which will be available to the delta smelt for spawning. This would not be available every year given it is dependent on the Sacramento River flows. A Conservation Measure which includes the Service in the development of the plans for the planting benches will ensure that the benches can provide habitat for the delta smelt. It is expected that planting portions of the sites post-construction will replace loss of primary productivity within the Sacramento River water column. On-site mitigation will be determined on a site by site case in consultation with the Service. The current discussion of off-site mitigation includes sites which are not currently connected to the river, through some sort of levee breach. This would open up new potential spawning habitat to the delta smelt within critical habitat.

Giant Garter Snake

Borrow Site 2 – Upland habitat for the giant garter snake will be disturbed at borrow site 2 (5.5 acres) when heavy equipment is brought in to remove soil for the Arcade Creek levee repair. Removal of soil from the site will result in the crushing of burrows that snakes use for aestivating and thermoregulation. Fencing the borrow site prior to borrow excavation will minimize the likelihood that snakes will be in the borrow site when construction equipment begins to mobilize. Fencing the site will temporarily (one active season) exclude the use of the area for giant garter snake. This could result in snakes having to move further distances to find upland refugia in the summer months and expose them to predation or other sources of mortality such as being run over by a vehicle on the levee road on the opposite side of the NEMDC. About 1.2 acres of aquatic habitat for the giant garter snake would be unavailable to the snake for up to 3 months during the snake's active season due to dewatering. Since snakes use aquatic habitat to forage for food, thermoregulate, and evade predators, the loss of this 1.2 acres will negatively affect the giant garter snake. Snakes will have to find alternative areas to forage in during these 3 months which could leave snakes more vulnerable to predation as they move to other areas for foraging.

Upon completion of the project, the site will restored and re-graded to create three habitat types. The 0.4 acre of freshwater marsh will provide a small increase in habitat along the bank during the summer months when the snake is active and will provide cover, an area for prey production, and refugia from predators. Additionally, the seasonal wetland bench will only provide aquatic habitat in the winter months when the snake is typically in burrows. The wetland bench will provide some upland habitat for the giant garter snake during the summer when the snake is active in the form of basking habitat and if dried wetland vegetation remains, some refugia from predators. However, because the site will be flooded in the winter it will not serve as overwintering habitat for the snake. The remaining 3.5 acres of the borrow site will be restored to native grassland and will function as summer upland refugia and basking habitat and in the winter serve as overwintering habitat for the snake.

Sacramento Bypass – Enlarging the Sacramento Bypass and Weir will result in temporary effects to giant garter snake habitat. Geotechnical borings will be conducted during the active season of the snake and will be done in a manner that tries to avoid areas where giant garter snakes may be underground in burrows. Creation of the Bypass Transport Channel will result in temporary effects to 2.3 acres of aquatic habitat and 32.7 acres of upland habitat. An additional 0.3 acre of aquatic and 3.1 acres of upland habitat will be permanently affected through the filling of a section of canal. Construction effects will result in the project area being unavailable to the giant garter snake for one year. Construction equipment and earthmoving activities will result in collapsing of burrows and crushing of snakes that are in the project area. Upon the one year completion of this portion of the project there will be an additional 6.7 acres of aquatic habitat available to the giant garter snake. Water availability should be similar to existing conditions with agricultural drainage providing a water source in the summer months when the snake is active. Conservation measures including working during the snake's active season will minimize the amount of individuals that could be killed or injured.

Operation of the expanded Sacramento Weir and Bypass will result in an increase of water surface elevation of approximately 0.5-foot on the levee slopes on either side of the Yolo Bypass. However, when this increase occurs, during a 200-year flood event, the Yolo Bypass levees already contain water up to 21 feet deep. As a result, giant garter snake burrows would likely already be saturated before the additional water associated with the widened Sacramento Bypass is a factor. The additional 0.5-foot resulting from this action would not significantly change the timing or duration of this flooding and would not result in further impacts to giant garter snake habitat.

The Corps has proposed to evaluate effects to listed species including giant garter snake when long-term maintenance activities for the Sacramento Bypass can be described. If maintenance activities will affect giant garter snakes the Corps will reinitiate consultation with the Service. Therefore, this biological opinion does not address effects to the giant garter snake from any long-term levee maintenance activities.

Yellow-Billed Cuckoo

Sacramento River – The Corps is planning on removing 70 acres of riparian habitat along the Sacramento River. The riparian corridor in this section of the Sacramento River is narrow (about 100 feet wide) because the levees were constructed so close to the edge of the channel bank. This bank of riparian habitat is too narrow for the yellow-billed cuckoo to nest; however it is possible for the yellow-billed cuckoo to use the habitat as a stopover when migrating to the Central Valley to breed. Vegetation removal under the proposed project will reduce the width of the riparian corridor from 100 feet to 40 feet on average. The Corps proposal to plant the bank protection sites will create at least a 25-foot-wide soil filled planting berm. Similar to the discussion above under delta smelt effects, these planting benches will have a launchable rock toe that could deploy over the life of the project. The study the Corps is currently undertaking will determine the likelihood and effect to the planting bench. If it is found that the launch of the toe rock will affect the long-term viability of the on-site mitigation, the Corps will consult with the Service to determine the effects to the yellow-billed cuckoo and its habitat. The Corps proposes to offset the loss of the 70 acres of riparian habitat through creation of habitat on-site and the creation of up to 140 acres of riparian habitat along the lower American River. The Corps is including the Service in the development of the mitigation sites such that they can be sited and designed to create riparian habitat that will benefit the yellow-billed cuckoo.

American River – The construction of launchable rock trench and bank protection will remove up to 65 acres of riparian habitat along the lower American River. While large patches of riparian habitat will not be removed (only a strip will be removed adjacent to the levee), the removal of this strip could reduce the size of some of the riparian areas in the lower American River that could serve as potential nesting areas for the cuckoo.

To compensate for this loss of riparian habitat, the Corps is proposing to plant up to 130 acres of riparian habitat along the lower American River. As described in the Conservation Measures, a variable sized soil filled planting bench will be constructed in the bank repair sites, where feasible. This will be used to offset some of the effects of loss of riparian vegetation. The launchable toe is also proposed for the bank protection and effects to on-site mitigation will occur as discussed in the Sacramento River effects section above. The remainder of the mitigation will occur along the lower American River.

Sacramento Weir – Due to the expansion of the weir and Sacramento Bypass, the Corps will remove 13.74 acres of valley oak riparian that is on the railroad alignment and to the east of the railroad alignment. This area will be converted to a concrete weir. While this patch, similar to riparian along the Sacramento River, does not serve as nesting habitat for the yellow-billed cuckoo because of its small size, it does provide migratory stopover habitat for the cuckoo. The Corps is proposing to compensate for the loss of this habitat either in the Lower American River, at the Beach Stone Lakes Conservation Area, or through the purchase of riparian floodplain credits at a mitigation bank.

In addition to the habitat loss for both the Sacramento and American Rivers, construction activities have the potential to adversely affect individual yellow-billed cuckoos. Construction that occurs when the cuckoo is in the Sacramento Valley has the potential to harass the bird due to noise. To minimize effects to the cuckoo due to construction noise, the Corps' conservation measure to do pre-construction bird surveys prior to beginning construction and to remove all vegetation outside of the migratory bird nesting season (March 1 to September 31), will enable the Corps to avoid nesting yellow-billed cuckoos. However, cuckoos that could be foraging in the area could be disturbed due to construction activities and noise and move to other locations in the lower American River parkway which could expose individual cuckoos to increased predation.

The conservation areas will provide both habitat for yellow-billed cuckoo and valley elderberry longhorn beetles. These areas will also ensure that there is a net increase of potential yellow-billed cuckoo nesting habitat along the lower American River Parkway. Recognizing that there is overlap in valley elderberry longhorn beetle habitat and yellow-billed cuckoo habitat and due to the different ratios proposed by the Corps, impacts due to the proposed project and mitigation sites will be developed and coordinated with the Service to ensure that habitat is created and balanced for both species. In total there will be up to 306 acres of habitat that will be heterogenous and provide habitat for the valley elderberry longhorn beetle, yellow-billed cuckoo, and salmonids. This acreage will be broken up in a combination of on-site, off-site, and conservation bank credits and will be coordinated with the Service.

The proposed conservation plan of the action will have the effect of protecting and managing lands for the species' conservation in perpetuity. The compensatory lands will provide suitable habitat for breeding, feeding, or sheltering commensurate with or better than habitat lost as a result of the proposed project. Providing this compensatory habitat in a way that provides relatively large, contiguous blocks of conserved land may contribute to recovery efforts for the yellow-billed cuckoo.

Operation and Maintenance - The Corps has proposed to evaluate effects to listed species including yellow-billed cuckoo when long-term maintenance activities for the Sacramento River and American River can be described. If maintenance activities will affect yellow-billed cuckoos the Corps will reinitiate consultation with the Service. Therefore, this biological opinion does not address effects to the yellow-billed cuckoo from any long-term levee maintenance activities.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. 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 Act. During this consultation, the Service did not identify any future non-federal actions that are reasonably certain to occur in the action area of the proposed project.

Conclusion

After reviewing the current status of the valley elderberry longhorn beetle, delta smelt, giant garter snake, and yellow-billed cuckoo, the environmental baseline for the action area, the effects of the proposed American River Common Features 2016, and the cumulative effects, it is the Service's biological opinion that the American River Common Features 2016, as proposed, is not likely to jeopardize the continued existence of the valley elderberry longhorn beetle, delta smelt, giant garter snake, and yellow-billed cuckoo. The Service reached this conclusion because the project-related effects to the species, when added to the environmental baseline and analyzed in consideration of all potential cumulative effects, will not rise to the level of precluding recovery or reducing the likelihood of survival of the species based on the following:

1) Conservation measures that limit when work will occur to avoid when listed species are in the action area, or when they are less likely to be affected by the project;

2) Providing and protecting up to 396 acres of habitat for the valley elderberry longhorn beetle, delta smelt, and yellow-billed cuckoo; and

3) Create habitat on-site to allow connectivity for all for species.

After reviewing the current status of designated critical habitat for the delta smelt, the environmental baseline for the action area, the effects of the proposed American River Common Features 2016, and the cumulative effects, it is the Service's biological opinion that the American River Common Features 2016, as proposed, is not likely to destroy or adversely modify designated critical habitat. The Service reached this conclusion because the project-related effects to the designated critical habitat, when added to the environmental baseline and analyzed in consideration of all potential cumulative effects, will not rise to the level of precluding the function of the delta smelt critical habitat to serve its intended conservation role for the species based on the following:

1) Habitat effected within critical habitat for delta smelt will be offset through the creation/preservation of 3 times that which is being affected within the critical habitat area and

2) Benches will be constructed on-site in the shallow water habitat zone will be created on-site and created in a way that allows for sediment to accrete and serve as potential delta smelt spawning habitat.

The effects to delta smelt critical habitat are being mitigated both on-site and off-site and are not expected to appreciably diminish the value of the critical habitat or prevent it from sustaining its role in the conservation of the delta smelt.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by Service regulations at 50 CFR 17.3 as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the same regulations as an act which actually kills or injures wildlife. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the contractor to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the contract, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

Amount or Extent of Take

Valley Elderberry Longhorn Beetle

The Service anticipates that incidental take of valley elderberry longhorn beetle will be difficult to detect due to its life history and ecology. Specifically, valley elderberry longhorn beetles can be difficult to locate since most of their life cycle is spent in the elderberry shrub and finding a dead or injured individual is unlikely due to their relatively small size. There is a risk of harm, harassment, injury and mortality as a result of the proposed construction activities; therefore, the Service is authorizing take incidental to the proposed action as harm, harassment, injury, and mortality of all valley elderberry longhorn beetles within 7.92 acres of habitat that will be transplanted as a result of construction and 40 acres of elderberry shrubs that will be trimmed for maintenance purposes over the project's 50 year life.

Delta Smelt

The Service expects that incidental take of delta smelt will be difficult to detect or quantify for the following reasons: the small size of adults, their occurrence in turbid aquatic habitat makes them difficult to detect, and the low likelihood of finding dead or impaired specimens. The Service anticipates that the extent of incidental take will be minimized due to the proposed conservation measures and low relative abundance. Due to the difficulty in quantifying the number of delta smelt that will be taken as a result of the proposed action, the number of acres of affected habitat becomes a surrogate for the species that will be taken. The Service anticipates that all individual adult delta smelt in the 30 acres of the action area may be subject to incidental take in the form of harm as described in this biological opinion. Incidental take of delta smelt for maintenance activities is not covered in this biological opinion.

Giant Garter Snake

The Service anticipates that incidental take of the snake will be difficult to detect or quantify for the following reasons: snakes are cryptically colored, secretive, and known to be sensitive to human activities. Snakes may avoid detection by retreating to burrows, soil crevices, vegetation, and other cover. Individual snakes are difficult to detect unless they are observed, undisturbed, at a distance. Most close-range observations represent chance encounters that are difficult to predict. It is not possible to make an accurate estimate of the number of snakes that will be harassed during construction activities, including in staging areas and roads carrying vehicular traffic. In instances when take is difficult to detect, the Service may estimate take in numbers of species per acre of habitat lost or degraded as a result of the action as a surrogate measure for quantifying individuals. Therefore, the Service anticipates the number of giant garter snakes that may be found in 12.7 acres of aquatic and upland habitat will be harmed or killed as a result of habitat modification due to the proposed project. Incidental take of giant garter snake for maintenance activities is not covered in this biological opinion.

Yellow-Billed Cuckoo

The Service anticipates that incidental take of yellow-billed cuckoo will be difficult to detect due to its life history and ecology. Specifically, yellow-billed cuckoos can be difficult to locate due to their cryptic appearance and behavior and finding a dead or injured individual is unlikely. There is a risk of harm and harassment as a result of proposed construction activities and operations and maintenance of the restoration plantings; therefore, the Service is authorizing take incidental to the proposed action as harm and harassment of all yellow-billed cuckoos within 135 acres. Incidental take of yellow-billed cuckoo for maintenance activities is not covered in this biological opinion.

Upon implementation of the following reasonable and prudent measures, incidental take of valley elderberry longhorn beetle, delta smelt, giant garter snake, and yellow-billed cuckoo associated with the American River Common Features 2016 will become exempt from the prohibitions described in section 9 of the Act. No other forms of take are exempted under this opinion.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

Reasonable and Prudent Measures

All necessary and appropriate measures to avoid or minimize effects on the [Species] resulting from implementation of this project have been incorporated into the project's proposed conservation measures. Therefore, the Service believes the following reasonable and prudent measure is necessary and appropriate to minimize incidental take of the valley elderberry longhorn beetle, delta smelt, giant garter snake, and yellow-billed cuckoo:

1) All conservation measures, as described in the biological assessment and restated here in the Project Description section of this biological opinion, shall be fully implemented and adhered to. Further, this reasonable and prudent measure shall be supplemented by the terms and conditions below.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

1. The Corps shall include full implementation and adherence to the conservation measures as a condition of any permit or contract issued for the project.

2. In order to monitor whether the amount of incidental take anticipated from implementation of the proposed project is approached, the Corps will adhere to the following reporting requirement.

    a. For those components of the action that will result in habitat degradation or modification whereby incidental take in the form of harm is anticipated, the Corps shall provide a letter prior to construction of the actual impacts and mitigation as well as a precise accounting of the total acreage of habitat impacted per contract to the Service at the completion of the construction season.

    b. The Corps shall immediately contact the Service's Sacramento Fish and Wildlife Office (SFWO) at (916) 414-6541 to report direct encounters between listed species and project workers and their equipment whereby incidental take in the form of, harm, injury, or death occurs. If the encounter occurs after normal working hours, the Corps shall contact the SFWO at the earliest possible opportunity the next working day. When injured or killed individuals of the listed species are found, the Corps shall follow the steps outlined in the Salvage and Disposition of Individuals section below.

Salvage and Disposition of Individuals

Injured listed species must be cared for by a licensed veterinarian or other qualified person(s), such as the Service-approved biologist. Dead individuals must be sealed in a resealable plastic bag containing a paper with the date and time when the animal was found, the location where it was found, and the name of the person who found it, and the bag containing the specimen frozen in a freezer located in a secure site, until instruction s are received from the Service regarding the disposition of the dead specimen. The Service contact person is Jennifer Hobbs at the SFWO at (916) 414-6541.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following actions:

1) The Service recommends the Corps develop and implement restoration measures in areas designated in the Delta Fishes Recovery Plan (Service 1996) the Giant Garter Snake Recovery Plan (2017) and the Valley Elderberry Longhorn Beetle Recovery Plan (2019).

2) The Corps and SAFCA should develop and implement projects that support DWR's Central Valley Flood System Conservation Strategy. This document provides goals and measurable objectives and potential projects which could be implemented in a manner that while improving the riverine ecosystem also will improve the flood system.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION—CLOSING STATEMENT

This concludes formal consultation on the American River Common Features 2016. As provided in 50 CFR §402.16(a), reinitiation of consultation is required and shall be requested by the federal agency or by the Service where discretionary federal involvement or control over the action has been retained or is authorized by law, and:

1) If the amount or extent of taking specified in the incidental take statement is exceeded;

2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;

3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or written concurrence, or

4) If a new species is listed or critical habitat designated that may be affected by the identified action.

If you have any questions regarding this biological opinion, please contact Jennifer Hobbs (jennifer_hobbs@fws.gov), at the letterhead address or at (916) 414-6541.

Sincerely,

Michael Fris
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Re: Endangered Species Act Section 7(a)(2) Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the American River Watershed Common Features General Reevaluation Report Reinitiation 2020

Dear Ms. Kirchner:

Thank you for your letter of September 9, 2020, requesting reinitiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 *et seq*.) for American River Watershed Common Features General Reevaluation Report. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) for this action.

The enclosed biological opinion (BO) analyzes the effects of the American River Watershed Common Features General Reevaluation Report. This BO is based on the final biological assessment for the project, and on the best available scientific and commercial information. The BO concludes that the analyzed project is not likely to jeopardize the continued existence of the federally listed as endangered, Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) evolutionarily significant unit (ESU), the threatened Central Valley spring-run Chinook salmon ESU (*O. tshawytscha*), the threatened southern distinct population segment (DPS) of the North American green sturgeon (*Acipenser medirostris*), and the threatened California Central Valley steelhead (*O. mykiss*) DPS, and is not likely to destroy or adversely modify their designated critical habitats. NMFS has included an incidental take statement with reasonable and prudent measures and nondiscretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the project.

This letter also transmits NMFS's review of potential effects of the American River Watershed Common Features General Reevaluation Report on EFH for Pacific Coast salmon, designated under the MSA. This review was pursuant to section 305(b) of the MSA, implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation. The analysis concludes that the project would adversely affect the EFH of Pacific Coast salmon in the Action Area. The EFH consultation concludes with conservation recommendations.

Please contact Ally Lane at the California Central Valley Office of NMFS at (916)930-5617 or via email at Allison.lane@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for the
California Central Valley Office

Enclosure

cc: 151422-WCR 2020-SA00019

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
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Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

American River Watershed Common Features General Reevaluation Report

NMFS Consultation Number: WCRO-2020-03082

Action Agency: United Stated Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Central Valley spring-run Chinook Salmon ESU (*Oncorhynchus tshawytscha*)	Threatened	Yes	No	Yes	No
California Central Valley steelhead DPS (*O. mykiss*)	Threatened	Yes	No	Yes	No
Southern DPS of North American green sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	Yes	No
Sacramento River winter-run Chinook salmon ESU (*O. tshawytscha*)	Endangered	Yes	No	Yes	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for the California Central Valley Office

Date: May 12, 2021

TABLE OF CONTENTS

1. Introduction

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (BO) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 *et seq*.), and implementing regulations at 50 CFR 402, as amended.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 *et seq*.) and implementing regulations at 50 CFR 600 .

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the California Central Valley Office.

1.2. Consultation History

Authorization for the overall American River Common Features (ARCF) Project is provided by Section 101 of the Water Resources Development Act (WRDA) of 1996 (PL 104-303), and modified by WRDA 1999, Section 366 (PL 106-53). The authorization was reassessed under a reevaluation study known as the ARCF General Reevaluation Report (GRR) (Corps 2015). On September 9th, 2015, the National Marine Fisheries Service (NMFS) issued a BO (NMFS 2015) and on September 11, 2015, the U.S. Fish and Wildlife Service (USFWS) issued a BO (File No. 08ESMF00-2014-F-0518; referred herein as 2015 USFWS BO; USFWS 2015) on the ARCF GRR in accordance with Section 7(a)(2) of the Endangered Species Act of 1973, as amended (FESA) (16 U.S.C. 1531 *et seq*.).

The history of the section 7 consultation on the ARCF Project started during the development of the ARCF GRR in 2015. The BOs were issued by NMFS and USFWS as described above. Full consultation history of all aspects prior to this reinitiation can be found in the consultation history of the September 9, 2015 NMFS BO (referenced in this document as 2015 NMFS BO). Several aspects of the 2015 BO have already been implemented or are beginning to be constructed as follows:

- Sacramento River East Levee cutoff walls in several areas (2020-2021)
- Tree removal at several locations (2018-2021)
- Partial areas of seepage berm installed on the Sacramento River (2019)

- Beach Stone Lakes Mitigation Site south of Freeport, north of Morrison Creek on the east side of the Sacramento River (2020 and ongoing)
- Arcade Creek (2017-2020)
- Purchase of 20 mitigation credits at Fremont Landing Conservation Bank (2019)

NMFS has provided technical assistance during the development of the site designs and the BA between October 2019 and ongoing through March 2021. Project technical assistance and design team involvement have been occurring regularly since December of 2018.

- On September 30, 2020, the Corps and NMFS agreed on the use of the proposed improvements to the existing Sacramento Weir stilling basin as a mitigation project.
- On February 25, 2020, NMFS received a draft Biological Assessment (BA) from the United States Army Corps of Engineers (Corps) for review and comments.
- March 2, 2020, NMFS sent comments on the draft BA to the Corps.
- April 16, 2020, NMFS received new draft BA from Corps.
- From April 2020 through August 2020, numerous technical meetings, discussions, and revisions occurred to reduce impacts, clarify project description, and adjust mitigation.
- September 9, 2020, NMFS received new BA from Corps requesting reinitiation of consultation.
- September 15, 2020, NMFS requested clarification on the BA from Corps regarding the proposed action, effects, and additional information on their method of analysis.
- October 28, 2020, NMFS received updated information and responses from Corps, and consultation was initiated.
- February 1, 2021, NMFS received changes to the proposed action from Corps and agreed upon an extension of the BO due date to April 3, 2021.

1.3. Proposed Federal Action

Under the ESA, “action” means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02).

Under MSA, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).]

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not.

According to the Corps 2020 BA, Congress directed the Corps to investigate the feasibility of reducing flood risk to the city of Sacramento and surrounding areas. The Corps completed feasibility studies in 1991 and 1996, recommending a concrete gravity flood detention dam on the north fork of the American River at the Auburn site along with levee improvements downstream of Folsom Dam. Other plans evaluated in the report were Folsom Dam improvements and a stepped release plan for Folsom Dam releases. These additional plans also included levee improvements downstream of Folsom Dam. The ARCF Project was authorized in the WRDA of 1996 and a decision on Auburn Dam was deferred to a later date. Major construction components of ARCF in the 1996 and 2016 WRDA authorization included construction of seepage remediation along about 22 miles of American River levees and construction of levee strengthening and raising of 12 miles of Sacramento River levee in Natomas.

The purpose of the ARCF project is to reduce the flood risk for the City of Sacramento and surrounding areas. The BA identified following problems within the Sacramento levee system:

- Seepage and underseepage;
- Levee erosion;
- Levee stability;
- Levee overtopping;
- Access for maintenance and flood fighting;
- Vegetation and encroachments;
- Releases from Folsom Dam;
- Floodplain management; and
- Additional upstream storage from existing reservoirs.

In order to evaluate the effects to listed species, the Corps looked at the largest foreseeable footprint as a worst-case scenario. The Corps anticipates a reduced footprint once more detailed design development and the construction phase of the contracts occurs, likely resulting in reduced adverse effects to listed species.

The project is designed to support the surrounding levees for the release of 160,000 cubic feet per second (cfs) from Folsom Dam. The Corps has deemed that the levees along the American River are unable to withstand these maximum flows for extended periods of time without increased risk of erosion and potential failure. The exact locations where erosion will occur and to what extent erosion will occur during any given event is unknown.

The Corps' project involves the construction of fix-in-place levee remediation measures to address seepage, stability, erosion, and height concerns identified for the Sacramento River and American River levees, Natomas East Main Drainage Canal (NEMDC), and Arcade Creek. Most height concerns along the Sacramento River will be addressed by a widening of the Sacramento Weir and Bypass to divert more flows into the Yolo Bypass, thereby lowering water surface elevations downstream. Due to the urban nature and proximity of existing development within the American River North and South basins, the Corps is planning fix-in-place remediation. Table 1 below, summarizes the levee problems discussed above and the proposed measure/remediation for each waterway.

The Sacramento Area Flood Control Agency (SAFCA), one of the ARCF Project's sponsors, will complete some portions of the Federal project. SAFCA received Corps permission pursuant to 33 USC §408 (Section 408) for alteration of the Federal levees along the NEMDC and Arcade Creek. Those activities have been completed under the 2015 consultation (see consultation history) by SAFCA and will be discussed as it pertains to operations and maintenance.

In addition to the proposed levee improvements measures, the following measures and policies would be addressed during construction:

- The Corps will apply a semi-quantitative risk assessment methodology to evaluate the placement of on-site mitigation riparian tree and shrub species.

- The ARCF Project's non-Federal sponsors, CVFPB and SAFCA, will bring the levees into compliance with the Corps' standards using a System Wide Implementation Framework (SWIF) process. A SWIF is a long-term plan developed by the levee sponsor(s) and accepted by the Corps to implement system-wide improvements to a levee system (or multiple levee systems within a watershed) to address system-wide issues, including correction of unacceptable levee inspection items, in a prioritized way to optimize flood risk reduction. The standard levee footprint consists of a 20-foot crown width, 3:1 waterside slope and 2:1 landside slope. There may be locations where a 3:1 waterside slope design is not possible, and in those cases the slope would be buttressed with revetment, which would solve slope stability and erosion concerns (Corps BA, 2020).

Table 1. Remediation by Waterway.

Waterway	Seepage Measures	Stability Measures	Erosion Protection Measures	Overtopping Measures
American River[1]	---	---	Bank Protection (31,000 linear feet), Launchable Rock Trench (45,000 linear feet)	---
Sacramento River	Cutoff Wall (50,300 linear feet)	Cutoff Wall (50,300 linear feet)	Bank Protection (43,000 linear feet)	Sacramento Bypass and Weir Widening, Levee Raise (1,500 feet)
NEMDC	Cutoff Wall (6,000 linear feet)	Cutoff Wall	---	Floodwall (15,600 linear feet)
Arcade Creek	Cutoff Wall (22,000 linear feet)	Cutoff Wall	---	Floodwall (22,000 linear feet)

[1]American River seepage, stability, and overtopping measures were addressed in a previous construction project.

1.3.1. American River

The Corps has concluded that levees along the American River require improvements to address erosion. The proposed measures for these levees consist of waterside armoring to prevent erosion to the riverbank and levee, which could potentially undermine the levee foundation. Two primary measures described on the American River levees in the ARCF GRR: (1) a maximum of 31,000 linear feet (LF) of bank protection, and (2) a maximum of 65 acres/45,000 LF of launchable rock trench (Figure 1). Several alternative designs are described below, but may vary in footprint and overall impacts. These numbers are maximized because there is some overlap identified to account for the uncertainty of site-specific conditions.

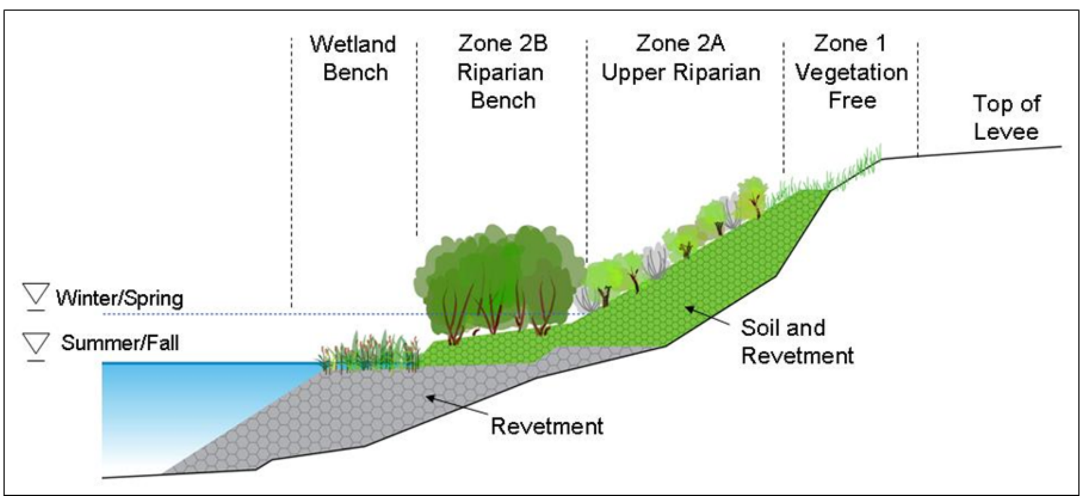
Bank Protection

This measure consists of placing rock revetment on the river's bank to prevent erosion. It entails installing revetment along the stream bank based on site-specific analysis (Figure 1). When necessary, the eroded portion of the bank will be filled and compacted prior to the rock placement. The sites will be prepared by clearing and stripping loose material and understory growth prior to construction. In most cases, large vegetation will be permitted to remain at these sites. Temporary access ramps will be constructed, if needed, using imported borrow material that would be trucked on site.

The placement of rock onto the bank will be conducted from a land-based staging area using long reach excavators and loader. The loader brings rock from a permitted source and stockpiles it near the levee in the construction area. The excavator then moves the rock from the stockpile to the waterside of the levee.

The revetment will be placed on the existing bank at a slope varying from 2V (vertical):1H (horizontal) to 3V:1H depending on site-specific conditions. Where hydraulic stage impacts have been deemed acceptable and space allows, a planting berm consisting of either a soil-fill trench or a soil-rock mix, supported by a launchable rock toe, will be constructed to support onsite mitigation. Planting berms would be scaled on a site-by-site basis based on site-specific constraints and design performance targets.

Figure 1. Example of Bank Protection with Planting Bench.

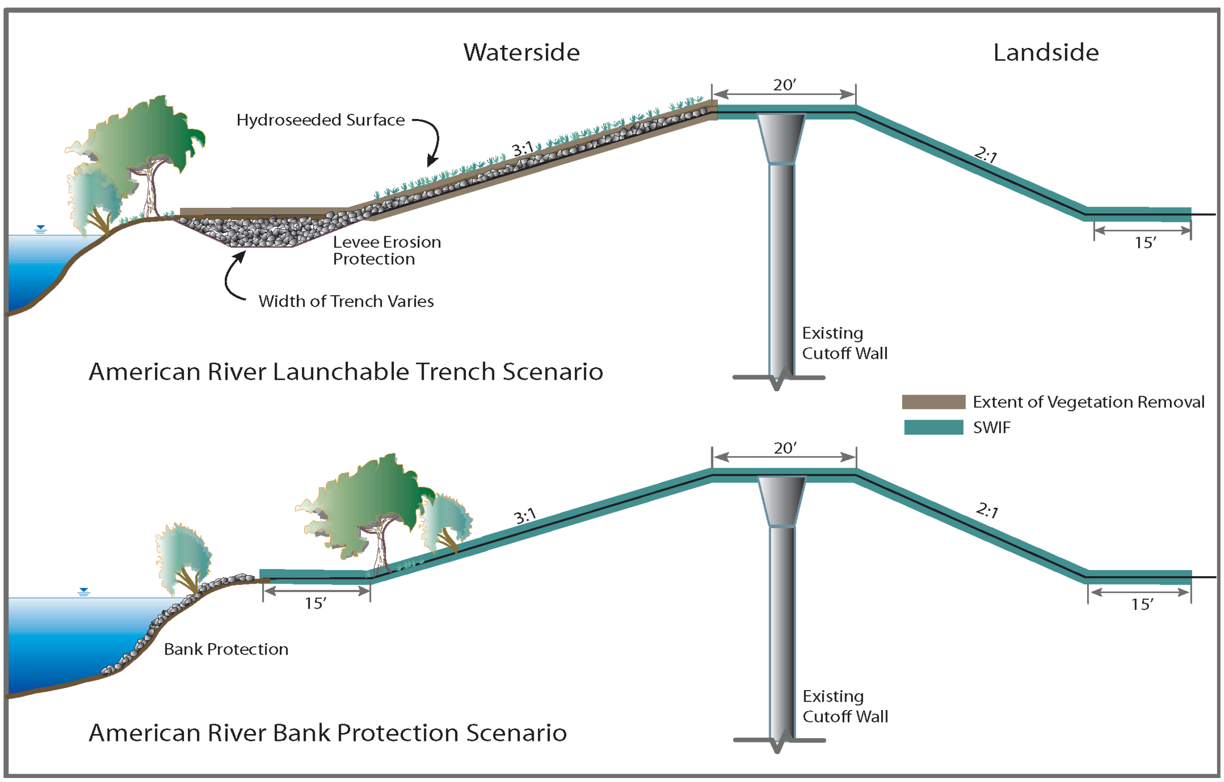


Launchable Rock Trench

For the purposes of this project description, it is assumed that up to 65 acres of the lower American River will incorporate the launchable rock trench measure for remediation. The construction of the launchable rock-filled trench would be designed to deploy once erosion has removed the bank material beneath it (Figure 2). All launchable rock trenches will be constructed outside of the natural river channel, and be well above the ordinary high water mark (OHWM). The vegetation will be removed from the footprint of the trench and the levee slope prior to excavation of the trench. The trench configuration will be a range of side slopes between 1:1 and 3:1 and will be excavated at the toe of the existing levee. All soil removed during trench excavation will be stockpiled for potential reuse or disposed of offsite.

After excavation, the trench will be filled with revetment that will be imported from an offsite commercial location. After rock placement, the trench will be covered with a minimum of 3 feet of soil for a planting berm. Rock placed on the levee slope may be covered with soil and as with all disturbed areas will be reseeded with native grasses and small shrubs.

Figure 2. Launchable Rock Trench and Bank Protection.



Additional Potential Designs

Additional bank protection measures may be considered and found to be appropriate during the implementation of site-specific designs as described in the *Stakeholder Engagement Process* section in the 2020 Corps BA. Design and analysis of any additional measures would be carried out during the site-specific planning and design phase. Examples of additional measures include, but are not limited to, toe protection, flow modification, cut bank, and alternative design and materials for reduction of riprap. These and other measures, which may be developed in the future, would be designed in coordination with NMFS and USFWS to minimize adverse effects to listed species and their habitat resulting from the Proposed Action.

One current design for a segment on the American River includes cutting the bank back to create a more gentle slope less prone to erosion. This cut bank design, combined with launchable buried rock tiebacks oriented perpendicular to the river and spaced in intervals between 30-100 feet is a design that was adopted as a set of measures to protect both the levee and the bank while providing a natural bank line that will support a naturally functioning riparian community between the rock tiebacks. This combination of measures is to eliminate or slow the retreat or loss of the bank, create more shallow water, shaded riverine aquatic habitat below the (OHWM), and retain the contiguous riparian corridor with onsite plantings between and within the soil-filled riprap tiebacks.

1.3.2. Arden Pond Mitigation Site

Also being constructed alongside the earlier erosion projects is one offsite mitigation area at Arden Pond (American River, River Mile [RM] 12). Arden Pond is approximately 29.5 acres in size (Figure 3). Work at Arden Pond includes grading and fill to reconnect the area with the river by constructing a side channel shoal system and adjacent emergent vegetation. A full description can be found in the *Arden Pond Supplemental Information for NMFS Consultation* document (ESA January 2021), which is summarized below for analysis purposes.

The proposed Arden Pond Mitigation Site is located at approximately RM 12 as illustrated in Figure 3**.** While there is the potential for listed species to occur seasonally in Arden Pond in its current state, it does not provide suitable habitat for rearing juvenile salmonids. Conversely, juvenile salmonids that enter Arden Pond have a high risk of mortality due to predation, warm water temperatures, and low water quality. The proposed Arden Pond Mitigation Site is being designed to continue to provide recreational opportunities for the public, while increasing suitable habitat for salmonids.

Separating the recreational pond from the restoration area would reduce depths in the area to meet habitat requirements for juvenile salmonids and support emergent vegetation to improve habitat by providing shade, cover, and food. Revegetation using emergent species (tules) would occur within portions of the new shoal perimeter of the placed fill. A swale would extend from the inlet channel mouth to the upstream end of the outlet channel. The final grading plan would include several islands within the mitigation site that would be designed to support riparian trees and shaded riverine aquatic (SRA) habitat. SRA and riparian vegetation would be created along the berm shoreline. Instream woody material (IWM) would also be added in various places for salmonid rearing habitat.

There has not been a bathymetric data collection effort conducted within the pond area; however, it is estimated that the depth of the pond is around 8 feet when flows in the LAR are at 2,000 cfs. The primary components of the mitigation site, as illustrated in Figure 3, include:

1. A Bass Pond (up to 11.3 acres) within the existing footprint of Arden Pond for recreational fishing activities;
2. A shallow side channel habitat within the existing footprint of Arden Pond as rearing and migration habitat for juvenile salmon with two design features:
   a. 6.1 acres of shallow flow areas with depths between 2 and 3 feet at 3,900 cfs during the winter/springs months
   b. 12.1 acres of riparian vegetation plantings along the shallow flow areas of the pond to create shaded riverine habitat;
3. A 2.8-acre earth-filled berm, with a section of permeable materials, to separate the two ponds to prevent predation of juvenile salmonids by bass while still providing flow circulation of fresh water into the area of the pond inhabited by bass; and
4. Two inundated floodplain mitigation sites (a 7.1-acre "West" and 2.3-acre "East" Mitigations Sites) to be excavated to the 2,660 cfs water surface elevation with gradual slopes and planting benches excavated above this elevation. The material excavated from these sites would be used for fill in Arden Pond.

Construction of the Arden Pond Mitigation Site would involve placement of approximately 330,000 cubic yards (CY) of soil into the restoration area, which is to come from the cut bank excavation of Site 2-3, excavated material from the bass pond, and excavated materials from the West and East Mitigation Sites (see description below). Approximately 140,000 CY would be placed in the 18-acre mitigation area to create 1- to 3-foot deep shoals at elevations of 1 to 3 feet below the 3,900 cfs flow water surface elevation up to the existing vegetated shoreline edges and the new berm.

The Bass Pond will be connected to the mitigation site via constructed open channel. The intent of the connection is to allow water levels in the Bass Pond to rise and fall with water levels in the neighboring mitigation site and to provide similar water quality conditions in the remaining Bass Pond to the existing pond. The connection will provide volitional passage for juvenile salmonids when active. The connection will likely be dry during drought and late summer months similar to the existing pond connection. The connection will be constructed with boulders, cobbles, and gravels as a natural channel Bass Pond

The existing Bass Pond would be excavated to a total depth of 6 feet with the material used for the construction of the berms and channel. Construction would decrease the area of the Bass Pond to approximately 11.3 acres within the existing mitigation site footprint. A non-permeable earth-filled berm (3 acres) would separate the pond from the side channel to prevent predation of juvenile salmon in the channel by bass in the pond. The pond will be dewatered to an elevation below the existing pond bottom elevation in the bass pond. (Existing pond elevation is at approximately 27 feet, pond to be dewatered to elevation of approximately 25 feet). Excavators will track out and excavate material and place material in haul equipment, which will haul over and dump into the fill location. The pond is thought to have a relatively coarse sand bottom over hard deposits. Tracked haul equipment or temporary matting may be required to support vehicles. Excavation will not occur in areas with standing water. Material is estimated to range from 24,000 to 50,000 CY.

West and East Mitigation Sites

The East and West Mitigation Sites would be excavated from the existing American River bank near the downstream extent of Arden Pond. The East and West Mitigation Site segments would include the enhancement and creation of aquatic habitat along an approximately 880-linear foot segment (430 linear feet at the West and 450 linear feet at the East Mitigation Site) along the riverbank. The majority of the excavation will occur above the typical summer water surface elevations. If excavation is required below the water surface level, it would take place in late summer when water levels are at their lowest. Excavation and grading activities within the site would be completed prior to breaching to the river to complete the connection. A turbidity curtain would be placed along the shoreline from the west edge of the West mitigation site to the eastern boundary of the East Mitigation at the start of construction and remain in place until construction activities were complete.

The East Mitigation Site would require excavation of about 30,000 CY of material and the West Mitigation Site would require excavation of about 125,000 CY of material. Excavated material from these sites would be used for fill at Arden Pond. The existing elevation at these sites is currently above the 2-year water surface elevation and does not generally support woody vegetation. The Proposed Action would excavate material from the existing banks at these sites down to the 2,660 cfs water surface elevation. The sites would include shallow islands, flat slopes of 5H:1V, or flatter with IWM, and benches, which would be planted with native riparian vegetation. The flat slopes, vegetation, and lower surfaces would provide rearing habitat and aquatic habitat suitable for juvenile salmonid rearing at a range of flows. The sites together would provide an additional approximate increase of 7 acres of habitat (5.16 acres on the West and 1.95 acres on the East Mitigation Site) below the 18,500 cfs water surface elevation.

Construction Methods and Phasing

Construction would occur in six phases starting in the winter of 2021/2022. Trees would be removed between November 2021 and February 2022, before the nesting season. After these activities and prior to July 1, 2022, mobilization would include the application of temporary best management practices (BMPs) for the control of off-site stormwater runoff and sedimentation, building temporary access roads, preparing staging areas, rerouting pedestrian and bicycle trails, and installing signage for traffic and alternate transportation routes that would be affected by construction activities (e.g., bicycle routes). Vegetation clearing could be needed to allow for site access and to accommodate construction activities.

A turbidity curtain, or other minimization measures approved by the State Water Resources Control Board (SWRCB), the California Department of Fish and Wildlife (CDFW), NMFS, and USFWS, would be installed prior to any in-water work conducted on the waterside of the levee.

The work limits and staging areas would be fenced with orange construction fencing to protect sensitive habitat and to identify disturbance area limits. In addition, a 6-foot-tall temporary chain-link security fencing would be installed around staging areas and along the access routes within the sites.

Prior to commencing earthwork activities within the Arden Pond or East and West Mitigation Sites, measures to eliminate water within the construction footprint would be implemented first. These measures would not occur at the East and West Mitigation Sites until the beginning of the in-water work window on July 1. The inlet channel to Arden Pond would be blocked starting June 1 using a temporary dam structure (e.g., a water filled bladder dam or sand or gravel filled sacks). The outlet channel would be notched with an excavator to gradually lower the pond level to an elevation of about 25 feet NAVD88 (North American Vertical Datum of 1988). The excavator will slowly notch the channel to maintain a controlled rate of lowering pond levels. The controlled rate will be determined at further levels of design to meet geotechnical, fisheries, and water quality requirements. Biological monitors will be on-site to observe for fish presence prior to use of excavator to remove and sidecast material from the channel lowering the channel outlet. After the pond level has been decreased to a water surface elevation 25, fish rescue within the pond would occur (See Conversation Measures Section below). Sediment capture material will be placed in the channel.

If required, pumps may be installed within Arden Pond to lower the pond level below the elevation of the American River channel at the outlet. The pump system and fish screen would conform to the anadromous salmonid passage facility design criteria issued by NMFS in July 2011. Water would be pumped directly into the American River, and turbidity testing would occur during the pond lowering to ensure values are within SWRCB water quality permit conditions.

Conservation Measures Specific to Arden Pond Mitigation Sites

In addition to the conservation measures already proposed, the following measures will be included specific to Arden Pond:

1. In-water construction activities shall be conducted within in-water work windows to avoid and minimize effects to critical salmonid life stages (juvenile rearing, and juvenile and adult passage), typically from July 1 through October 31. The exception being, that in-watering work related to what is necessary for dewatering activities would begin starting June 1. Any requested in-water work outside this window will be coordinated with NMFS.

2. Erosion protection material used within restoration areas would consist of a cobblestone rock mix ranging between 0.5 to 4 inches in diameter, which is consistent with the rock sizing recommended by the USFWS and NMFS to meet salmonid spawning protection requirements.

3. Because installation of the cofferdam and dewatering in the Arden Pond site during construction could result in fish stranding, both during initial temporary dam installation

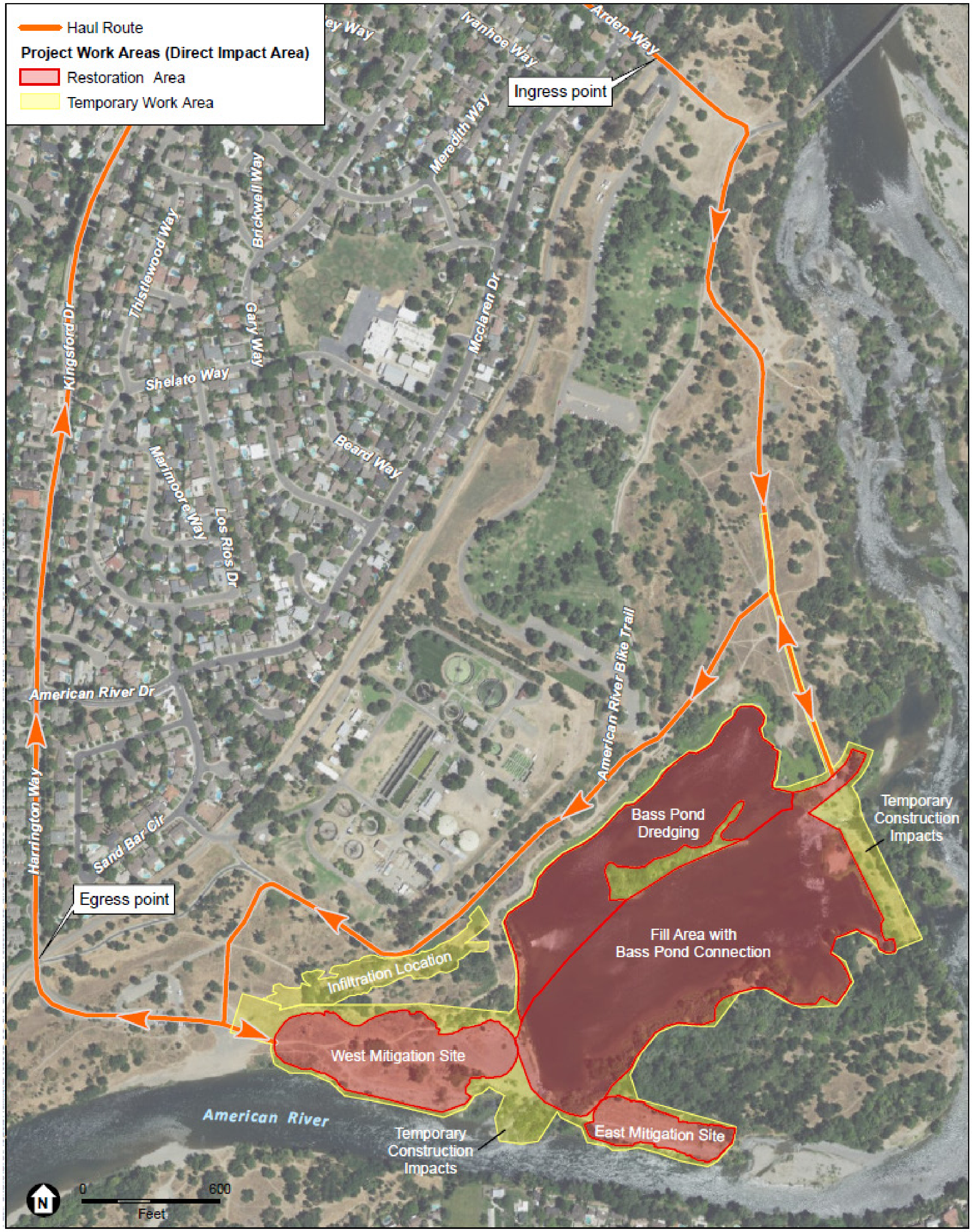
and following potential temporary dam overtopping events. The Corps will implement fish rescues acceptable to NMFS and shall implement dewatering in a manner that is not harmful to fish or other aquatic or semi-aquatic wildlife. Dewatering efforts would utilize the least impactful techniques, such as draining the pond via gravity first and then if necessary, using a pump system to complete dewatering activities. If a pump is required, the suction end of the intake pipe shall be fitted with fish screens intended to prevent entrainment or impingement of small fish[1] . The Corps will ensure that dewatering shall be implemented with a fish rescue team composed of several qualified fisheries biologist and/or technicians, each with experience in fish capture and handling to maximize efficiency of rescues while avoiding potential stranding or desiccation of fish. The fish rescue effort will be implemented during the dewatering of the pond area behind the temporary dams and involve capture and return of those fish to suitable habitat within adjacent waterways, or to another NMFS approved location. The area will first be seined, to the extent feasible, followed by electrofishing to remove fish that are behind the dam. The contractor will monitor the progress of dewatering and allow for the fish rescue to occur prior to completely closing the dam and again when water depths reach the approximate elevation of the American River. NMFS will be notified at least 48 hours prior to the start of fish rescue efforts. Information on the species, number, and sizes of fish collected will be recorded during the fish rescue and provided in a letter report to be submitted within 30 days after the fish rescue to NMFS. Implementation of fish rescues would minimize lethal impacts to listed fish species (when present) associated with fish stranding during dewatering activities related to the construction activities.

Mitigation/Compensation for ARCF Actions from Arden Pond

Restoration efforts proposed at Arden Pond have been designed to provide compensatory mitigation for the ARCF GRR Proposed Action. The 29.5 acres of pond within Arden Pond will be regraded and a portion filled to create the side channel. Creation of additional juvenile habitat within the Arden Pond channel and East and West Mitigation sites would result in the temporary disturbance of (roughly 6.48 acres of SRA habitat and 9.8 acres of riparian habitat) low quality juvenile salmonid rearing and riparian habitat. However, the project will create an estimated 12.1 acres of higher quality riparian habitat along the shores and islands of the proposed channel and an additional 13.21 acres of inundated rearing habitat between the channel (6.1 acres) and the East and West mitigation Sites (7.11 acres).

1 http://www.dfg.ca.gov/fish/ResQurces/Projects/Engin/Engin ScreenCriteria.asp

Figure 3. Arden Pond Mitigation Site plan view



SOURCE: USDA, 2018; NHC, 2021; ESA 2021 ARCF 2016 American River Contract 2

The Corps also proposes to degrade the island, just upstream of the Howe Ave boat launch, for the purpose of Hydraulic Mitigation. This concept involves removing the mid-channel island and using the material to fill in the bank. The bank fill area extends from the existing bank at approximately elevation 30 feet out into the channel to the 3,900 cfs water surface elevation (approximately 18 feet). The proposed design cuts down half of the island to 16 feet and then cuts down to existing ground at a gradual slope. The area at 16 feet elevation provides shallow fish rearing habitat, as it is in the 95 percent (%) exceedance flow and will not grow vegetation. The area at and around 18 feet is expected to grow vegetation, as this elevation is where natural recruitment is seen elsewhere on the river. The area is not in close proximity to known active steelhead spawning areas. An option with the island fully cut down to existing elevation was modeled and considered as well.

1.3.3. Sacramento River

Seepage, Stability, and Overtopping

The Corps reports that levees along the Sacramento River need improvements to address seepage, stability, and erosion. About 43,000 LF of bank protection and 50,300 LF of cutoff wall or slope stability work is planned for the Sacramento River. In addition, these levees may need a total of one mile of intermittent height improvements in order to ensure that additional river flows that exceed current design levels could be accommodated without risk of levee failure.

Where the existing levee does not meet the levee design requirements, as discussed above, slope flattening, crown widening, and/or a minimal amount of levee raise is required. This improvement measure addresses problems with slope stability, geometry, height and levee crest access and maintenance. To begin levee embankment grading, loose material and vegetation understory will be cleared, grubbed, stripped, and where necessary, portions of the existing embankment will be excavated to allow for bench cuts and keyways to tie in additional embankment fill. Excavated and borrow material (from nearby borrow sites) will be stockpiled at staging areas. Haul trucks and front end loaders will bring borrow materials to the site, which will then be spread evenly and compacted according to levee design plans.

The levee will be raised about 1 to 2 feet resulting in the levee footprint extending out a maximum of 5 feet on the landside from the existing levee. The levee crown patrol road will be re-established at the completion of construction.

Cutoff Walls

To address seepage concerns, a cutoff wall will be constructed through the levee crown. The cutoff wall will be installed by one of three methods: (1) conventional open trench cutoff walls, (2) deep soil mixing (DSM) cutoff walls, and (3) jet grout cutoff walls. The method of cutoff wall selected for each reach will depend on the depth of the cutoff wall needed to address the seepage. The open trench method can be used to install a cutoff wall to a depth of about 85 feet. For cutoff walls of greater depth, the DSM method will be utilized. Jet grout cutoff walls may be used when underground utilities prevent the installation of other types of cutoff walls.

Prior to any cutoff wall construction method, the construction site and any staging areas will be cleared, grubbed, and stripped. The levee crown will be degraded up to half the levee height to create a large enough working platform (about 30 feet) and to reduce the risk of hydraulically fracturing the levee embankment from the insertion of slurry fluids. This method of slurry wall installation will also reduce the risk of slurry mixture following seepage paths and leaking into the river or into landside properties.

Open Trench Cutoff Wall

Under the open trench method, a trench about 3 feet wide will be excavated at the top of levee centerline and into the subsurface materials up to 85 feet deep with a long boom excavator. As the trench is excavated, it is filled with low-density temporary bentonite water slurry to prevent cave in. The soil from the excavated trench is mixed nearby with hydrated bentonite, and in some applications cement. The soil bentonite mixture is backfilled into the trench, displacing the temporary slurry. Once the slurry was hardened, it will be capped and the levee embankment will be reconstructed with impervious or semi-impervious soil.

DSM Cutoff Wall

The DSM method involves a crane supported set of two to four mixing augers used to drill through the levee crown and subsurface to a maximum depth of about 140 feet. As the augers are inserted and withdrawn, a cement bentonite grout will be injected through the augers and mixed with the native soils. An overlapping series of mixed columns will be drilled to create a continuous seepage cutoff barrier. A degrade of up to one-half the levee height will be needed for construction of the DSM wall. For both methods, once the slurry has hardened it will be capped and the levee embankment will be reconstructed with impervious or semi-impervious soil.

Jet Grout Construction

Jet grout construction involves injecting grout into the soil at very high pressures and will be used in areas where there are utilities that cannot be removed, such as the regional sewer line and the Pacific Gas and Electric (PG&E) natural gas line near the Pioneer Bridge. The grout is a mixture of cement and water that would be mixed in a batch plant located in the staging area and transported through high- pressure hoses to the location of construction. The jet grout process involves drilling a hole straight down into the levee to a depth of up to approximately 130 feet, then injecting grout into the hole through a high-pressure nozzle. As the grout is injected from the bottom to the top of the hole, the high pressure excavates the soil around the nozzle to a radius of 3 to 4 feet, mixing the soil within the levee with grout. The grout injection may be accompanied with air and water to assist the excavation of soil. The nozzle is rotated and lifted at a slow, smooth, constant speed to achieve thorough mixing and consistent quality. The grout then solidifies to create a column of low permeability. Multiple columns constructed together create a wall through the levee that prevents seepage. Soil that is displaced from the injection site would be piped into drying beds or containment cells located in the staging area for later disposal.

Jet grouting activities near Pioneer Bridge may occur on a 24 hour a day schedule to expedite work, which will generate noise and require night lighting.

Municipal Drainage Systems

Several municipal drainage systems, both legacy and operational, have pipes that run through the levee. These facilities require removal and replacement to install the cutoff walls. Temporary waterside access below the OHWM of the river is required to remove or replace these structures. A small portion of concrete apron will be poured as part of an outfall pipe replacement (also called Sump 70), and will likely extend below the OHWM. This concrete apron is to protect the shoreline below from erosion that may occur from water exiting the outfall pipe. While other outfall pipes will need to be replaced as part of this project, this is currently the only one anticipated to require work below the OHWM. Temporary access will consist of dewatering the area with the use of a cofferdam approximately five feet high (1.75 feet above the typical water level) and approximately 120 feet in length. The cofferdam would be installed, and work completed between July 1 and October 31, which is outside of sensitive fish species migration windows. A portion of the existing revetment would be removed. Work to replace individual drainage facilities is estimated to take up to 15 days. There may be up to five areas where in-water work may be needed to remove or replace these pump systems throughout all Sacramento River east levee contracts.

Stability Berms and Blankets

Stability berms and blankets address shallow foundation and/or levee embankment through-seepage. A stability berm or blanket is a prism of compacted soil that acts as a buttress to increase stability factors of safety and, in some cases, includes an inclined filter/drain zone placed on the landside slope of a levee to capture seepage that would otherwise exit on and potentially erode the unprotected levee slope. Typical stability berms are 10-15 feet high (depending on the height of the levee) and 10-25 feet wide, and are considered in limited areas that do not have substantial right of way issues. Alternatively, the stability berm can be constructed within the existing levee in areas with constrained access along the landside levee toe. The inset stability berm would be constructed by excavating the landside levee slope, constructing the filter/drain zone, then rebuilding the levee slope to approximately the original grade with compact fill.

Toe Drains

The primary purpose of a toe drain is to capture through-levee seepage before it exists on the levee slope, potentially causing erosion and instability, and to filter the discharge in such a way as to reduce velocity and fine soil carrying capacity. A toe drain would typically be used when through-seepage or through-seepage-driven landslide slope stability is problematic. Toe drains could be used in several limited reaches where the levee does not have an existing shallow cutoff wall and there is a concern regarding potential seepage breakout on the levee slope or the levee toe. Toe drains would be constructed by excavating into the levee prism and constructing a filtered drain within the downstream toe of the levee embankment.

Bank Protection

Proposed bank protection along the Sacramento River will address erosion concerns. The Sacramento River levees have a medium to high risk of breach due to erosion (Corps 2020 BA). Bank protection will be addressed with rock revetment and planting berms when feasible. The bank protection measure for the Sacramento River consists of placing rock protection on the bank to prevent erosion. This measure entails filling the eroded portion of the bank, where necessary, and installing revetment along the waterside levee slope and streambank from streambed to a height determined by site-specific analysis. Large trees on the lower half of the waterside slope may be protected in place when possible to retain SRA habitat. The sites will be prepared by removing vegetation along the levee slopes at either end of the site for construction of a temporary access ramp, if needed. The ramp will then be constructed using imported commercial borrow material that will be trucked on site.

The placement of rock onto the levee slope will occur from atop the levee and/or from the waterside by means of barges. Rock placed within the channel, both above and below the water line at the time of placement, will be mixed with soil where feasible and placed by an excavator from a barge. Construction may require two barges: one barge would carry the crane and/or excavator, while the other barge will hold the stockpile of rock to be placed on the channel slopes. While most sites will not need rock on the levee embankment, when it is installed on the upper portions of the slopes, it will be placed by an excavator located on top of the levee. Rock placement from atop the levee will require one excavator and one loader for each potential placement site. The loader brings the rock from a permitted source and stockpiles it near the levee in the construction area. The excavator then moves the rock from the stockpile to the waterside of the levee.

The revetment will be placed via the methods discussed above on existing bank at a slope varying from 2V:1H to 3V:1H depending on site-specific conditions. After initial revetment placement has been completed, a small planting berm where feasible, consisting of either a soil-fill trench or a soil-rock mix, supported by a launchable rock toe, will be constructed to support onsite mitigation.

Additional Measures

Additional bank protection measures may be considered and found to be appropriate during the implementation of site-specific designs in coordination with NMFS. Design and analysis of any additional measures would be carried out during the site-specific planning and design phase. Examples of additional measures include, but are not limited to, toe protection, flow modification, cut bank, and alternative design and materials for reduction of riprap. These and other measures, which may be developed in the future, would be designed in coordination with NMFS and USFWS to minimize effects to listed species and their habitat from the proposed action. Adverse effects to listed fish species described below within the Section 2.5 Effects of the Action are anticipated to cover these site-specific design variations. Measures for erosion protection that the Corps is considering include rock toe launchable berms with soil-filled or soil-rock mix riparian planting benches and soil filled riprap upslope, sheet pile, articulated concrete blocks, tule benches with IWM anchored in place in rock terraces, and keyed-in bendway weirs.

Natomas East Main Drain Canal and Arcade Creek

The Corps anticipates that the east levee of the NEMDC will need 6,000 LF of improvements to address seepage and stability at locations where historic creeks had intersected the current levee alignment. A cutoff wall will be constructed at this location to address the seepage and stability problems. The cutoff wall will be constructed by one of the methods described in the Sacramento River section above. SAFCA is proposing to construct 2,500 LF of cutoff wall beginning just south of the confluence of Arcade Creek and extending south along the NEMDC. The Corps will construct the remaining 3,500 LF of cutoff wall.

The Corps also proposes that the Arcade Creek levees will need improvements to address seepage, slope stability, and overtopping when the event exceeds the current design. A centerline cutoff wall will be constructed to address seepage along 22,000 LF of the Arcade Creek levees. Levees from Rio Linda Boulevard to Marysville Boulevard will have a cutoff wall constructed at the waterside toe of the levee. Construction of the waterside toe cutoff wall will require constructing a workbench along the toe of the levee. Excavation for the bench will extend deep enough below existing grade to remove organic material and soft, unsuitable foundation soils. Bench excavation will also extend into the existing waterside slope of the levee as needed. Riprap will be placed on the waterside benches after construction of the waterside toe cutoff wall. Some portions of the Arcade Creek north levee will require more substantial excavation and reconstruction of the waterside slope to provide a low permeable seepage levee slope barrier. Bench fill material will be integrated with the slope reconstruction fill to provide an integral seepage barrier with the cutoff wall over the full height of the levee slope. A small section of levee will have a sheet pile cutoff wall at the centerline of the levee, rather than the waterside toe cutoff wall.

There is a ditch adjacent to the north levee at the landside toe, which provides a shortened seepage path, and could affect the stability of the levee. The ditch will be replaced with a conduit or box culvert and then backfilled. This will lengthen the seepage path and improve the stability of the levee. Additionally, pressure relief wells will be installed along the landside toe of the levee along the north levee west of Norwood Avenue.

The majority of the Arcade Creek levees have existing floodwalls; however, there remains a height issue in this reach. A 1- to 4-foot floodwall will allow the levees to pass flood events greater than the current design level. The floodwall will be placed on the waterside hinge point of the levee and will be designed to disturb a minimal amount of waterside slope and levee crown for construction. The waterside slope will be re-established to its existing slope and the levee crown will grade away from the wall and be surfaced with aggregate base.

1.3.4. Sacramento Weir and Fish Passage Facility

The proposed action will include a new fixed-crest passive weir structure north of the existing Sacramento Weir, setting back the Sacramento Bypass north levee approximately 1,500 feet, a new bridge over the weir on Old River Road, a fish passage structure, a levee embankment between the existing weir and new passive weir, realignment of County Road 124, and removal of the railroad embankment.

New Weir and Bridge

A new 1,496-foot-long passive weir will be constructed along the right bank (looking downstream) of the Sacramento River, north of the existing weir. The new weir and existing weir will be separated by a levee embankment. The proposed weir would be composed of 60-foot-wide weir bays, separated by 3- to 5-foot-wide piers. A concrete approach slab and weir crest would form the floor between the piers. The weir crest elevation would be at 26 feet.

The new primary weir structure will be constructed behind the existing levee and Old River Road; therefore, only 1 year of in-water work is anticipated for the levee degrade, rock slope placement, and fish exit pool construction.

The existing levee, which will be in front of the newly constructed weir, would be removed in the final year of construction, and the soil will be used to create a graded approach to the new weir. The elevation of the graded approach to the new weir would be excavated down to an elevation of 22 feet, which would require the removal of 82,567 CYs of material. Once grading of the approach is completed, part of the area will be seeded with native perennial herbaceous species to stabilize the approach and protect it from erosion. Based on the proposed elevation of the approach, the Corps anticipates that this area would likely be inundated on an annual to biennial basis, given the OHWM is 2 feet higher than the proposed approach.

Once the graded approach is completed, areas that cannot be seeded due to erosion risk will have rock slope protection placed. Rock placed above the 10-foot contour would be 20 inches thick, while rock placed below this elevation would be 30 inches thick. A total of 18,358 CYs of rock are anticipated to be necessary. Placement of the rock would be achieved using an excavator staged from a barge or on land, and/or by bottom dumping rock from a barge. It may also be necessary to install a vibratory driven sheet-pile cofferdam to dewater the work area for installation of the rock slope protection. Turbidity would be controlled via a cofferdam, installation of a turbidity curtain, or other means and methods approved by the Regional Water Quality Control Board and NMFS. Up to 6.2 acres of habitat may be permanently impacted by construction activities, rock placement, or concrete pouring.

Fish Passage Structure

In 2015, a fish passage feature was added into the proposed action for the purpose of increasing adult fish passage and reducing fish stranding in the expanded Sacramento Bypass. The new fish passage features are intended to mitigate adverse effects of the weir expansion. The fish passage elements for the proposed action were formulated through a series of meetings with the fish passage project design team (PDT). The PDT (consisting of the Corps, the California Department of Water Resources (DWR), SAFCA, NMFS, CDFW, and HDR Consulting) formed in December 2018, came to a decision on a technical fishway approved by all agencies. See the full 2020 Sacramento Weir BA for a full description of the fishway evaluation process.

Based on the 2015 NMFS BO, the working group established the following goals for fish passage:

- Provide upstream migration for adult salmonids and southern Distinct Population Segment (sDPS) of Green sturgeon (green sturgeon).
- Design and construct the new weir such that fish stranding will be minimized to the greatest extent possible. Minimizing fish stranding includes:
  - ➢ Minimizing both adult and juvenile fish stranding on the downstream (bypass) side of the new weir when floodwater stops overtopping.
  - ➢ Minimize stranding in depressions in the widened Sacramento Bypass following receding floodwaters.

Fish Passage Project Elements

The proposed action's fish passage design includes the following design elements:

- Hydraulic Control Structure and Fishway Exit Pool
- Fish Ladder
- Fish Passage Channel
- Stilling Basin Drain
- Transition of open channel fishway into Tule canal.

Similar to the new weir, the majority of the fish passage facility would be constructed behind the existing Sacramento River and Tule Canal levees. As such, the only components of the fish passage facility that would affect ESA-listed species and their habitats during construction include the fishway exit pool and the tie-in of Lower Elkhorn Basin Levee Setback (LEBLS) ditch to the Tule Canal.

Hydraulic Control Structure and Fishway Exit

The hydraulic control structure for the fish passage facility will include two concrete channels. One channel will discharge flow to the fish ladder and the other will provide water to the open channel fishway. Both channels will include a vertical lift gate for flow control to the fishways. The north channel, with a floor elevation of 8 feet, will be used for lower Sacramento River stages. The south channel, with a floor elevation of 14 feet, will be used for higher Sacramento River stages.

The vertical lift gates will be just downstream of the weir feature and roadway deck, integrated into sections of the control structure that are between the south road abutment wall and the new weir. The top of the fish passage channel and fish ladder gates (while in the closed position) are at elevations 17 feet and 27 feet, respectively. Concrete headwalls above these elevations extend to the top of the adjacent walls to cut off flow above the operating water surface elevations for the gates.

The top of wall elevations upstream of the vertical lift gates are 36.16 feet or greater such that the 100-year flood does not overtop the walls. The minimum top of wall elevation includes 3 feet of freeboard above the 100-year flood elevation in the Sacramento River. The walls upstream and downstream of the gates will include slots for temporary stop logs to allow the gate area to be dewatered for maintenance. The stop logs will be manufactured and stored on site near the hydraulic controls, which will be located on the embankment between the existing and new weir structures.

Fish Exit Pool

The primary purpose of the fish exit pool is to provide a low-velocity channel for fish to exit the fishway and continue their upstream migration in the Sacramento River, while simultaneously providing water flow to the fishways. The exit pool will also incorporate features for minimizing the entrainment of debris and sediment into the ladder. Such features are likely to include debris booms, trash racks, and/or other appropriate means and methods to be further defined through coordination with the PDT and DWR's operations and maintenance. To provide a fish exit channel of adequate depth, the fish pool area located between the concrete fish passage facility and the Sacramento River would be excavated down to an elevation of 5 feet.

Similar to the new weir, the majority of the fish passage facility would be constructed behind the existing Sacramento River levee with the exit pool construction happening in the last year. To construct the fish exit pool, a sheet-pile cofferdam is expected to be required so that the work area can be isolated and dewatered. It is anticipated that the exit pool will be lined with rock similar to that placed in front of the new weir, and that a cofferdam will be required to complete the construction of this component of the fish passage facility. An estimated 6,720 CYs of rock slope protection will be placed in the fish exit pool.

Fish Ladder

Downstream of the control structure, a vertical slot fish ladder will provide a fish passage route when the water level in the Sacramento River is between elevation 15 feet and 26 feet. The fish ladder is a 398.5-foot-long vertical slot fish ladder with pools separated by baffles. Baffle numbers and slot configurations are still in development with the PDT; however, 16 single slot baffles with a bottom orifice for sturgeon are proposed. Slot widths will increase progressively downstream.

The fish ladder entrance pool is located immediately downstream of the fish ladder. This area also serves as the transition pool between the fish passage channel and fish ladder. The entrance pool provides fish access to the fish ladder. It is about 29 feet wide and 34 feet long with a flat bottom of elevation 7 feet.

Fish Passage Channel

The channel would begin at the downstream end of the flow control structure and run parallel to the north wall of the fish ladder. Downstream, the channel would turn to connect to the fish ladder entrance pool, and then continue west, aligned with the fish ladder centerline. Three hundred feet downstream of the fish ladder, the entrance pool of the fish passage channel would turn southwest. The channel would continue approximately 260 feet downstream before turning west and continuing into Tule canal.

The intent of the fish passage channel is to provide fish passage for the lower stages of the Sacramento River and to provide a channel readily passible by sturgeon. The lower stages of the Sacramento River is a headwater range of 9 feet to 15 feet, with a current expectation to operate to elevation 10 to 12 feet based on consultation with the PDT. The floor of the open channel fishway will be at an elevation of 8 feet to receive flow for this entire range. Providing ease of navigation for sturgeon includes the incorporation of resting pools, lower velocities, and less of a vertical climb than the fish ladder.

The Corps believes it may be necessary to install a vibratory driven sheet-pile cofferdam to dewater the work area where relatively high groundwater levels may otherwise limit dry conditions for channel grading and shaping.

Stilling Basin Drain

The stilling basin of the new weir drains to the fish passage channel. The stilling basin drain provides a path for adult and juvenile green sturgeon that may pass over the new weir to exit the stilling basin and return to the Sacramento River. Design of the stilling basin will continue to be updated further during 95% design planning.

Construction - Fish Rescue and Salvage

Construction of portions of the new weir and the fish passage channel may require isolation and dewatering of areas in the Sacramento River and Tule Canal where in water work would occur. Isolation and dewatering of these work areas has the potential to result in stranding and/or the loss of NMFS-regulated species. To minimize any potential effects during dewatering activities, the Corps would design a comprehensive fish rescue and salvage plan, which the Corps would submit to NMFS for approval no less than 30 days prior to any isolation of in-water work areas. Isolation methods may vary between areas in the Sacramento River and in Tule Canal. For example, installation of a sheet-pile cofferdam may be required to effectively isolate the work area in the Sacramento River, whereas the work area in Tule Canal may require the use of water bladder dams and bypass of flow. Because of these area-specific considerations and site fidelity of species, the Corps' plan will address rescue and salvage activities targeted for the Tule Canal and Sacramento River areas, as they may differ from each other.

If isolated areas are to be dewatered, the fish rescue and salvage plan would have two phases: clearing the isolation area of aquatic species prior to full isolation, followed by final fish rescue and salvage during dewatering. If isolated areas are not to be dewatered, the plan would consist of only the first phase. These phases would be repeated, as necessary, should the fish exclusionary barrier fail during the fish passage facility construction. The fish rescue and salvage plan would be implemented by a fish rescue team composed of several qualified fisheries biologists and/or technicians, each with experience in fish capture and handling.

- Exclusionary barriers used to create the isolation area may vary depending on the means of project implementation, but may include a turbidity curtain or sheet-pile cofferdam. If used, the exclusionary barrier would be installed from an upstream to downstream direction. At the downstream extent of the isolation area, the exclusionary barrier would be left open to allow biologists to herd any fish out of the isolation area. To cover the entire depth of the water column, biologists would sweep the isolation area by stacking seine nets top-to-bottom and end-on-end, as needed, to push fishes and aquatic species outside of the exclusionary barrier. Fish would not be handled during this process, reducing the potential for additional stress. The goal would be to clear aquatic inhabitants before the work area is completely isolated. While the exact length of the seine nets may vary based on conditions (for example, depth, velocity, aquatic vegetation) and professional judgment, the following characteristics would be consistent for all potential nets employed:
  - Individually 6 to 8 feet deep;
  - 5/8 inch mesh;
  - Floats 1 foot apart on top; and
  - 4-ounce lead weights 1 foot apart on bottom.

  Biologists would conduct a minimum of three passes through the partially isolated work area prior to installing the final section of the exclusionary barrier. After each pass, a block net would be installed at the downstream opening in the exclusionary barrier to prevent fish from re-entering the area.

- The second phase of the fish rescue and salvage plan would take place after the area has been completely isolated, usually the day after Phase I of the plan. If the isolation area is to be dewatered, the fish rescue and salvage effort would occur as dewatering is occurring. Any pumps used to dewater the area would be fitted with NMFS-approved screens. This phase of the effort would be conducted using a combination of seines and dip nets, and would occur in the early morning hours to take advantage of the coolest temperatures. Immediately after collection, all fish, including native and non-native fish, would be placed in aerated 5-gallon buckets and/or coolers filled with river water (and freshened with new water as necessary), identified, measured, enumerated, and transported to a location outside of the isolation area for release back into the main channel. Listed fish would be processed before any other fish. In the event that water temperatures become stressful (>21° Celsius) or are elevated upon arrival (19 to 20° Celsius), a biologist would be assigned to rapidly transport fish from the work area to the release area as they are sampled without counting or identification to expedite the rescue. The biologist(s) would remain on site during the entire process of dewatering, if implemented. The rescue would end when few or no non-listed fish are rescued after multiple seine pass attempts.

Fish Monitoring

Fish monitoring will occur in both the Sacramento River and Tule Canal. Active construction monitoring would consist of deploying a hydro acoustic receiver array and acoustic positioning systems. This technology is currently being utilized throughout the west coast, and complements other ongoing acoustic studies in the area. The array and positioning system will determine the fish's site fidelity and behavioral characteristics within the project area as construction activities are occurring. Pre-construction monitoring is anticipated to occur in the spring of 2020, using the acoustic array. Pre-construction monitoring is occurring to establish baseline conditions within the project/action area.

Fish monitoring will include the placement of up to twenty-five individual 14-inch diameter steel poles or pilings to be placed throughout the ARCF action area in the Sacramento River. Minor pile driving activities are anticipated to occur, both vibratory and impact hammer methods may be used. The purpose of the poles is for the placement/tethering of multi-functioning fish acoustic monitoring equipment, water quality monitoring equipment and an acoustic Doppler current profiler. There will be navigation warning signs placed on top of each station. Monitoring will provide data for majority of the fish studies occurring within the Sacramento River. Cooperative agency monitoring would include agencies from DWR, U.S. Geological Survey (USGS), the Corps, CDFW, NMFS and USFWS. Additionally, the installation would comply with the criteria from Interim Criteria for Injury of Fish Exposed to Pile Driving Operations (Popper et al. 2006).

1.3.5. Utility Relocation

Many utilities will be avoided; however, some utilities may need to be temporarily removed or relocated prior to construction. Temporary bypass pumping may be required for sanitary sewers. SAFCA and the construction contractors will coordinate with utility owners to manage the utilities in advance of construction. Disturbed utilities will be restored after construction consistent with CVFPB requirements.

1.3.6. Stormwater Pollution Prevention

Temporary erosion/runoff best management control measures would be implemented during construction to minimize stormwater pollution resulting from erosion and sediment migration from the construction, borrow, and staging areas. These temporary control measures may include implementing construction staging in a manner that minimizes the amount of area disturbed at any one time; secondary containment for storage of fuel and oil; and the management of stockpiles and disturbed areas by means of earth berms, diversion ditches, straw wattles, straw bales, silt fences, gravel filters, mulching, revegetation, and temporary covers as appropriate. Erosion and stormwater pollution control measures will be consistent with National Pollutant Discharge Elimination System (NPDES) permit requirements and included in a Stormwater Pollution Prevention Plan (SWPPP).

After completion of construction activities, the temporary facilities (construction trailers and batch plants) will be removed and the site would be restored to pre-project conditions. Site restoration activities for areas disturbed by construction activities, including borrow areas and staging areas, will include a combination of regrading, reseeding, constructing permanent diversion ditches, using straw wattles and bales, and applying straw mulch and other measures deemed appropriate.

1.3.7. Geotechnical Explorations

Geotechnical explorations include activities, such as geotechnical borings, erosion jet tests, geotechnical trenching, and geotechnical potholing. A brief description of each follows below.

Geotechnical Borings – Borings are done to determine the geologic composition of the foundation of various flood features (erosion protection, slurry walls, and Sacramento Weir). Each borehole will be about 4 to 6 inches in diameter, and will be drilled to a depth of 50 to 100 feet. Equipment will include a tire-mounted drill rig, a support truck, and three crew trucks. Prior to initiating drilling, the workers will clear surface vegetation within the immediate borehole location (about 12 inches in diameter at each borehole). Woody vegetation will be avoided. Upon completion of each boring, the borehole will be backfilled with cement-bentonite grout. Drilling fluid and cuttings will be disposed of at an offsite location.

Erosion Jet Tests – Soil jet tests are used to classify erosion conditions along the waterside banks of the rivers. Tests will be conducted as close to the bank toe as feasibly possible. All jet tests will occur in the dry but may occur below the OHWM. Two to six jet tests will be conducted at each site.

Geotechnical Trenching – This action involves digging trenches about 10 feet deep. The purpose of geotechnical trenching is to validate the composition of the levee embankment or other surface soil conditions. Additionally, trenching is often conducted in a similar manner as part of preconstruction geoarchaeological studies to determine the potential for presence of buried archaeological resources in the project area. Following site characterization, the trenches will be back-filled with soil.

Geotechnical Potholing – Geotechnical potholing is a method whereby the location of underground utilities is exposed. Potholing involves the drilling of exploratory holes, the depth of which spans from ground level to the required extent of the investigation. Potholing confirms the location of utility features on site that have the potential to be damaged by other techniques. The potholing is carried out using a vacuum truck to minimize potential damage to the utilities, and to biological resources. Any excess excavated material will be hauled offsite. All disturbed areas will be returned to their original state upon completion of each pothole.

1.3.8. Borrow Sites and Haul Routes

Borrow Sites **-** The estimated maximum amount of borrow material is shown below in Table 2, and will be needed to construct the ARCF Project. Detailed studies of the borrow material needs have not been completed. Actual volumes exported from any single borrow site will be adjusted to match demands for fill.

To identify potential locations for borrow material, soil maps and land use maps were obtained for a 20-mile radius surrounding the project area. Borrow site selection will include the following criteria: avoid threatened and endangered species effects and habitat, current land use patterns, and soil types. Fill may be borrowed from bank protection sites, when available, for the use of project-related mitigation.

Clean rock will be commercially acquired in order to construct the American and Sacramento River bank protection sites. For the Sacramento River, rock will be acquired from a commercial source in the Bay Area and barged up the Sacramento River to the construction sites (see Table 2 for total barge trips estimated). Rock for the American river sites will be acquired from a commercial source within a 50-mile radius and will be hauled in trucks to the construction sites.

Table 2. Barge Traffic associated with ARCF activities.

Activity	Total # of Round Trips	Total maximum volume of material transported
Sacramento Weir and Bypass 2021	28 barge trips	25,000 cubic yards (cy)
Sacramento Weir and Bypass 2023	83 barge trips	75,000 cy
Sacramento River Erosion Contract 1	26 barge trips	23,000 cy
Sacramento River Erosion Contracts 2, 3 and 4	2,188 barge trips	1,000,000 cy

Haul Routes – Haul routes will be determined during the design phase and will depend on what borrow sites and staging areas are selected. Haul routes will be selected based on existing commercial routes and levee roads. Haul routes will be selected that minimize effects to federally listed species.

1.3.9. Construction Process, Staging, Sequencing, and Equipment

Mobilization – Site Access and Staging Area

Mobilization will take place at each project site. Mobilization may include creation of temporary access roads, if needed; securing the site; and transporting equipment and materials to the site (*e.g.*, clearing and grubbing, and construction of the repair). Access to construction sites will occur primarily along existing roads, levee crown roads, or unpaved private farm roads. Barges will be used to transport rock to the sites on the Sacramento River. At several sites, a barge crane may be used to transport and stockpile rock and soil to the site. The staging areas will be selected, so removal of native trees or shrubs are minimized and previously disturbed areas will be preferred. Landside staging areas may frequently be required for stockpiling materials and equipment. For landside and certain waterside repairs, staging areas may require construction easements from the landowners adjacent to the construction site. Activities that will occur within staging areas would include storing necessary imported materials (*e.g.*, rock, soil); parking, refueling, and servicing of construction equipment; establishing a temporary restroom; and parking construction staff transportation vehicles.

Site Preparation

Vegetation clearing may need to occur for site access and construction purposes. Site preparation may also include the removal of submerged instream woody debris and fallen trees within the construction footprint. A turbidity curtain, cofferdam, or other NMFS approved minimization measure will be installed prior to any in-water work conducted on the waterside of the levee where there is potential for listed fish within range. The work limits and staging areas will be fenced (orange construction fencing) to prevent vehicles and equipment from approaching the waterside edge of the existing bank where applicable, to protect sensitive habitat, and to identify disturbance area limits.

Where necessary, existing vegetation within the work area will be removed during project construction except for trees or shrubs identified and marked for protection prior to construction. Trees within the repair area identified for protection and outside the work limit may require trimming or removal for equipment clearance, excavation, or due to severely undermined tree health. All tree and sensitive plant removal will be documented. The construction site may be cleared of grasses, ground cover, or any other undesirable materials, using mechanized equipment.

Construction Process

Rock or other fill material (*e.g.*, sand, soil, and cobble) will be placed using a long-arm bucket excavator, barge crane, or other heavy equipment. As necessary, fill may need to be compacted using vibrating plates. IWM may be installed, if feasible, near the water surface during time of construction to replace or enhance riverine aquatic habitat to the repair area.

1.3.10. Vegetation Plantings Installation

Vegetation within the sites will be developed in coordination with NMFS and USFWS during the design phase. A variety of materials for revegetation and site-enhancement may be used depending on the site-specific conditions. Below is a description of commonly used materials and methods used for revegetation purposes.

Instream Wood Material

The incorporation of IWM functions into site designs are intended to replace lost instream cover and habitat from construction impacts. Entire trees with root balls and canopies are used as the IWM. The trees shall be anchored into the quarry stone to one-half of the tree length. They are placed to be submerged when fish are generally present in the area.

Willow Fascines

Willow fascines, which are live bundles of willow cuttings, are also incorporated into the site designs in order to replace lost instream cover and habitat due to construction. The fascines are anchored just above the winter mean water surface elevation at 15-foot spacing triangular spacing.

Other Plant Materials

Plant material installation is designed to mitigate for lost riparian and SRA habitat post construction. The proposed planting design includes an appropriate mix of local system native riparian trees and shrubs. Plantings will be incorporated into the sites at appropriate elevations to maximize on-site mitigation to the extent feasible.

1.3.11. Demobilization, Rehabilitation, and Clean-up

Following construction, all equipment and materials will be removed from the work area and excess materials will be disposed of at appropriate facilities. All areas would be cleaned and cleared of rubbish and left in a safe and suitable condition.

1.3.12. Operation and Maintenance

Operation and maintenance (O&M) of the levees in the Sacramento area are the responsibility of the local maintaining agencies, including the American River Flood Control District, the DWR, and the City of Sacramento (Table 3). The applicable O&M Manual for the Sacramento area levees is the Standard Operation and Maintenance Manual for the Sacramento Flood Control Project. Typical levee O&M in the Sacramento in the Sacramento area currently includes the following actions:

- Vegetation maintenance up to four times a year by mowing or applying herbicide.
- Initial vegetation maintenance will include irrigation that may need pumping from the nearest waterside of the levee. Riparian establishment may require irrigation and pumping activities between March through November initially (see Table 3 for full irrigation details). Pumps will be screened to NMFS screen criteria.
- Control of burrowing rodent activity monthly by baiting with pesticide.
- Slope repair, site-specific and as needed, by re-sloping and compacting.
- Patrol road reconditioning up to once a year by placing, spreading, grading, and compacting aggregate base or substrate.
- Visual inspection at least monthly, by driving on the patrol road on the crown and maintenance roads at the base of the levee.
- Post-construction, groundwater levels will be monitored using the piezometers.

The Corps will work with local maintaining agencies to develop the maintenance activities necessary for long-term operations and maintenance. This will occur during the preconstruction engineering and design phase of the project.

Following construction, the O&M manual for these reaches will be adjusted to reflect the vegetation variance and the SWIF plan. Under the adjusted O&M manual, large trees that are protected in place under the variance will be allowed to remain on the waterside slopes and additional vegetation will be planted on the planting benches. Vegetation maintenance includes keeping maintenance roads clear of overhanging branches.

Table 4. O&M by Maintaining Agency

Local Maintaining Agency	Levee Systems Covered
American River Flood Control District	Lower American River, Arcade Creek, NEMDC
Maintenance Area 9	Sacramento River east levee between Sutterville Road and the Beach Lake Levee
City of Sacramento	Sacramento River East Levee between the confluence of the American River and Sutterville Road

1.3.13. Green Sturgeon Habitat, Mitigation, and Monitoring Plan

Through collaboration with NMFS, the Corps will implement the following additional measures to minimize adverse effects to green sturgeon habitat.

1) The Corps will develop a green sturgeon habitat, mitigation, and monitoring plan (HMMP) in coordination with other project consultations (Sacramento River Bank Protection Project (the Corps, 2019) and West Sacramento General Reevaluation (the Corps, 2015). The GS HMMP will include adaptive management, based on findings and is expected to be ongoing throughout construction of erosion protection on the Sacramento River and construction of the Sacramento Weir.

   a) The purpose of the HMMP, as it relates specifically to ARCF, is to monitor any potential take occurring during and post-construction through observation of green sturgeon behavior in the project area via acoustic telemetry tracking, and make recommendations to minimize impacts to sturgeon in future bank protection projects. Post-construction monitoring will occur for up to three years for erosion protection actions on the Sacramento River and when the Sacramento Weir fish passage structure is activated, not to exceed five years post-construction.

   b) Because the HMMP will not be finalized until September 2021, any specific mitigation recommendations based on the current understanding of fish behavior under the HMMP may only benefit Sacramento Weir and later erosion actions on the Sacramento River. As the Corps is proposing to move forward with a large-scale mitigation site for erosion protection actions and in essence ARCF is “first through the door” on a multi-year HMMP process, the lessons learned, best practices, and other recommendations from the HMMP are more likely to benefit the West Sacramento GRR Project and the Sacramento River Bank Protection Project.

   c) The broad umbrella goal of developing the HMMP is to ensure that adverse impacts to green sturgeon resulting from Corps erosion protection projects are fully mitigated in order to maintain the growth, survival, and recovery of the species in the action area for these projects.

2) The Corps purchased 20 acres of green sturgeon conservation bank credits. These credits were purchased by the Corps on July 22, 2019, from the Fremont Landing Conservation Bank, to mitigate effects associated with ARCF. In addition to benefiting green sturgeon, these credits can apply to California Central Valley steelhead (steelhead), Central Valley sping-run Chinook salmon (spring-run Chinook salmon), and Sacramento River winter-run Chinook salmon (winter-run Chinook salmon).

In the BA, the Corps recognizes flaws from the existing Standard Assessment Model (SAM). It is not producing functional assessments and mitigation recommendations that appear to be reasonable based on species' use of aquatic habitats in the area during different life stages or times of the year. Updating the SAM and including a green sturgeon module is anticipated to reduce the overall mitigation burden for future projects (*e.g.,* West Sacramento and potentially later contracts of ARCF erosion on the Sacramento River). The SAM update with the green sturgeon module, when it is delivered in 2022, would mostly benefit future flood risk reduction erosion protection activities as a part of the West Sacramento GRR and Sacramento Bank projects, but also could benefit later erosion action contracts under ARCF in 2023 and 2024.

The Corps proposes to either refine the SAM or develop an alternative green sturgeon survival and growth response model that reflects green sturgeon's preference for benthic habitat and that accounts for the physical loss of habitat from revetment footprints instead of the convention used by the SAM where the fish response is evaluated at the intersect of seasonal water surface elevations. The new modeling may include hydraulic modeling, but must be capable of evaluating green sturgeon survival in response to levee repair projects in the project impact area and their effects on all habitat conditions, not exclusively flow changes.

The ARCF Project, part of the larger Supplemental Program funding package issued to the Corps in 2018, was required to commence construction on project features with acceptable designs and PED began immediately after. Construction on Sacramento River East Leave Reach D Contract 1 began in 2019 and construction on the remainder of ARCF will conclude by 2024. PED was truncated or in some instances eliminated for most activities under ARCF based on the funding and schedule directive received under the Supplemental Program.

Without the habitat model, impacts to green sturgeon may be larger than originally assessed in the 2015 NMFS BO. Therefore, the Corps has coordinated with NMFS to develop the following alternative measure to minimize effects to green sturgeon that does not rely on the SAM:

Mitigation commitments of the 2021 USFWS BO for Delta smelt require a minimum of 90 acres of Delta smelt habitat to be restored to minimize project effects based on anticipated impacts from the ARCF project (USFWS 2015; 2017; 2019). If this mitigation occurs within green sturgeon critical habitat, green sturgeon will also benefit. By selecting mitigation sites that benefit multiple listed species, in this case the Delta smelt and the green sturgeon, any excess impacts that could not be measured by the previously proposed habitat model (SAM) will be offset for this project.

1.3.14. Green Sturgeon Study

The Corps is proposing to award 5 million dollars in funding to a qualified agency or academic institution by grant (or other funding mechanism), to conduct a study that leads to a better understanding of juvenile green sturgeon behavior in proximity to unscreened diversions, analyze how river substrate characteristics effect green sturgeon behavior, and develop adult green sturgeon passage requirements that apply to conditions the species encounter in their habitat within the Central Valley. The Corps asserts that the information developed by such a study will benefit the species by providing a better understanding of the sturgeon's behavior, result in the development of diversion screen criteria that may reduce entrainment of the species range-wide, and help the development of regionally appropriate fish passage criteria that can be applied to new and existing diversions and barriers to reduce stranding. A better understanding of green sturgeon behavior in the system would contribute to the recovery of the species. The results of the study would also likely benefit other listed species under the jurisdiction of NMFS known to occur in the ARCF WRDA 16 Project area including spring-run Chinook salmon, winter-run Chinook salmon, and steelhead.

Given federal acquisition process timelines, including those applying to grants, it is anticipated that the study would be funded and commence by 2022. NMFS will be invited to participate on the technical team to inspect the performance work statement and the deliverables produced.

The Corps has put forth and NMFS has agreed that funding such a study will be applied to reduce the temporal mitigation ratio by a factor of 1. For example, the 2015 NMFS BO outlined a 1:1 ratio for mitigation prior to construction, 2:1 ratio for mitigation done during construction, or 3:1 ratio for mitigation completed after construction. With the addition of this grant proposal, the mitigation ratios will be reduce to 1:1 for mitigation done during construction or 2:1 for mitigation done after construction. These ratios are further described below in 1.3.17 *Compensatory Mitigation*.

The large-scale mitigation site is anticipated to be 100 to 200 acres in size and provide aquatic habitat that would be used by all life stages of winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and juvenile green sturgeon. If the site is constructed below the I Street Bridge, it would also benefit delta smelt.

The mitigation project is likely to require a levee setback to connect the prospective property to the Sacramento River. The site will be appropriately graded to slowly drain to prevent stranding that may occur in a tidally influenced area or seasonal water elevation changes. Where it is found to be feasible, some mosaic riparian habitat will be established within the site and along the perimeter. In-stream woody material and other constituents of SRA will be incorporated into the design where feasible. The Corps will require that the contractor constructing the site maintain a ledger similar to those maintained by mitigation banks to determine how much acreage has been used for ARCF activities. Any remainder acreage not used to compensate for construction effects may be applied to effects related to O&M activities for the project, or depending on an authority's analysis, may be applied to construction effects generated by Sacramento Bank or West Sacramento GRR projects.

Although it is unanticipated, if the large-scale mitigation site is unable to fully compensate for effects from ARCF construction, one or more smaller mitigation sites may need to be constructed or mitigation bank credits may be used to round fulfill the remaining mitigation requirements.

1.3.15. Fisheries Conservation Measures

The Corps has proposed the following minimization measures, including mitigation, to minimize and offset effects of the Proposed Action on federally listed fish species. A number of measures will be applied to the entire project or species-specific actions, and other measures may be appropriate at specific locations within the project area. Avoidance activities to be implemented during final design and construction may include, but are not limited to, the following:

General Minimization Measures

The Corps will:

1. Conduct construction activities within in-water work windows to avoid and minimize effects to critical salmonid life stages (juvenile rearing, and juvenile and adult passage), from July 1 through October 31, with a two week extension until November 15 to work in the dry, below OHWM. Any requested in-water work outside this window will be coordinated with NMFS.

2. Develop a Storm Water Pollution Prevention Plan and Water Pollution Control Plan that minimize soil or sediment from entering the river, which includes daily inspections of all heavy equipment for leaks.

3. Screen any water pump intakes for activities, such as irrigation or dewatering, to maintain an approach velocity of 0.2 feet per second or less when working in areas that may support federally listed fish species.

4. Minimize the removal of existing vegetation during project-related activities. When feasible, removed or disturbed vegetation will be replaced with native riparian vegetation.

5. Implement measures to prevent slurry seeping out to river and install piping system on land- side only.

6. Stockpile construction materials, such as portable equipment, vehicles, and supplies, at designated construction staging areas and barges.

7. Stockpile all liquid chemicals and supplies at a designated impermeable membrane fuel and refueling station with a 110% containment system (container with 10% extra capacity).

8. Limit site access to the smallest area possible in order to minimize disturbance.

9. Minimize ground and vegetation disturbance during project construction, project

limits will be clearly marked, including the boundaries of designated equipment staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; and equipment exclusion zones.

10. Observe a 20-mile-per-hour speed limit or less within construction areas for all project-related vehicles, except on County roads and on State and Federal highways.

11. Secure or remove litter and debris from the project area daily. Such materials or waste will be deposited at an appropriate disposal or storage site.

12. Immediately (within 24 hours) clean up and report any spills of hazardous materials to the USFWS, NMFS, and CDFW. Any such spills, and the success of the efforts to clean them up, shall also be reported in post-construction compliance reports.

13. Designate a NMFS-approved biologist as the point-of-contact for any contractor who might incidentally take a living, or find a dead, injured, or entrapped threatened or endangered species. This representative will be identified to the employees and contractors during an all employee education program. If lethal take is to occur on any ESA listed species, the Corps and NMFS will be contacted immediately.

14. Avoid adverse effects from nighttime construction activities. For Sacramento River East Levee work, the Corps will use the minimal amount of lighting necessary to safely and effectively illuminate the work areas. Shielding and focusing lights on work areas and away from the water surface (*e.g.,* Sacramento River), to the maximum extent practicable.

15. Make efforts to compensate for impacts to native riparian habitat in the places where the impacts occur, or in close proximity. Riparian vegetation impacted will be replaced on a 2:1 habitat acreage basis. Where possible, riparian habitat will be established in the Lower American River Parkway in areas where it will also provide SRA. If sites along the Lower American River are unavailable, other sites or banks may be used between Verona and Walnut Grove along the Sacramento River mainstem.

16. Develop a Conservation Strategy, which is consistent with the Sacramento Regional County Park's Natural Resource Management Plan. It will cover riparian habitat restoration, focused on the Lower American River Parkway with the overall goal of maximizing the ecological function and value of riparian project mitigation on-site and off- site as to provide contiguous habitat and SRA. The Corps will deliver this document to the Services before the first contract commences on the Lower American River and utilize it as a means to track mitigation opportunities completed in the Parkway.

17. Participate in the Sacramento County Park's Natural Resources Management Plan development that will guide riparian restoration opportunities in the Parkway.

18. Develop compensatory mitigation plans and associated monitoring and adaptive management plans for on-site mitigation efforts. Monitoring for the establishment of riparian tree and shrub species within shaded riparian aquatic habitat is expected to last approximately 5 to 8 years, not to exceed 10 years. Establishment success will be based on criteria determined on a site-by-site basis with NMFS. Once the monitoring period is complete, all vegetation maintenance and monitoring will transfer and be the responsibility of the non-federal sponsor and local maintaining agency.

19. Provide a copy of the issued BO, or similar documentation, to the prime contractor, making the prime contractor responsible for implementing all requirements and obligations included in these documents and to educate and inform all other contractors involved in the project as to the requirements of the issued BO. A notification that contractors have been supplied with this information will be provided to the NMFS. A NMFS-approved Worker Environmental Awareness Training Program for construction personnel will be conducted by the NMFS-approved biologist for all construction workers prior to the commencement of construction activities. The program will 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 afforded these animals under the ESA, and an explanation of the relevant terms and conditions of the issued BO. Written documentation of the training will be submitted to NMFS within 30 days of the completion of training.

20. Conduct acoustic fish monitoring at ARCF sites pre-construction, during and post-construction. For erosion prevention features along the Sacramento River, the Corps would conduct telemetry monitoring of green sturgeon for 3 years post-construction. Since the new Sacramento Weir fish passage structure would not be expected to operate annually, adding a reasonable amount of monitoring time to post-construction monitoring of the fish passage structure is warranted. The Corps therefore proposes to conduct fish monitoring at the fish passage structure while in operation up to, but not to exceed, five years post-construction. Acoustic telemetry will occur in the ARCF action area and would involve staff monitoring of the real-time telemetry data available online.

21. Continue to implement a benthic substrate sampling monitoring program, to coincide with the need for the GS HMMP. Substrate sampling that will occur in the ARCF action area will include both pre-construction, during, and post-construction sampling within construction-impacted areas.

22. Use their authorities to ensure the widening of the Sacramento Weir will fully compensate for fish passage impacts by including a green sturgeon and salmonid adult fish passage facility. Measures also shall be taken to modify the downstream side of the Weir to prevent adult and juvenile green sturgeon from stranding in the spillway basin.

23. Identify all habitats containing, or with a substantial possibility of containing,

listed terrestrial, wetland, aquatic, and/or plant species in the potentially affected project areas. The project will minimize effects by modifying engineering design to avoid potential effects.

24. Where feasible, use a rock soil mixture to facilitate re-vegetation and/or a soil-filled trench. The soil-rock mixture (70% rock and 30% soil) would be placed on top of the of the rock revetment that is below the water to allow native riparian vegetation to be planted to insure that SRA habitat lost is partially replaced or enhanced.

25. Ensure that the widening of the Sacramento Bypass is designed and constructed to minimize stranding of fish at the weir facilities and in the depressions of the bypass though grading, construction of drainage channels, or other mechanisms. The Corps has and will continue to coordinate with NMFS to ensure the Sacramento Bypass and Weir is constructed in a manner that includes an operational structure to allow for controlled ramp down rates of water into the Sacramento Bypass to alleviate impacts to listed fish species.

26. Work with local cost-share sponsors to ensure that ARCF GRR-related future flood risk reduction actions related to widening the Sacramento Weir shall fully mitigate upstream and downstream fish passage effects at the weir and within the spillway basin. The goal is to ensure that adult spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon are able to migrate upstream, while the weir is spilling into the bypass, and that juvenile stranding in the spillway basin is minimized to the maximum extent possible.

27. Update the O&M manual to require: (1) that the operations of the Sacramento Bypass and Weir include a Weir Gate Operations Plan. The Plan will allow for ramp down flows in a manner that minimize juvenile fish stranding in the Sacramento Bypass, (2) integration of Sacramento Weir and Bypass operations with the Yolo Bypass.

28. Develop a stranding monitoring plan for the Sacramento Bypass that includes baseline post-project monitoring. The monitoring plan will be developed in coordination with NMFS. A separate section 7 consultation with NMFS and USFWS will be needed for the updated O&M manual, which will occur at a later date.

29. Install IWM on a case-by-case basis where it is compatible with erosion protection measures being installed to provide a portion of the on- site mitigation for lost SRA from the project. The purpose of IWM is to enhance the structural diversity of the shoreline, with woody material being a component of SRA, and ultimately to maximize the refugia and rearing habitats for juvenile fish.

30. Mix in choke stone (or cobble/gravel) to reduce interstitial spaces for predator habitat where riprap may not be covered by soil.

1.3.16. Riparian Habitat Mitigation Site Maintenance

Adverse effects to NMFS listed species may occur as a result of pumping for irrigation activities associated with riparian habitat mitigation site maintenance, both onsite and offsite, in or near the American River Parkway. Maintenance activities commence immediately following completion of the initial planting. The following activities are performed throughout the year, though some vary according to weather and season. General clean-up maintenance, including picking up trash, vandalism repairs, and the removal of used planting accessories (bamboo stakes, ties, browse guards, etc.), would occur throughout the year. For irrigation, maintenance crews would connect a screened pump to the irrigation system for each irrigation cycle per the irrigation schedule described in Table 4. Crews would weed within the watering basins of the transplants and within an 18” radius of each woody and grass associate plant, so non-native herbaceous growth does not compromise the health of the transplants. The estimated schedule for irrigating and weeding is shown in Table 6.

Table 5. Estimated three to five year maintenance schedule for riparian habitat mitigation.

Monitoring Year	Watering (Years 1 & 2: March 15-November 15) (Year 3-5: April 1-October 31)	Plant Replacement Like species* (size and type) with fertilizer and mulch
Year 1 (March 15-November 15)	50 gallons per plant or 3 inches of spray applied precipitation every 10 to 14 days	Replant to original amount of planting installed
Year 2 (March 15-November 15)	30 gallons per plant or two inches of spray applied precipitation every week to 10 days	Replant to original amount of planting installed
Year 3-5	10 gallons per plant or one inch of spray applied precipitation twice a week	No replanting
Weeding	Four times per year between March 1 and September 30	Four times per year between March 1 and September 30

* Adjustments may be made to the species palette based on observations of success and failure.

1.3.17. Compensatory Mitigation

The Corps will seek to avoid and minimize construction effects on listed species and their critical habitat, and will implement on-site and off-site compensation actions as necessary.

For identified designated critical habitat, compensation for impacts will be as close as possible to the place of occurrence. An interagency approved Standard Assessment Model (SAM) has been used throughout the Sacramento River basin and Delta flood control system to inform impacts to designated critical habitat, SRA, and instream components. Estimates of suitable habitat in the field will be verified in the field by the Corps prior to initiating proposed actions to determine the extent of suitable habitat present NMFS. The Corps will develop and implement a compensatory mitigation accounting plan to ensure the tracking of compensatory measures associated with implementation of the Proposed Action. The Corps will continue to coordinate with NMFS after construction during the monitoring periods for habitat establishment via written monitoring reports, electronically, and through site visits as requested.

The Corps will incorporate compensation for SRA habitat losses either by project constructed compensation sites (on-site and/or off-site) or in combination with purchase of credits at a NMFS-approved conservation bank, where appropriate. The Corps will construct a large-scale tidal marsh or shallow water aquatic habitat mitigation site between I Street Bridge Sacramento, California, and Antioch, California.

An updated mitigation proposal was received by the Corps on November 25, 2020 (Large Scale mitigation Site Crediting Memo, Revised) amending the mitigation as follows. If the site is constructed, with site contouring and planting substantially complete (over 50% done) by December 31, 2024, the Corps proposes the following mitigation ratios for NMFS species based on the RM distance from the southern extent of the area of impact of the project:

a. 0 to 20 miles (RM marker 27 to 47):
    i. 1:1 mitigation acres to impact acres (Sacramento to Walnut Grove vicinity).
b. 20 to 40 miles (RM marker 7 to 27):
    i. 1.5:1 mitigation acres to impact acres (Walnut Grove to Decker Island area)
c. c. 40 to 47 miles (RM marker 7 to 0):
    i. 1.75:1 mitigation acres to impact acres (Decker Island to Antioch).

If mitigation is not substantially complete (over 50% done) by the end of 2024, as committed to in the September 2020 BA for NMFS, the Corps would be responsible for the following mitigation ratios for NMFS species:

a. 2:1 for sites 0 to 20 miles away
b. 2.5:1 for sites up to 40 RMs away from the southern extent of project effects.
c. 2.75:1 for sites up to 47 RMs away from the southern extent of project effects.

Off-site mitigation in the Lower American River includes fish habitat mitigation at Arden Pond that would benefit fall-run Chinook, late fall-run Chinook and steelhead. Riparian plantings to support fish and wildlife species will be installed onsite on planting benches and slopes. The two sites near Rio Americano High School will provide upland riparian habitat primarily to support valley elderberry longhorn beetle. An additional shallow floodplain area will be considered in the Lower American River is at Glenn Hall Park, and has the potential to provide some benefit for the above listed salmonids.

Offsite mitigation will be required outside of the Sacramento River project footprint due to a lack of available space on the waterside and landside of the east levee. Compensatory mitigation for impacts along the Sacramento River are not able to be fully mitigated on the Lower American River because of the different fish species on these streams. Green sturgeon and winter-run Chinook salmon may be impacted on the Sacramento River, but are not known to occur upstream of RM 1.0 on the American River.

Mitigation on the Sacramento River will ideally be sited between the areas of Verona and Walnut Grove, and preferably south of the I Street Bridge in Sacramento as described above. The purpose of the location is to benefit all fish species (including delta smelt) impacted by the project. NMFS and USFWS will serve on the mitigation site technical team.

The Corps will explore the feasibility of developing a large-scale mitigation site to account for fisheries impacts not otherwise accounted for (tidally influenced shallow water and/or tidal marsh) along the Sacramento River mainstem (smelt, Chinook salmon, steelhead, and sturgeon). Riparian and fish habitat may not be able to be completely mitigated at the same site, so it is the Corps' intent to continue to pursue restoration and establishment of these habitat types within the Lower American River Parkway in combination with the purchase of bank credits.

Shaded Riparian Aquatic Vegetation Plantings along the American River

Mitigation sites are currently being pursued by the Corps, DWR, and SAFCA in coordination with the County of Sacramento. Riparian plantings may be utilized for erosion protection projects along the American River. As a form of project mitigation, the following actions are typical to establish riparian plantings:

Access and Stating

Permanent and temporary access to the sites is necessary for plant installation and establishing the site and long-term maintenance. A temporary staging area would also be established to house an 8-foot by 16-foot storage container, a portable toilet, and a wash station.

Planting Site Elements

The sites would be cleared of existing grasses and non-native vegetation. Existing native trees, shrubs, and listed species would be protected in place by construction fencing. The sites would be trimmed with hand held string trimmers. Invasive plant species would be removed by hand and disposed off-site. No grading of the riparian sites would occur.

A temporary above grade irrigation system would be installed for establishment and maintenance period of riparian habitat mitigation. A 1.5-inch or 2-inch polyvinyl chloride (PVC) schedule 40 pipe would be installed above grade for the establishment and maintenance period. Irrigation water would be applied manually by drip or spray irrigation connected to a screened portable water pump at the river edge. Due to seasonal inundation, the irrigation system may be partially or entirely removed for seasonal high water flows. The pump system would conform to the Fish Screening Criteria for Anadromous Salmonids (NMFS 2011).

Plantings would be spaced out in rows four to six feet apart. Seedlings would be planted in holes that are at least 12-inch wide by 12-inch deep and cuttings would be placed in holes created by a digging bar. Browse guards would be used to deter wildlife for at least the first three years and may consist of cages and/or perimeter fencing. See Table 5 for an example of a native woody riparian planting palette. Planting mixture may slightly vary on a site-by-site basis.

Table 6. Example of a potential planting mix.

Alnus rhombifolia	White alder	15%
Baccharis salicifolia	Mulefat	5%
Cephalanthus occidentalis	Buttonbush	5%
Populus fremontii	Fremont cottonwood	25%
Salix exigua	Sandbar willow	25%
Salix lasiolepis	Arroyo willow	25%

Sacramento Weir Existing Stilling Basin

The Corps-proposed improvements to the existing stilling basin would be equivalent to up to 13.5 acres of habitat being restored, and could be used as mitigation to offset habitat loss from the construction of the Sacramento Weir and erosion protection on the Sacramento River as a result of the proposed action. This repair will be constructed at the same time as the new weir and fish passage facility.

The Corps proposes to make minor modifications to the stilling basin of the existing weir, and to provide a new drainage canal that will connect the stilling basin of the existing weir with the proposed fish passage facility.

The improvements to the existing stilling basin could involve creating new orifices at the base of the four guide vanes. To create the orifices, a 42-inch by 84-inch section of each guide vane would be removed. The purpose of the orifices is to provide an escape route for fish as floodwaters recede. In addition to the orifices, the Corps is proposing to create a new drainage feature that will extend from the north end of the existing stilling basin to the fish passage channel and structure. The design for the improvements to the existing stilling basin are in the conceptual stages and will likely evolve as the design advances; however, the overall objectives of the improvements will remain the same: reduce stranding potential of fish during the descending limb of the hydrograph by providing an opportunity for escape via the new fish passage facility from the existing basin. The improvements to the existing stilling basin will occur concurrently with the construction of the new weir.

No effects to listed species are expected to occur during construction, as the stilling basin is well above the river channel. If construction happens during a higher water year and water is retained in the stilling basin, a fish rescue may need to occur to ensure no listed fish are stranded in the stilling basin prior to being conducted. The Corps would conduct fish rescue efforts and would follow the procedures outlined above, and propose to coordinate with CDFW and NMFS prior to implementation.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1. Analytical Approach

This biological opinion (BO) includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This BO relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this BO we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.1.1. Use of Analytical Surrogates

The effects of the Common Features GRR in 2015 were primarily analyzed using Standard Assessment Methodology (SAM). The Corps provided the background data, assumptions, analyses, and assessment of habitat compensation requirements for the federally protected fish species relevant to the 2015 consultation. In the 2015 consultation, the Corps proposed updating the SAM model when numerous limitations of the model became obvious.

As the model has not been updated at the time of this 2021 reinitiation, the method of determining habitat impacts will utilize a combination of the SAM model, as well as expected construction and mitigation footprints.

Once site-specific designs are completed, the SAM analysis will be run. The planned project footprint and scale of on-site mitigation will then be compared against the SAM analysis to determine accuracy of the analysis. In instances where on-site mitigation and impacts are determined by NMFS to not be represented properly by the SAM analysis, impacts will be calculated by projects footprints and impacts will be agreed upon between NMFS and the Corps.

Standard Assessment Methodology Analysis

The SAM was designed to address a number of limitations associated with previous habitat assessment approaches and provide a tool to systematically evaluate the impacts and compensation requirements of bank protection projects based on the needs of listed fish species.

It is a computational modeling and tracking tool that evaluates bank protection design alternatives by taking into account several key factors affecting threatened and endangered fish species. By identifying and then quantifying the response of focal species to changing habitat conditions over time, project managers, biologists and design engineers can make changes to project design to avoid, minimize, or compensate for impacts to habitat parameters that influence the growth and survival of target fish species by life stage and season. The model is used to assess species responses as a result of changes to habitat conditions, through quantification of bank stabilization design parameters (*e.g.,* bank slope, substrate).

The assumptions, model variables, and modeling approaches used in the SAM have been developed to be adapted and validated through knowledge gained from monitoring and experimentation within the SRBPP while retaining the original overall assessment method and framework. The first update to the SAM included the addition of green sturgeon, as well as a number of modifications to modeled-species responses based upon updated literature reviews and recent monitoring efforts at completed bank protection sites (Stillwater Sciences 2012, The Corps 2012).

The SAM quantifies habitat values in terms of a weighted species response index (WRI) that is calculated by combining habitat quality (*i.e.*, fish response indices) with quantity (*i.e.*, bank length or wetted area) for each season, target year, and relevant species/life stage. The fish response indices are derived from hypothesized relationships between key habitat attributes (described below) and the species and life stage responses. Species response indices vary from 0 to 1, with 0 representing unsuitable conditions and 1 representing optimal conditions for survival, growth, and/or reproduction. For a given site and scenario (*i.e.*, with or without project), the SAM uses these relationships to determine the response of individual species and life stages to the measured or predicted values of each habitat attribute for each season and target year, and then multiplies these values together to generate an overall species response index. This index is then multiplied by the linear feet or area of shoreline to which it applies to generate a weighted species response index expressed in feet or square feet. The species WRI provides a common metric that can be used to quantify habitat values over time, compare project conditions to existing conditions, and evaluate the effectiveness of on-site and off-site compensation actions.

The WRI represent an index of a species growth and survival based on a 30-day exposure to post project conditions over the life of the project. As such, negative SAM values can be used as a surrogate to quantify harm to a target fish species by life stage and season. Also, although SAM values represents an index of harm to a species, since the values are expressed as “weighted bank line feet” or “weighted area”, these values can be used to help quantify compensatory conservation actions such as habitat restoration, and are used for that purpose in this BO.

During this reinitiated consultation, the Corps and NMFS identified several shortcomings with the SAM as a tool for relaying the impacts and onsite mitigation accurately when the impacts or benefits span beyond the small area where SAM focuses, making it an unreliable tool. The primary shortcoming is that the SAM evaluates habitat conditions at the average seasonal water surface intersection with the riverbank. While potentially relaying impacts and benefits at those specific water levels, it does not quantify impacts above or below those water levels.

2.1.2. Compensation Timing

As described in the proposed action, this project proposes compensation for unavoidable effects to species and impacts to habitat. Under the initial Corps BA (Corps 2015), compensation timing was defined by the SAM modeled impact at the proposed timing (Green sturgeon: 15 years: Chinook salmon, 5 years: Central Valley steelhead, 4 years) as being sufficient to compensate for project effects. NMFS adopts a slightly different approach to the analysis of this 2021 BO in that the timing for completed compensation should be to target avoiding exposure of more than one generation of a population with a multiple age class structure. Although the approach is different, the number of years for each species is the same under both approaches. Negative impacts extending beyond those years (Green sturgeon: 15 years: Chinook salmon, 5 years: Central Valley steelhead, 4 years) may have additional detrimental effects to the species. Beyond those timeframes, impacts would reduce the species survival and recovery in the wild, or substantially reduce the value of habitat for the conservation of the species, because the adverse effects (reduced growth and survival of individuals) would begin to reduce the number of reproducing individuals across multiple generations. As such, this BO applies the following maximum timing for completed compensation as general targets for meeting the intended value of offsetting long-term effects of the proposed action:

- Chinook salmon, 5 years
- Central Valley steelhead, 4 years
- Green sturgeon: 15 years

The combination of on-site and off-site mitigation and associated timing included in the proposed action has a substantial portion of mitigation that will occur during construction or immediately following, so as not to surpass the earliest of those targets (steelhead, 4 years). The large scale of the project increases the need for resolving temporal impacts in a more concise manner. The large-scale off-site mitigation has an associated timeline proposed with it (substantial function by 2024 secures a lower credit ratio), to assist in reaching the species compensation targets listed above.

We expect, with the combination of pre-construction bank credit purchases, research funding, on-site mitigation, and large offsite mitigation, and with the variety of minimization and conservation measures being implemented, the impacts to species and habitat will be offset over the course of the entire construction timeline, as opposed to having all adverse effects occurring simultaneously, and lag in mitigation execution.

2.1.3. Description of Assumptions Used In This Analysis

For the purpose of the analysis of the habitat being affected by the proposed action, some reasonable assumptions were made for aspects with some uncertainty. One assumption made was due to the uncertainty of final designs for a number of sites. In coordination with USFWS (whose BO also included riparian mitigation), and after discussions with the Corps, impacts to NMFS species are calculated from the OHWM and below for the purposes of calculating mitigation amounts. While NMFS analyzes all the likely effects of the project (whether above or below the OHWM), it is expected that by calculating the area of impact from the full rock placement (including rock placed at depths that would not generally be utilized by salmonids), that the calculation will be appropriate to provide an estimate of mitigation acreage for the Corps proposed compensation. If at any time this assumption proves to be inaccurate in determining the extent of effects, reinitiation will be required.

Another decision between multiple potential analytical methods for this BOs analysis is in regards to the calculation of area of impact. For all impacts on banks/levees, NMFS considers the full measure of the actual acreage of impacts measured across the full slope where these effects are occurring. Another method proposed uses of the "lateral extent" of the repairs, which involves calculation of the area of a straight line from the top of the repair, horizontally out into the center of the channel, to the end of the repair. When comparing these methods, the "lateral extent" method ranged in inaccuracy anywhere from 10% up to 50% in the acres actually being impacted. This method has thus been deemed inaccurate and unacceptable as a form of effects analysis, and will not be used by NMFS as a method of analysis. NMFS will use the actual area of impact to determine habitat effects.

2.2. Rangewide Status of the Species and Critical Habitat

This BO examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The BO also examines the condition of critical habitat throughout the designated area, evaluates the value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that value for the conservation of the listed species.

Table 7. Description of species, current Endangered Species Act (ESA) listing classifications, and summary of species status.

Species	Listing Classification and Federal Register Notice	Status Summary
Sacramento River winter-run Chinook salmon ESU	Endangered, 70 FR 37160; June 28, 2005	According to the NMFS 5-year species status review (NMFS 2016e), the status of the winter-run Chinook salmon ESU, the extinction risk has increased from moderate risk to high risk of extinction since the 2007 and 2010 assessments. Based on the Lindley et al. (2007a) criteria, the population is at high extinction risk in 2019. High extinction risk for the population was triggered by the hatchery influence criterion, with a mean of 66% hatchery origin spawners from 2016 through 2018. Several listing factors have contributed to the recent decline, including drought, poor ocean conditions, and increased hatchery influence. Thus, large-scale fish passage and habitat restoration actions are necessary for improving the winter-run Chinook salmon ESU viability.

Species	Listing Classification and Federal Register Notice	Status Summary
Central Valley spring-run Chinook salmon ESU	Threatened, 70 FR 37160; June 28, 2005	According to the NMFS 5-year species status review (NMFS 2016c), the status of the CV spring-run Chinook salmon ESU, until 2015, has improved since the 2010, 5-year species status review. The improved status is due to extensive restoration, and increases in spatial structure with historically extirpated populations (Battle and Clear creeks) trending in the positive direction. However, more recent declines of many of the dependent and independent populations, high pre-spawn and egg mortality during the 2012 to 2016 drought, uncertain juvenile survival during the drought are likely increasing the ESU's extinction risk. Monitoring data showed continued sharp declines in adult returns from 2014 through 2018 (CDFW 2018).
California Central Valley steelhead DPS	Threatened, 71 FR 834; January 5, 2006	According to the NMFS 5-year species status review (NMFS 2016b), the status of steelhead appears to have remained unchanged since the 2011 status review that concluded that the DPS was in danger of becoming endangered. Most natural-origin populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to natural-origin fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in steelhead.

Species	Listing Classification and Federal Register Notice	Status Summary
Southern DPS of North American green sturgeon	Threatened, 71 FR 17757; April 7, 2006	According to the NMFS 5-year species status review (NMFS 2015) and the 2018 final recovery plan (NMFS 2018), some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers. Also, several habitat restoration actions have occurred in the Sacramento River Basin, and spawning was documented on the Feather River. However, the species viability continues to face a moderate risk of extinction because many threats have not been addressed, and the majority of spawning occurs in a single reach of the main stem Sacramento River. Current threats include poaching and habitat degradation. A recent method has been developed to estimate the annual spawning run and population size in the upper Sacramento River so species can be evaluated relative to recovery criteria (Mora et al. 2017).

Table 8. Description of critical habitat, Listing, and Status Summary.

Critical Habitat	Designation Date and Federal Register Notice	Description
Sacramento River winter-run Chinook salmon ESU	June 16, 1993; 58 FR 33212	Designated critical habitat includes the Sacramento River from Keswick Dam RM 302 to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta (Delta); all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge from San Pablo Bay to the Golden Gate Bridge. The designation includes the river water, river bottom and adjacent riparian zones used by fry and juveniles for rearing. PBFs considered essential to the conservation of the species include: Access from the Pacific Ocean to spawning areas; availability of clean gravel for spawning substrate; adequate river flows for successful spawning, Incubation of eggs, fry development and emergence, and downstream transport of juveniles; water temperatures at 5.8–14.1°C (42.5–57.5°F) for successful spawning, egg incubation, and fry development; riparian and floodplain habitat that provides for successful juvenile development and survival; and access to downstream areas so that juveniles can migrate from spawning grounds to the San Francisco Bay and the Pacific Ocean. Although the current conditions of PBFs for SR winter-run critical habitat in the Sacramento River are significantly limited and degraded, the habitat remaining is considered highly valuable.

Critical Habitat	Designation Date and Federal Register Notice	Description
Central Valley spring-run Chinook salmon ESU	September 2, 2005; 70 FR 52488	Critical habitat for CV spring-run Chinook salmon includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water mark. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bank full elevation. PBFs considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas. Although the current conditions of PBFs for CV spring-run Chinook salmon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

Critical Habitat	Designation Date and Federal Register Notice	Description
California Central Valley steelhead DPS	September 2, 2005; 70 FR 52488	Critical habitat for CCV steelhead includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bank full elevation. PBFs considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas. Although the current conditions of PBFs for steelhead critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

Critical Habitat	Designation Date and Federal Register Notice	Description
Southern DPS of North American green sturgeon	October 9, 2009; 74 FR 52300	Critical habitat includes the stream channels and waterways in the Delta to the ordinary high water line. Critical habitat also includes the main stem Sacramento River upstream from the I Street Bridge to Keswick Dam, the Feather River upstream to the fish barrier dam adjacent to the Feather River Fish Hatchery, and the Yuba River upstream to Daguerre Dam. Critical habitat in coastal marine areas include waters out to a depth of 60 fathoms, from Monterey Bay in California, to the Strait of Juan de Fuca in Washington. Coastal estuaries designated as critical habitat include San Francisco Bay, Suisun Bay, San Pablo Bay, and the lower Columbia River estuary. Certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) are included as critical habitat for green sturgeon. PBFs considered essential to the conservation of the species for freshwater and estuarine habitats include: food resources, substrate type or size, water flow, water quality, migration corridor; water depth, sediment quality. In addition, PBFs include migratory corridor, water quality, and food resources in nearshore coastal marine areas. Although the current conditions of PBFs for green sturgeon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

Recovery Plans

In July 2014, NMFS released a final Recovery Plan for spring-run Chinook salmon, winter-run Chinook salmon, and steelhead (NMFS 2014, Recovery Plan). The Recovery Plan outlines actions to restore habitat, access, and improve water quality and quantity conditions in the Sacramento River to promote the recovery of listed salmonids. Key actions for the Recovery Plan include conducting landscape-scale restoration throughout the Delta, incorporating ecosystem restoration into Central Valley flood control plans that includes breaching and setting back levees for juveniles to access floodplains, and restoring flows throughout the Sacramento and San Joaquin River basins and the Delta.

In August 2018, NMFS released a final Recovery Plan for the green sturgeon (NMFS 2018), which focuses on fish screening and passage projects, floodplain and river restoration, and riparian habitat protection in the Sacramento River Basin, the Delta, San Francisco Estuary, and nearshore coastal marine environment as strategies for recovery.

Global Climate Change

One major factor affecting the rangewide status of the threatened and endangered anadromous fish in the Central Valley (CV) and aquatic habitat at large is climate change. Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen et al. 2000); Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). Projected warming is expected to affect CV Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether any CV Chinook salmon populations can persist (Williams 2006).

SR winter-run embryonic and larval life stages that are most vulnerable to warmer water temperatures occur during the summer, which makes the species particularly at risk from climate warming. The only remaining population of SR winter-run depends on the cold-water pool in Shasta Reservoir, which buffers the effects of warm temperatures in most years. The exception occurs during drought years, which are predicted to occur more often with climate change (Yates *et al.* 2008). The long-term projection of how the Central Valley Project (CVP) and State Water Project (SWP) will operate incorporates the effects of climate change in three possible forms: less total precipitation; a shift to more precipitation in the form of rain rather than snow; or, earlier spring snow melt (Reclamation (U.S. Bureau of Reclamation and ESSA Technologies Ltd 2008). Additionally, air temperature appears to be increasing at a greater rate than what was previously analyzed (Lindley 2008 , Beechie *et al.* 2012, Dimacali 2013). These factors will compromise the quantity and/or quality of SR winter-run habitat available downstream of Keswick Dam. It is imperative for additional populations of SR winter-run to be re-established into historical habitat in Battle Creek and above Shasta Dam for long-term viability of the ESU (NMFS 2014).

Spring-run adults are vulnerable to climate change, because they over summer in freshwater streams before spawning in autumn (Thompson *et al.* 2011). Spring-run spawn primarily in the tributaries to the Sacramento River and those tributaries without cold-water refugia (usually input from springs) will be more susceptible to impacts of climate change.

Steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the Central Valley, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 14°C to 19°C (57°F to 66°F).

The Anderson Cottonwood Irrigation District (ACID) Dam is considered the upriver extent of green sturgeon passage in the Sacramento River. The upriver extent of green sturgeon spawning, however, is approximately 19 miles downriver of the ACID Dam where water temperature is warmer than at the ACID Dam during late spring and summer. Thus, if water temperatures increase with climate change, temperatures adjacent to the ACID Dam may remain within tolerable levels for the embryonic and larval life stages of green sturgeon, but temperatures at spawning locations lower in the river may be more affected.

In summary, observed and predicted climate change effects are generally detrimental to these listed species (McClure 2011, Wade *et al.* 2013), so unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100. While the uncertainty associated with these projections increases over time, the direction of climate change is relatively certain (McClure 2011).

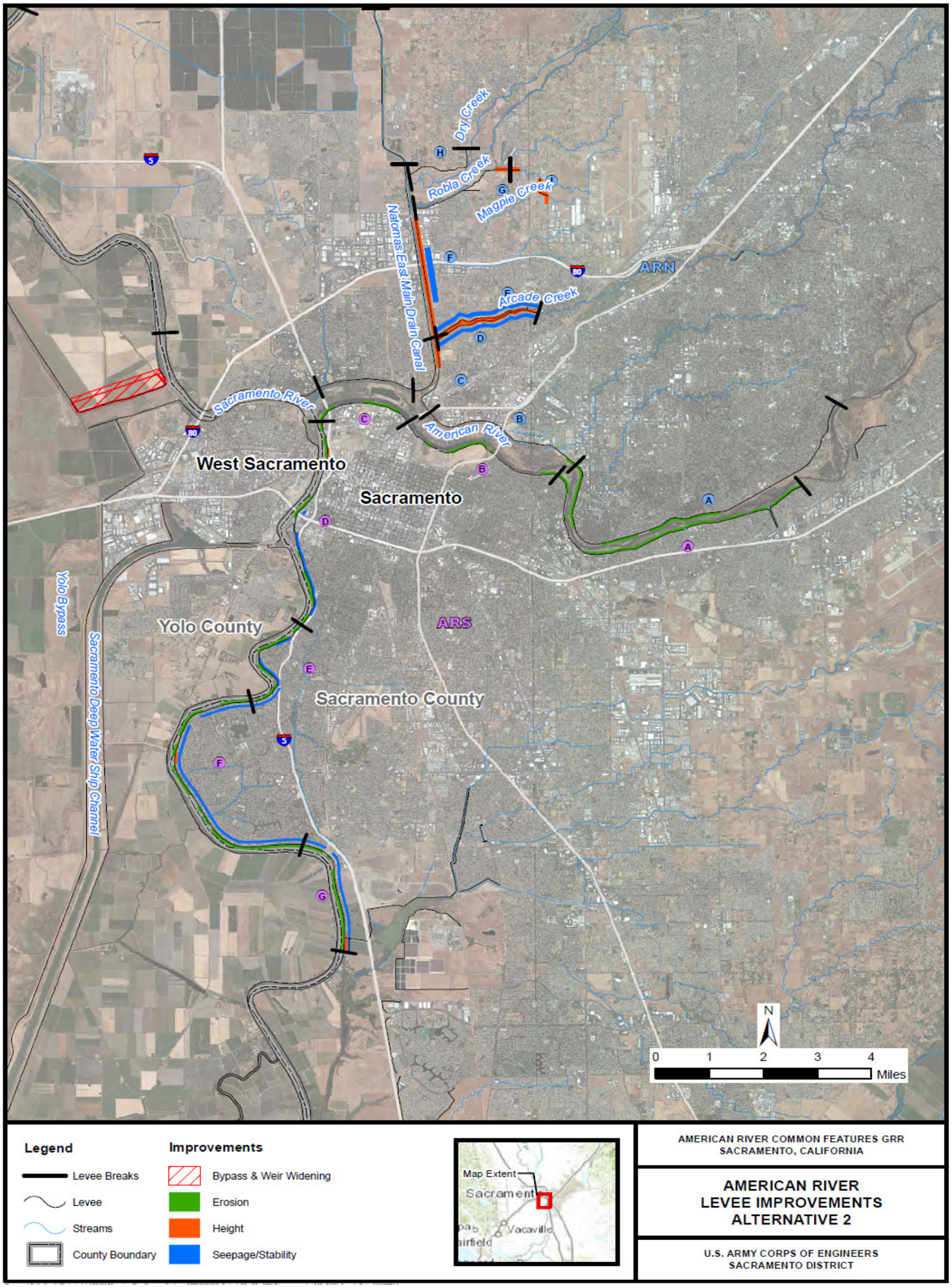
2.3. Action Area

"Action area" means 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). The Action Area for this section 7 consultation encompasses all areas that may be directly or indirectly affected as a result of activities for ARCF project and the broader area that, while outside the construction zone, may be directly or indirectly affected by implementation of the Proposed Action, such as vibrations, noise, increased turbidity, or sedimentation movement associated with the proposed action. This includes all areas that will be affected in the short-term and long-term, by the construction and maintenance for the ARCF project.

The Action Area encompasses areas along the Sacramento River from the Sacramento Bypass downstream to RM 45, the Yolo Bypass south the confluence of the Sacramento Bypass, the lower American River from Nimbus Dam to the confluence of the Sacramento River, Arcade Creek from Marysville Boulevard to the confluence of the NEMDC, the NEMDC from the south Dry Creek levee to just south of the NEMDC Arcade Creek confluence, the southern Dry Creek levee between Dry Creek Road and Rose Street, the borrow site along the NEMDC, and other haul, access, and borrow sites associated with construction activities.

Vessel traffic for construction material hauling may extend as far west as San Francisco in order to transport material to sites along the Sacramento River. The Action Area also includes any areas that may be affected by the implementation of conservation measures, including compensatory mitigation and planting areas, including the Fremont Landing Conservation Bank. These areas include on the mainstem Sacramento River down to RM 0, the American River watershed up to Nimbus Dam, areas adjacent to the expanded Sacramento Bypass, and adjacent waterways in the Sacramento-San Joaquin Delta legal boundaries.

Figure 4. Map of the American River Common Features Action Area as described by the Corps.



2.4. Environmental Baseline

The “environmental baseline” refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency’s discretion to modify are part of the environmental baseline (50 CFR 402.02).

This section describes the physical conditions and general vegetation, wildlife, and fisheries resources present within the ARCF Action Area. These conditions are first presented generally throughout the ARCF Action Area and then site specific SRA is analyzed as well as affected species in the ARCF Action Area.

The ARCF Action Area includes the mainstem Sacramento River from Freeport (RM 46) in the Delta upstream to the American River confluence (RM 60), and the Sacramento Bypass. The region also includes the lower American River from the confluence with the Sacramento River upstream to RM 11, NEMDC, Arcade Creek, Dry/Robla Creeks and Magpie Creek.

The Sacramento River watershed receives winter/early spring precipitation in the form of rain and snow (at higher elevations). Prior to the construction and operation of any reservoirs, winter rainfall events caused extensive flooding and spring snowmelt resulted in high flows during spring and early summer. Summer and fall flows were historically low. Currently, much of the total runoff is captured and stored in reservoirs for gradual release during the summer and fall months. High river flows occur during the winter and spring, but these are usually lower than during pre-European settlement times; summer and fall low flows are sustained by releases from upstream reservoirs.

Downstream from the American River confluence, the Sacramento River is moderately sinuous (average sinuosity of 1.3), with the channel confined on both sides by man-made levees enhanced by decades of man-made additions. The channel in this reach is of uniform width, is not able to migrate, and is typically narrower and deeper relative to the upstream reach due to scour caused by the concentration of shear forces acting against the channel bed (Brice 1977). Channel migration is similarly limited along the lower American River because of man-made levees and regulated flows from Folsom Dam.

The natural banks and adjacent floodplains of both rivers are composed of silt- to gravel-sized particles with poor to high permeability. Historically, the flow regimes caused the deposition of a gradient of coarser to finer material, and longitudinal fining directed downstream (sand to bay muds). The deposition of these alluvial soils historically accumulated to form extensive natural levees and splays along the rivers, 5 to 20 feet above the floodplain for as far as 10 miles from the channel (Thompson 1961). The present day channels consist of fine-grained cohesive banks that erode due to natural processes as well as high flow events (Corps 2012).

Most existing habitat impacts are the result of development of the basin-wide flood control system, the SRFCP (Sacramento River Flood Control Project), and other human developments. The current system evolved from private efforts begun in 1850 into the joint Federal-State SRFCP, which was essentially completed in 1960. Because the SRFCP removed large acreages of riparian floodplain and overflow basins from the river system, the natural regeneration of riparian woodland communities was negatively impacted. Additional effects occurred to recruitment of large woody material to the river system, spawning and rearing of fish in floodplain and floodplain functions, and allochthonous (imported) input of nutrients and food to the aquatic system. The SRFCP largely eliminated the possibility of natural channel migration and habitat renewal over a considerable portion of the river system. Reaches throughout the action area historically provided both shallow and deeper water habitat. However, channel confining levees and upstream reservoirs that maintain year-round outflow have eliminated much of the adjacent shallow water floodplain habitat. The existing levees influence the natural meander and ecosystem of the Sacramento and American Rivers, included in the action area. Many native fish species are adapted to rear in flooded, shallow water areas that provide abundant cover from prey. As a consequence of habitat alterations, and introduction of non-native species and pollutants, some native fish species are now extinct while most others are reduced in numbers (Moyle 2002).

The Proposed Action is occurring in the Sacramento River, American River, and other tributaries, most of which serve as rearing habitat and migratory corridors for listed winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon. As mentioned above, much of the Sacramento and American River watersheds have been substantially altered from human activities, and this has dramatically reduced the habitat value of the watersheds for listed fish species. However, despite the impaired status of the Sacramento River watershed in the proposed action area, the value of the area for listed fish species is high, as it provides some of the last remaining critical habitat for listed fish. The lower Sacramento River is the essential migratory corridor for all winter-run Chinook salmon, and the majority of spring-run Chinook salmon populations, steelhead populations, and green sturgeon, and contains habitat elements that support the rearing and growth of juveniles and the successful upstream migration of adults. The same high value habitat can be attributed to the lower American River for spring-run Chinook salmon, steelhead, and green sturgeon.

Seasonal high flows enter the adjacent Yolo Bypass from this reach of the Sacramento River via the Sacramento Bypass (RM 63). Tidal influence emanating from Suisun Bay extends up the Sacramento River for 80 miles to Verona, with greater tidal variations occurring downstream during low river stages in summer and fall.

NEMDC is an approximately 13.3-mile, human-made, partially leveed drainage channel that provides drainage from Sankey Road and connects streams of the American Basin (Dry, Robla, and Arcade Creeks) to the American River. South of the confluence with Arcade Creek, the east and west levees of NEMDC are dominated by wild oats grasslands, while the channel is characterized by Fremont cottonwood forest, with smaller amounts of valley oak woodland, smart-weed cocklebur patches, and perennial rye grass fields.

The approximately 16.2-mile-long channel of Arcade Creek extends east-to-west from Orangevale to the American River, via NEMDC. The north and south levees are dominated by wild oats grasslands. Valley oak woodland is the main riparian vegetation type along Arcade Creek, but Fremont cottonwood forest occurs in small patches along the easternmost reach of Arcade Creek near NEMDC. Hardstem bulrush marsh is found within Arcade Creek near Norwood Avenue while water primrose wetlands are predominant within the channel of Arcade Creek from approximately the confluence with NEMDC to Norwood Avenue. East of Norwood Avenue, the creek channel becomes narrower, and dominated by a shaded canopy of valley oak woodland.

Vegetation in the Action Area

The Action Area consists of primarily riparian forest, valley oak woodland, riparian scrub-shrub habitat, and typically non-native annual grassland. Scrub-shrub generally refers to areas where the woody riparian canopy is composed of young trees or shrubs less than 20 feet high. Species that are typically found in riparian forest, valley oak woodland, and scrub habitats include cottonwood, several willow species, sycamore valley oak, black walnut, Oregon ash, white alder, boxelder, blue elderberry, buttonbush, Himalaya blackberry, wild grape, and poison oak. Understory vegetation may consist of an herbaceous layer of sedges, rushes, grasses, and forbs.

Riparian forest typically has a dominant overstory of cottonwood, California sycamore, black walnut, black willow, or valley oak. Dominant species found in the sub canopy may also include alder, ash and box elder. Layers of climbing vegetation make up part of the subcanopy, with wild grape being a major component, but wild cucumber and clematis vines are also found in riparian communities.

Several species of invasive non-native trees, shrubs and vines may be present in some riparian locations, predominantly red sesbania, Himalayan blackberry, tamarix, false bamboo, tree-of-heaven, eucalyptus, and ivy.

The herbaceous ruderal groundcover, primarily nonnative annual grassland, is found on most levees along the Sacramento River. It occurs on the levees and also within gaps in the riparian habitats. Plant species include wild oats, soft chess, ripgut brome, red brome, wild barley, Bermuda grass, and foxtail fescue. Common forbs include broadleaf filaree, red stem filaree, turkey mullein, clovers, and many others. The majority of these plants are not native to the Action Area.

Early riparian habitat may be called scrub-shrub. Scrub-shrub generally refers to areas where woody riparian canopy is composed of trees or shrubs approximately 20 feet high. Species that are typically found in these habitats include young cottonwood (*Populus trichocarpa*), willow (*Salix* spp.), elderberry (*Sambucus* spp.), buttonbush (*Cephalanthus occidentalis*), Himalaya blackberry (*Rubus armeniacus*), wild grape (*Vitis vinifera*), and poison oak (*Toxicodendron spp.*).

Riparian herbaceous cover includes herbland cover and gravel and sand bar community types. Areas are designated as riparian herbaceous cover if they are enclosed by riparian vegetation or the stream channel. Gravel and sand bar community types were included in this grouping by the the Corps, because these areas support annual and short-lived perennial species, including herbs, grasses and subshrubs that cover less than 50% of the area (Nelson 2000). Species that are typically found in these habitats include European annual and native perennial grasses; native perennials, such as Douglas' sagewort (*Artemisia douglasiana*), Santa Barbara sedge (*Carex barbarae*), smooth horsetail (*Equisetum laevigatum*), California pea (*Lathyrus jepsonii* var. *californicus*) and cudweed (*Gnaphalium* sp.); non-native forbs and grasses, such as garden asparagus and Bermuda grass (*Cynodon dactylon*); and invasive plants, such as yellow star-thistle (*Centaurea solstitialis*). Monospecific stands of the invasive exotic giant reed (*Arundo donax*) are also included in this vegetation type category.

Emergent marsh includes valley freshwater marsh and common reed plant community types. Common species found in emergent marsh habitat include cattails (*Typha* spp.) and tule (*Scirpus* spp.) with some sedge or associated broad-leaved aquatic species (such as *Verbena hastata*), and common reed (*Phragmites australis*), which can grow in inundated areas along the channel edge.

Other cover types found in the action area include bare ground (areas devoid of vegetation), agricultural, ruderal vegetation (areas with sparse to moderate herbaceous plant cover dominated by weedy upland species), and urban (including structures, roads and parks, but are usually located on the landward side of the levee).

Historical Human Resource Use and Current Riparian Vegetation

Historical precipitation and runoff patterns resulted in the Sacramento River being bordered by up to 500,000 acres of riparian forest, with valley oak woodland covering the higher river terraces (Katibah 1984). However, human activities of the 1800s and 1900s have substantially altered the hydrologic and fluvial geomorphic processes that create and maintain riparian forests within the Sacramento basin, resulting in both marked and subtle effects on riparian communities. Riparian recruitment and establishment models (Mahoney and Rood 1998; Bradley and Smith 1986) and empirical field studies (Scott et al. 1997, 1999) emphasize that hydrologic and fluvial processes play a central role in controlling the elevational and lateral extent of riparian plant species. These processes are especially important for pioneer species that establish in elevations close to the active channel, such as cottonwood and willows (*Salix* spp.). Failure of cottonwood recruitment and establishment is attributed to flow alterations by upstream dams (Roberts et al. 2001) and to isolation of the historic floodplain from the river channel. In addition, many of these formerly wide riparian corridors are now narrow and interrupted by levees and weirs. Finally, draining of wetlands, conversion of floodplains to agricultural fields, and intentional and unplanned introduction of exotic plant species have altered the composition and associated habitat functions of many of the riparian communities that are able to survive under current conditions.

Site-Species Analysis of Riparian Vegetation

Analysis of total LF of SRA was conducted using Google Earth Pro for the reaches only associated with bank protection on the American and Sacramento Rivers in the ARCF Action Area (Table 8). However, site-specific conditions at proposed bank protection sites will evaluate SRA habitat values using the SAM method of analysis to determine impacts and onsite compensation value based on actual designs. It is not anticipated that trees would need to be removed within the Sacramento Bypass as a result of the levee relocation effort, since the footprint of the expanded Bypass area is open farmland with no trees present. However, trees along the Sacramento River would be removed to construct the new 1,500-foot Sacramento Weir.

Below in Table 8 is the estimate of linear footage of existing riparian habitat along the reaches of the American and Sacramento Rivers where bank protection is expected to be constructed.

Table 9. Summary of Reach-Specific SRA Analysis from ARCF BA (Corps, 2020)

	American River		**Sacramento River**
Reach	**Linear Feet (LR) of SRA**	**Reach**	**Linear Feet (LR) of SRA**
Total	45,367	**Total**	51,804

2.4.1. Previous Flood Management within the Action Area

The environmental baseline also includes past and present flood management actions within the action area. The action area is encompassed by levees built from around 1850 up through 1960. Several large-scale bank repair actions have occurred within the action area prior to this consultation. The largest are by far the Sacramento River Bank Protection Program (SRBPP) and the West Sacramento General Re-evaluation Study (West Sac GRS), a sister project to the ARCF proposed action.

The SRBPP was originally authorized by the Flood Control Act of 1960, in order to protect levees and flood control facilities of the SRFCP from erosion damage. The SRBPP has been thus far described in two phases: SRBPP Phase I and Phase II. Each phase includes flood risk management actions consisting mainly of bank protection and levee repairs to correct erosion problems and protect low-lying areas of the Sacramento Valley and Sacramento-San Joaquin Delta from damaging floods. Phase I was constructed from 1962 to 1975. Phase II was originally authorized in 1974 and consists of 405,000 LF of bank protection. An additional 80,000 LF was added to Phase II by the Water Resources Development Act (WRDA) of 2007, and 30,000 LF of this has been consulted on previously with NMFS.

The West Sac GRS was consulted on in 2015 and has not yet been constructed. Based on information provided by the Corps, it is likely that construction will begin concurrently with the ARCF proposed action. The West Sac GRS will be constructing erosion repairs on the west side of the Sacramento River from the Sacramento Bypass, stretching down 11 miles as well as installing cut-off walls and further repairs within the Deep Water Ship Channel and levees within the Yolo Bypass. The construction will require the removal of most of the riparian vegetation from the levee temporarily, with up to 66% permanent vegetation loss possible. The construction was mitigated for locally through the Southport levee setback, a large floodplain construction action that was completed in 2018. This provided access to 120 acres of historic floodplain habitat to offset the impacts of the construction of the West Sac GRS action.

Although site-level impacts have been addressed from compensatory mitigation associated with the SRBPP and West Sac GRS, ecosystem impacts have largely been left unaddressed. Levees constructed as part of the SRBPP have replaced the naturally occurring shallow water habitat that existed along the banks of rivers and sloughs, which historically provided a spectrum of complex habitats. Shallow water habitats had a broad range of depths, water velocities, riparian vegetation, fallen trees and woody materials (*i.e.*, IWM), and gave the river the ability to migrate across the floodplain to create additional complexity in the geometry of its cross section. Naturally flowing rivers were able to construct riverside benches and naturally formed levees during flood events. These benches could be up to 20 feet high and extended for considerable distances inland, creating suitable conditions for the establishment and successful development of structurally diverse riparian vegetation communities (The Bay Institute 1998). Large, continuous corridors of riparian forests and vegetation were present along major and minor rivers and streams in the Central Valley. Native fish species, including listed salmonids and green sturgeon, evolved under these environmental conditions.

The construction of levees and the "reclamation" of floodplains eliminated these riparian areas. Only remnant riparian forests exist in the action area today, as many of the levees are extensively riprapped with stone armoring. Only in a few areas where waterside benches exist outside of the levee toe and vegetation is allowed to grow, does naturally established vegetation exist. These stands of riparian vegetation are discontinuous and frequently very narrow in width, providing a fraction of the ecological benefits of their historical predecessors.

In particular, the loss of large wood recruitment and IWM on a large-scale is becoming increasingly concerning, as our understanding of the functionality of IWM for fish and other wildlife resources continues to develop. IWM is very important to fish, playing key roles in physical habitat formation, sediment and organic-matter storage, and in maintaining essential habitat complexity and refugia (USFWS 2004). Loss of IWM reduces habitat quality and carrying capacity (USFWS 2004). The act of riprapping river banks not only removes any existing IWM, but prevents recruitment of IWM along the riprapped banks and reduces the retention of IWM recruited from any upstream, non-armored areas (USFWS 2004). In fact, "the cumulative loss of IWM functioning for the lower Sacramento River is now likely at least 67-90%, or more, compared to pre-SRBPP conditions" (USFWS 2004).

Loss of IWM negatively impacts salmonids through multiple phases of their life history. Schaffter et al. (1983) showed that juvenile Chinook salmon densities along riprapped banks are one third that of natural banks with the presence of fallen trees and their root balls in the water. They concluded that traditional riprap methods of protection will likely cause decreases in the salmon numbers in the Sacramento River basin. USFWS (2000) reported that in studies conducted in the Sacramento River near the Butte Basin, the highest number of juvenile Chinook salmon were associated with the nearshore areas with woody material, sloping banks, and moderate velocities. Juvenile Chinook salmon catches (*i.e.*, measured as catch per unit effort) were consistently lowest at riprapped sites and highest at natural bank sites with overhead cover and IWM, and intermediate in areas where experimental mitigation studies with artificially placed IWM. USFWS (2000) reported that additional studies conducted between Chico Landing and Red Bluff on the Sacramento River confirmed the low value of riprapped banks, the high value of natural banks with varying degrees of instream and overhead woody cover, and the intermediate value of mitigated sites.

In large mainstem streams and rivers such as the Sacramento River, the primary benefit of IWM occurs along channel margins. The woody materials act to deflect and break up stream flow, creating small eddies, pools, undercut banks, variability in channel depth, and back water areas conducive to rearing and growth (Murphy and Meehan 1991, Bisson et al. 1987). Sediment that is trapped by the woody material and stored along the channel margins contributes to the hydraulic and biologic complexity of the stream reach, particularly where organically rich materials are present (Bisson et al. 1987). These storage areas create new habitat complexity by trapping inorganic material that creates bars and holes and organic materials that contribute energy and carbon to the local food web of the stream reach (Murphy and Meehan 1991, Bisson et al. 1987). These breaks in the river flow also create ideal holding areas with plentiful food resources and the conditions where salmonids can hold with minimal energy expenditure and feed while rearing. These areas are also beneficial to a wide range of other species native to the system. Such refuges are critically important to the lower river reaches where levee construction and riprapping have disconnected the rivers from the adjoining floodplain where slow water refugia and rearing habitats formerly existed.

Riprapping affects the stability of IWM along the river channel margin. Stable wood retention is important for creating and maintaining good fish habitat (Bisson et al. 1987). Whole trees and their root balls are more important for long-term stability than smaller fragments, as they tend to stay in place for long periods of time. These large pieces of wood may remain in place for decades and in the process trap additional IWM, thus adding complexity to the overall bank structure. The longevity of IWM, however, may mask changes in the input of woody materials to the river. Since these large pieces of wood would normally be slow to decay, a decline in the woody material input may be masked. Riprapping of the upper river and Delta waterway banks prevents the normal input of upstream woody materials through erosion. The homogeneity and unvarying hydraulic roughness along the riprapped banks prevents pieces of woody materials from becoming anchored and remaining in place. The woody materials are transported downstream, but the riprapping of the lower river and Delta waterway banks further limit these pieces from becoming lodged on the banks and the woody material is lost to the system. There is a continuing reduction of IWM input from upstream and local waterways, so much so, that the presence of IWM in the Delta is becoming exceedingly rare. Spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon must all migrate through the Delta in order to survive, and therefore the large-scale removal of IWM upstream affects listed species growth and survival. Existing pieces that are removed or break apart from decay are not being replenished from upstream.

Riprapping halts the accretion of point bars and other depositions where new riparian vegetation can colonize (DWR 1994 cited in USFWS 2004). Riprapping also halts the meander migration and reworking of floodplains, which eventually reduces habitat renewal, diversity, complexity, and heterogeneity (DWR 1994; Larson 2002; USFWS 2004). This, in turn, has adverse effects on aquatic ecosystems, ranging from carbon cycling to altering salmonid population structures and fish assemblages (Schmetterling 2001; USFWS 2004). Riprapping can also incise the thalweg of the river adjacent to the riprapped area, narrowing the low-flow channel width, resulting in decreased hydrological and biological diversity (DWR 1994, USFWS 2004). Riprapping decreases river sinuosity, which increases the river channel slope, increasing the bedload transport and possible bed degradation and scour near the toe of the riprapped bank (USFWS 2004, Larson 2002). Riprapping alters the future channel planform of the river at the riprapped site as well as downstream from the site, which can cause more erosion of the channel bank downstream than if the riprap revetment were not present (USFWS 2004, Larson 2002).

Riprapping creates a relatively smooth surface along the riverbank, which is contrary to the habitat hydrodynamic complexity required for endangered salmonids (Lister 1995; NRC 1996; USFWS 2004). Riprap fills in sloughs, tributary channels, and oxbow lake areas, causing loss of nearby wetland habitat and diversity (USFWS 2004, DWR 1994). Riprap limits the lateral mobility of the river channel, decreasing general habitat complexity in the near-shore aquatic area and reducing complex lateral habitat, including small backwaters and eddies, which removes important refugia for plants, invertebrates, fish, birds, and mammals (USFWS 2004; Welcomme 1979). Riprapping also decreases near-shore roughness, which causes stream velocities to increase more rapidly with increasing discharge, further eliminating critical refugia areas for fish and other aquatic organisms during high flows and causing accelerated erosion downstream, which can in turn result in riprap creating the need for more riprap (Gregory 1991; USFWS 2004). Riprap also halts erosion and reduces habitat complexity, which in turn reduces the ability of near-shore areas to retain sediments and organic materials, and isolates the river from its watershed (Gregory 1991; USFWS 2004). Riprap impedes plant growth, resulting in vegetation being pushed far back from the shoreline, further reducing food resources for aquatic invertebrates that would have been provided from such vegetation (Murphy 1991; USFWS 2004).

The above effects of riprapping are well documented, but there are additional, complex, and relatively poorly understood and unaddressed effects of large-scale riprapping, which warrant additional study and consideration (USFWS 2004). Studies that seek to provide insights into presently poor understood effects of large-scale riprapping include those related to the effects of bank stabilization of channelization on rivers, and the effects of snagging and clearing operations (USFWS 2004).

Environmental Effects of the Corps Vegetation Policy

The continuation of the Corps Engineering Technical Letter (ETL) policy of no vegetation within 15 feet of the levee toe on both the waterside and landside of the levee greatly exacerbates the negative attributes of the currently armored levee habitat in the area. Removal of the vegetation on the waterside and landside of the levees prevents the input of allochthonous organic materials to adjacent waterways and severely reduces the function of riparian and nearshore habitat along the affected levee reaches. By preventing the input of organic materials that serves as a source of energy and organic carbon, aquatic and terrestrial food webs are negatively impacted and the quantity and quality of nearshore rearing habitat is measurably reduced. Removal of riparian vegetation has reduced the amount of overhead shade along significant stretches of the Sacramento River mainstem and tributaries.

Compliance with the ETL policies prevents the establishment of riparian vegetation communities. The ETL policy does not allow woody vegetation to become established that could eventually be recruited into the adjacent aquatic habitat through erosion or death of the woody plants. Allowance of only grasses, sedges, and small bushes to grow on the waterside banks of the levees will not create the full functionality of a riparian zone, or create the equivalent complexity of habitat that a full riparian vegetation community would possess.

The NMFS Salmonid Recovery Plan identifies loss of juvenile rearing habitat in the form of lost natural river morphology and function, and lost riparian habitat and instream cover as a "very high stressor" affecting the viability of salmon and steelhead in the Central Valley (NMFS 2014). The Recovery Plan also establishes a strategic approach to recovery, which identifies critical recovery actions for the Central Valley, as well as watershed- and site-specific recovery actions. Watershed-specific recovery actions address threats occurring in each of the rivers or creeks that currently support spawning populations of the Sacramento River winter-run Chinook salmon ESU, the Central Valley spring-run Chinook salmon ESU, or the California Central Valley steelhead DPS. Site-specific recovery actions address threats to these species occurring within a migration corridor (*e.g.*, Sacramento River [SAR], San Francisco Bay, or the Delta [Del], Feather River [FER], American River [AMR]). Relevant recovery actions proposed include:

CEV-1.8 (Priority 1): *Develop and implement State and National levee vegetation policies to maintain and restore riparian corridors.*

Del-1.4 (Priority 1): *Conduct landscape-scale restoration of ecological functions throughout the Delta to support native species and increase long-term overall ecosystem health and resilience.*

Del-1.7 (Priority 1): *Restore, improve and maintain salmonid rearing and migratory habitats in the Delta and Yolo Bypass to improve juvenile salmonid survival and promote population diversity.*

SAR-1.2 (Priority 1): *Restore and maintain riparian and floodplain ecosystems along both banks of the Sacramento River to provide a diversity of habitat types including riparian forest, gravel bars and bare cut banks, shade vegetated banks, side channels, and sheltered wetlands, such as sloughs and oxbow lakes following the guidance of the Sacramento River Conservation Area Handbook (Resources Agency of the State of California 2003).*

SAR-2.1 (Priority 2): *Ensure that riverbank stabilization projects along the Sacramento River utilize bio-technical techniques that restore riparian habitat, rather than solely using the conventional technique of adding riprap.*

SAR-2.8 (Priority 2): *Implement projects that promote native riparian (e.g., willows) species including eradication projects for non-native species (e.g., Arundo, tamarisk).*

SAR-2.11 (Priority 2): *Improve instream refuge cover in the Sacramento River for salmonids to minimize predatory opportunities for striped bass and other non-native predators.*

AMR-1.6 (Priority 1): *Implement a long-term wood management program to provide habitat complexity and predator refuge habitat.*

AMR-2.5 (Priority 2): *Develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the American River Watershed.*

AMR-2.7 (Priority 2): *Utilize bio-technical techniques that integrate riparian restoration for riverbank stabilization instead of conventional riprap in the American River.*

ETL compliance that reduces or eliminates the potential for establishing riparian communities along the program's levee reaches will significantly impair implementation of these key recovery actions and will make it difficult to recover the ecosystems upon which ESA-listed salmon and steelhead in the Central Valley depend. Furthermore, the ongoing requirement under the ETL to remove vegetation will typically require the application of herbicides to control vegetation on the levee faces. Herbicides and their additives, such as surfactants, can have negative or deleterious effects upon sensitive receptors of fishes, invertebrates, or plants, in the aquatic environment. Spraying of herbicides on "unwanted" vegetation can create situations where the herbicides drift into adjacent waters and contaminate those water bodies, or is contained in runoff from surface flow during rain events.

Future projects should focus on channel margin enhancement to protect and restore key migratory and rearing areas. Degradation of channel margins by retaining riprap and removing riparian and nearshore vegetation should be mitigated on-site first or at least elsewhere on the migratory corridor. Benefits from off-site mitigation should be carefully evaluated, as the species impacted from the program development may not benefit at all from mitigation conducted elsewhere, particularly if the mitigated area is removed from the migratory corridors of the impacted fish populations (*i.e.*, the ESUs and DPSs of listed fish species).

The reduction in the quality and quantity of beneficial habitat through previous actions, and the continued maintenance of these poorly functioning habitats through discretionary actions of vegetation management results in the severely diminished habitat value for ESA-listed fish species.

2.4.2. Status of the Species in the Action Area

The action area, which is described above, encompasses the mainstem and tributaries of the Sacramento River, from RM 45 to the Sacramento Weir and Bypass (RM 63), the lower 12 miles of the American River, and all associated floodplains and riparian areas at and adjacent to the proposed construction sites. These sites function as a migratory corridor for spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon. The action area is also used for rearing and adult feeding.

Presence of Sacramento River winter-run Chinook salmon in the Action Area

The temporal occurrence of Sacramento River winter-run Chinook salmon smolts and juveniles within the action area are best described by a combination of the salvage records of the CVP and SWP fish collection facilities and the fish monitoring programs conducted in the northern and central Delta. Based on salvage records at the CVP and SWP fish collection facilities, juvenile Sacramento River winter-run Chinook salmon are expected in the action area starting in December. Their presence peaks in March and then rapidly declines from April through June. The majority of winter-run juveniles will enter the action area during February through June. Presence of adult Chinook salmon is interpolated from historical data. While no spawning population of winter-run exists within the American River, rearing juveniles have been captured at the screw traps at RM 9, and expected to be present within the Lower American River in similar time windows as their presence in the Sacramento River. Adult winter-run Chinook salmon are expected to enter the action area starting in January, with the majority of adults passing through the action area between February and April.

The action area contains CV winter-run Chinook salmon from the Basalt and Porous Lava Diversity group (*i.e.*, mainstem Sacramento River below Keswick Dam). Within the action area, there are “Core 1” populations of CV winter-run Chinook salmon, as designated in the Recovery Plan for the species (NMFS 2014). Core 1 watersheds possess the known ability or potential to support a viable population. For a population to be considered viable, it must meet the criteria for low extinction risk for Central Valley salmonids (Lindley *et al*. 2007). The criteria include population size, population decline, catastrophic decline and hatchery influence.

Presence of CV spring-run Chinook salmon in the Action Area

CVP/SWP salvage records and the northern and Central Delta fish monitoring data indicate that juvenile spring-run Chinook salmon first begin to appear in the action area in December and January, but that a significant presence does not occur until March and peaks in April. By May, the salvage of juvenile CV spring-run Chinook salmon declines sharply and essentially ends by the end of June. The data from the northern and central Delta fish monitoring programs indicate that a small proportion of the annual juvenile spring-run emigration occurs in January and is considered to be mainly composed of older yearling spring-run juveniles based on their size at date. Adult spring-run Chinook salmon are expected to start entering the action area in approximately January. Low levels of adult migration are expected through early March. The peak of adult spring-run Chinook salmon movement through the action area is expected to occur between April and June with adults continuing to enter the system through the summer. Currently, all known populations of CV spring-run Chinook salmon inhabit the Sacramento River watershed.

The action area contains CV spring-run Chinook salmon from the Basalt and Porous Lava Diversity group, Northwestern California Diversity group, and the Northern Sierra Nevada Diversity group. Within the action area, there are both “Core 1”, “Core 2”, and “Core 3” populations of CV spring-run Chinook salmon, as designated for by NMFS recovery plan for the species (NMFS 2014). The Core 1 populations include Battle Creek, Clear Creek, Butte Creek, Deer Creek, and Mill Creek. Core 2 populations meet, or have the potential to meet, the biological recovery standard for moderate risk of extinction. The Core 2 populations within the actions area include the Mainstem Sacramento (below Keswick), Cottonwood/Beegum Creek, Yuba River, Big Chico Creek, and Antelope Creek. These watersheds have lower potential to support viable populations, due to lower abundance, or amount and quality of habitat. These populations provide increased life history diversity to the ESU/DPS and are likely to provide a buffering effect against local catastrophic occurrences that could affect other nearby populations, especially in geographic areas where the number of Core 1 populations is lowest. Core 3 watersheds have populations that are present on an intermittent basis and require straying from other nearby populations for their existence. These populations within the action area are Thomes Creek and Stony Creek. These populations likely do not have the potential to meet the abundance criteria for moderate risk of extinction. Core 3 watersheds are important because, like Core 2 watersheds, they support populations that provide increased life history diversity to the ESU/DPS and are likely to buffer against local catastrophic occurrences that could affect other nearby populations. Dispersal connectivity between populations and genetic diversity may be enhanced by working to recover smaller Core 3 populations that serve as stepping stones for dispersal.

Presence of steelhead in the Action Area

The CCV steelhead DPS final listing determination was published on January 5, 2006 (71 FR 834) and included all naturally spawned populations of steelhead (and their progeny) downstream of natural and manmade barriers in the Sacramento River and its tributaries. FRFH steelhead are also included in this designation. Depending on the year, there is potential spawning habitat present within the action area in the American River. There is also rearing and migration habitat present in the action area. Juveniles use rearing and migration habitat rear year-round in the mainstem Sacramento River and tributaries. Juveniles and smolts are most likely to be present in the action area during their outmigration, which begins in November, peaks in February and March, and ends in June.

Adult steelhead originating in the Sacramento River watershed will have to migrate through the action area in order to reach their spawning grounds and to return to the ocean following spawning. Likewise, all steelhead smolts originating in the Sacramento River watershed will also have to pass through the action area during their emigration to the ocean. The waterways in the action area also are expected to provide some rearing benefit to emigrating steelhead smolts. The steelhead DPS occurs in both the Sacramento River and the surrounding watersheds.

The action area contains steelhead from the Basalt and Porous Lava Diversity group, Northwestern California Diversity group, and the Northern Sierra Nevada Diversity group. Within the action area, there are both “Core 1”, “Core 2”, and “Core 3” populations of steelhead, as designated by NMFS Recovery Plan for the species (NMFS 2014). Core 1 populations include Battle Creek, Clear Creek, Deer Creek, Mill Creek, and Antelope Creek. Core 2 populations include Cow Creek, Mainstem Sacramento (below Keswick), Little Sacramento, Redding Area Tributaries, Putah Creek, Thomes Creek, Cottonwood/Beegum Creek, American River, Auburn Ravine, Feather River, Yuba River, Big Chico Creek, and Butte Creek. Core 3 populations are Stony Creek, Dry Creek, and Bear River.

Presence of North American Green Sturgeon in the Action Area

The Sacramento River is an important migratory corridor for larval and juvenile sturgeon during their downstream migration to the San Francisco Bay Delta and Estuary. Detailed information regarding historic and current abundance, distribution and seasonal occurrence of North American green sturgeon in the action area is limited due to a general dearth of green sturgeon monitoring. The action area is located on the main migratory route for adults moving upstream to spawn, post spawn adults migrating back to the ocean, juvenile outmigrants, and rearing subadults (NMFS, 2018). Juvenile green sturgeon are routinely collected at the CVP and SWP salvage facilities throughout the year. Based on the salvage records, green sturgeon may be present during any month of the year, and have been particularly prevalent during July and August. Adult green sturgeon begin to enter the Delta in late February and early March during the initiation of their upstream spawning run. The peak of adult entrance into the Delta appears to occur in late February through early April with fish arriving upstream in April and May. Adults continue to enter the Delta until early summer (June-July) as they move upriver to spawn.

It is also possible that some adult green sturgeon will be moving back downstream in April and May through the action area, either as early post spawners or as unsuccessful spawners. Some adult green sturgeon have been observed to rapidly move back downstream following spawning, while others linger in the upper river until the following fall. It is possible that any of the adult or sub-adult sturgeon that inhabit the Delta may enter the American River.

2.4.3. Status of Critical Habitat within the Action Area

The action area and includes the mainstem Sacramento River (RM 45-63), Yolo and Sacramento Bypasses, the lower American River, and numerous tributaries. Designated critical habitat for winter-run Chinook salmon (June 16, 1993, 58 FR 33212), spring-run Chinook salmon (September 2, 2005, 70 FR 52488), steelhead (September 2, 2005, 70 FR 52488) and green sturgeon (October 9, 2009, 74 FR 52300) occur in the ARCF action area.

The PBFs of critical habitat essential to the conservation of winter-run Chinook salmon, spring-run Chinook salmon, and steelhead are physical habitat, water quality and quantity, available forage required to maintain habitat for spawning, larval and juvenile transport, rearing, and adult migration. PBFs for Chinook salmon and steelhead within the action area include freshwater rearing habitat and freshwater migration corridors. The PBFs essential to the conservation of winter-run Chinook salmon, spring-run Chinook salmon, and steelhead include the following: sufficient water quantity and floodplain connectivity to form and maintain physical habitat conditions necessary for salmonid development and mobility, sufficient water quality, food and nutrients sources, natural cover and shelter, migration routes free from obstructions, no excessive predation, adequate forage, holding areas for juveniles and adults, and shallow water areas and wetlands. Habitat within the action area is primarily utilized for freshwater rearing and migration by steelhead and Chinook salmon juveniles and smolts and for adult freshwater migration. steelhead also utilize the parts of the American River within the action area for spawning habitat.

The PBFs essential to the conservation of green sturgeon are physical parameters needed for spawning, larval and juvenile transport, rearing, and adult migration. The action area includes the following green sturgeon PBFs: adequate food resources for all life stages; water flows sufficient to allow adults, subadults, and juveniles to orient to flows for migration and normal behavioral responses; water quality sufficient to allow normal physiological and behavioral responses; unobstructed migratory corridors for all life stages; a broad spectrum of water depths to satisfy the needs of the different life stages; and sediment with sufficiently low contaminant burdens to allow for normal physiological and behavioral responses to the environment.

The substantial degradation over time of several of the PBFs in the action area has diminished the function and condition of the freshwater rearing and migration habitats in the area. The action area now only has rudimentary functions compared to its historical status. The channels of the lower Sacramento and American Rivers have been replaced with coarse stone riprap on artificial levee banks and have been stabilized in place to enhance water conveyance through the system. The extensive riprapping and levee construction has precluded natural river channel migrations. The natural floodplains have essentially been eliminated, and the once extensive wetlands and riparian zones have been “reclaimed” and subsequently drained and cleared for agriculture.

Even though the habitat has been substantially altered and its quality diminished through years of human actions, its value remains high for the conservation of spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon. Many of the factors affecting these species throughout their range are discussed in the Rangewide Status of the Species and Critical Habitat section of this BO, and are considered the same in the action area. This section describes all factors that have resulted in the current state of critical habitats in the action area, particularly focusing on factors most relevant to the proposed action. During dry years, all out-migrating individuals from the Sacramento River and tributaries will travel through the action area, as this section is the bottleneck prior to opening into the Delta. During wet years, access to the Yolo Bypass allows fish to bypass the action area. The ARCF action area encompasses a very important portion of the remaining critical habitat for these species, and it is therefore critical to maintain the habitat functionality of what remains of the riparian corridors in the action area.

The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs affecting listed salmonids in the action area. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round. Current flood control practices require peak flood discharges to be held back and released over a period of weeks to avoid overwhelming the flood control structures downstream of the reservoirs (*i.e*., levees and bypasses). Consequently, managed flows in the mainstem of the river often truncate the peak of the flood hydrograph and extend the reservoir releases over a protracted period. These actions reduce or eliminate the scouring flows necessary to mobilize gravel and clean sediment from the spawning reaches of the river channel.

High water temperatures also limit habitat availability for listed salmonids in the lower Sacramento River. High summer water temperatures in the lower Sacramento River can exceed 72ºF (22.2ºC), and create a thermal barrier to the migration of adult and juvenile salmonids (Kjelson 1982). In addition, water diversions for agricultural and municipal purposes have reduced in-river flows below the dams. These reduced flows frequently result in increased temperatures during the critical summer months which potentially limit the survival of holding/spawning adults, incubating eggs, emerging fry, and juvenile salmonids (Reynolds 1993). The elevated water temperatures compel many salmon juveniles to migrate out of the valley floor systems quickly and forgo adequate rearing time before summer heat creates temperatures unsuitable for salmonids. Those fish that remain either succumb to the elevated water temperatures or are crowded into river reaches with suitable environmental conditions.

Levee construction and bank protection have affected salmonid habitat availability and the processes that develop and maintain preferred habitat by reducing floodplain connectivity, changing riverbank substrate size, and decreasing riparian habitat and SRA cover. Individual bank protection segments of the overall proposed action typically range from a few hundred to a few thousand LF in length. Such bank protection generally results in two levels of impacts to the environment: (1) site-level impacts which affect the basic physical habitat structure at individual bank protection sites; and (2) reach-level impacts which are the cumulative impacts to ecosystem functions and processes that accrue from multiple bank protection sites within a given river reach. Revetted embankments result in loss of sinuosity and braiding and reduce the amount of aquatic habitat. Impacts at the reach level result primarily from halting erosion and eliminating riparian vegetation. Reach-level impacts which cause significant impacts to fishes are reductions in habitat complexity, changes to sediment and organic material storage and transport, reductions of primary food-chain production, and reduction in IWM and SRA habitat.

The use of rock armoring limits recruitment of IWM (*i.e.*, from non-riprapped areas), and greatly reduces, if not eliminates, the retention of IWM once it enters the river channel. Riprapping creates a relatively homogeneous surface, which diminishes the ability of IWM to become securely snagged and anchored by sediment. IWM tends to become only temporarily snagged along riprap, and generally moves downstream with subsequent high flows. Habitat value and ecological functioning aspects are thus greatly reduced, because wood needs to remain in place to generate maximum values for fish and wildlife. Recruitment of IWM is limited to any eventual, long-term tree mortality and whatever abrasion and breakage may occur during high flows. Juvenile salmonids are likely being impacted by reductions, fragmentation, increased predation, and general lack of connectedness of remaining nearshore refuge areas.

Point and non-point sources of pollution resulting from agricultural discharge and urban and industrial development occur upstream of, and within the action area. The effects of these impacts are discussed in detail in the Rangewide Status of the Species and Critical Habitat section. Environmental stressors as a result of low water quality can lower reproductive success and may account for low productivity rates in fish (*i.e.*, green sturgeon, (Klimley 2002)). Organic contaminants from agricultural drain water, urban and agricultural runoff from storm events, and high heavy metals concentrations may deleteriously affect early life-stage survival of fish in the Sacramento River (USFWS 1995). Principle sources of organic contamination in the Sacramento River are rice field discharges from Butte Slough, Reclamation District 108, Colusa Basin Drain, Sacramento Slough, and Jack Slough (USFWS 1995). Other impacts to adult migration present in the action area, including migration barriers, water conveyance factors, water quality, are discussed in the Rangewide Status of the Species and Critical Habitat section.

The transformation of the Sacramento River from a sinuous, meandering waterway lined with a dense riparian corridor, to a highly leveed system under varying degrees of control over riverine erosional processes has resulted in homogenization of the river. These impacts include the removal of valuable pools and holding habitat for green sturgeon. In addition, channelization and removal of riparian vegetation and IWM have greatly reduced access to floodplain and off-channel rearing habitat. It has also diminished the quantity and quality of benthic habitat and the abundance of prey items in rearing, foraging, and holding habitats. A major factor in the decline of green sturgeon, and the primary reason for listing this species was the alteration of its adult spawning and larval rearing habitat in California's Sacramento River Basin (71 FR 17757, April 7, 2006).

Rapid reductions in flow create isolation or stranding within the existing Sacramento Weir stilling basin and bypass during rapid reductions in flow. With normal flow scour, some areas can become isolated pools or even completely dewatered when flood flows reduce. Juveniles seek slower flow habitat as resting stops when the bypass is inundated, which can cause high numbers of strandings. Adults will also seek deeper pools to avoid rapidly reducing flows and be caught within deeper pools and scour holes. CDFW monitoring reports show a range of numbers of different species and runs of anadromous fish observed and rescued in these efforts (Email communication, Shig Kubo June 21, 2019). Stranding within the current weir stilling basin and

Sacramento Bypass have been documented to occur every 10 years or so, and were most previously documented in 2011 and 2018.

2.4.4. Mitigation Banks and the Environmental Baseline

While the Corps is proposing on-site and off-site mitigation to offset the impacts from the proposed action, mitigation bank credits may be purchased to offset impacts. There are several conservation or mitigation banks approved by NMFS with service areas that include the action area considered in this BO. These banks occur within critical habitat for spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon. These include:

Liberty Island Native Fisheries Conservation Bank**:** Established in 2010, the Liberty Island Conservation Bank (Bank) is a conservation bank that serves the Delta region. It is located in the southern Yolo Bypass in Yolo County, CA. The Bank consists of 186 acres located on the still leveed northernmost tip of Liberty Island. Approved in July 2010 by NMFS, USFWS, and CDFW, the Bank provides compensatory mitigation for permitted projects affecting special-status Delta fish species within the region. The Bank provides habitat for all Delta fish species including: Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, delta smelt, and Central Valley fall- and late fall-run Chinook salmon. Of the 186 total acres, 139.11 acres can be used for salmonid conservation credits. Of the 139.11 acres available for salmonids, approximately 82 acres have been allocated. The habitat includes tidally influenced shallow freshwater habitat, SRA habitat, and tule marsh SRA habitat. The increased ecological value of the enhanced rearing habitat for juvenile salmonids (and potentially green sturgeon) which have already been purchased are part of the environmental baseline for the Project. While this bank does not service the Lower American River, all features of this bank are within the designated critical habitats for the species analyzed in this BO within the Sacramento River.

Fremont Landing Conservation Bank: Established in 2006, the Fremont Landing Conservation Bank is 100-acre floodplain site along the Sacramento River (RM 80) and was approved by NMFS to provide credits for impacts to winter-run Chinook salmon, spring-run Chinook salmon, and steelhead. There are off-channel shaded aquatic habitat credits, SRA habitat credits, and floodplain credits available. To date, there are roughly 9 acres credits available to service increased rearing habitat for juvenile salmonids. The increased ecological value of the enhanced rearing habitat for juvenile salmonids (and potentially green sturgeon) which have already been purchased are part of the environmental baseline for the Project. All features of this bank are within the designated critical habitats for the species analyzed in this BO.

Bullock Bend Mitigation Bank: Established in 2016, the Bullock Bend Mitigation Bank is a 119.65-acre floodplain site along the Sacramento River at the confluence of the Feather River (Sacramento RM 106) and was approved by NMFS to provide credits for impacts to winter-run Chinook salmon, spring-run Chinook salmon, and steelhead. There are salmonid floodplain restoration, salmonid floodplain enhancement, and salmonid riparian forest credits available. To date, there have been approximately 61 acres of credits sold and the ecological value (*i.e.*, increased rearing habitat for juvenile salmonids) of the sold credits are part of the environmental baseline. All features of this bank are within the designated critical habitats for the species analyzed in this BO.

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

The Proposed Action includes activities that are likely to adversely affect Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, green sturgeon, and their associated critical habitats. The following is an analysis of the potential effects to the species and their critical habitat that are reasonably certain to occur as a result of the implementation of this project.

Of the 43,000 LF of proposed erosion protection work along the Sacramento River, up to 76.6 acres of SRA and benthic habitats are expected to be altered and modified within the Action Area by construction of rock revetment or placement of other materials associated with site-specific designs. This calculation is based on measurements from the river's OHWM down to the end of the repair area that is expected to be altered by construction activities. Similarly, of the 31,000 LF within the construction footprint along the lower American River, an estimated range of 97.9 to 195.7 acres of SRA and benthic habitats are expected to be modified or altered by construction activities. This range of impact is derived from applying a uniform assumption, based on best available information, that impacts would occur 100 to 200 feet from the OHWM down into the wetted channel to where the rock placements ends. As stated in the Corps 2020 BA, the OHWM elevation is based on an 18,500 cfs 2-year reoccurrence interval flow scenario (determined from the Folsom Dam Water Control Manual period of record analysis). While these assumptions were used to estimate the extent of habitat impacts, actual site designs may vary. The accounting plan will verify that tracking of impacts as site designs are developed to ensure the level of adverse effects does not extend beyond what is analyzed here.

Ancillary to erosion protection, site-specific designs will aim to avoid or minimize effects to federally listed species and designated critical habitat to the extent feasible, and will implement on-site and off-site compensation actions as necessary to offset the loss of vegetated habitat along the rivers. Depending on the effects from erosion protection measures, a site design may incorporate various features to compensate for the loss of habitat. The sites will be designed in coordination with the resource agencies (NMFS and USFWS), in a manner to ensure the Corps is minimizing effects to listed species and critical habitat and maximizing on-site mitigation for each site.

2.5.1. Effects to Listed Fish Species

The Lower American River portion of the Action Area is a National Wild and Scenic River, and managed by the National Park Service. In an effort to allow the National Park Service to separate the effects analysis within this BO between watersheds, effects that will occur within the Lower American River will be indicated within each section. For the majority of the effects described below, they are similar between the species unless addressed in a more species-specific manner.

Physical Disturbance

Physical disturbance effects are expected within the entirety of the Action Area, including the Lower American River.

Physical disturbance in aquatic habitat will occur during construction activities, such as placement of materials (rock, soils, etc.), which have the potential to affect the juvenile and adult life stages of salmonids and green sturgeon through displacement, disruption of their normal behaviors, and direct injury or death from crushing during rock placement.

Instream construction activities may cause mortality and reduced abundance of benthic aquatic macroinvertebrates within the erosion footprint, due to the placement of rock over the existing streambed. These effects to aquatic macroinvertebrates are expected to be long-term as permanent bank armoring alters the natural streambed (USFWS 2004). The amount of food available for adult and juvenile salmonids and green sturgeon in the Action Area is therefore expected to be permanently decreased in the areas where submerged riprap is being placed.

During construction activities, both juvenile and adult fish may be able to detect areas of active disturbance and avoid those portions of the project footprint where equipment is actively operated or a turbidity plume occurs, particularly adults. Juveniles may also stay and hunker down in the activity zone. Occasionally, feeding juvenile salmonids and green sturgeon may be attracted to activity stirring up sediment, but are generally expected to avoid areas disturbed by active equipment. Juveniles will have opportunities to move to other portions of the channel where they can avoid potential injury or mortality. Adult salmonids and green sturgeon are expected to move out of the area to adjacent suitable habitat before equipment enters the water, or before gravel or boulders are placed over them due to the disturbance caused by vibrations on land. Some level of injury and death from crushing by construction equipment and rock placement is expected due to the large scale of the project footprint, but will be reduced through avoidance and minimization measures.

Due to the large project footprint of this Proposed Action, it is expected that a small number of juveniles of each species will be injured or killed as a result of the physical disturbance and rock placement. Though adults are more likely able to avoid rock placement, it is possible that a few adults may also be injured or killed due to the large scale of the Proposed Action. Proposed operations and maintenance (O&M) will cause intermittent small-scale physical disturbance over the long-term. While small disturbances from levee O&M may cause some minor injury or localized behavioral disturbances, it is not expected to cause any mortality to species.

Increased Turbidity and Suspended Sediment

Increased turbidity effects are expected within the entirety of the Action Area, including the Lower American River.

All activity within the Action Area with waterside repairs have the potential to temporarily increase turbidity and suspended sediment levels within the project work site and downstream areas. The re-suspension and deposition of instream sediments is an effect of construction equipment disturbances and rock entering the river. Increased exposure to elevated levels of suspended sediments have the potential to result in physiological and behavioral effects. The severity of these effects depends on the extent of the disturbance, duration of exposure, and sensitivity of the affected life stage.

Salmonids have been observed avoiding streams that are chronically turbid (Lloyd 1987) or moving laterally or downstream to avoid turbidity plumes (Sigler et al. 1984). Chronic exposure to high turbidity and suspended sediment may also affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995).

Elevated turbidity and suspended sediment levels have the potential to adversely affect salmonids during all freshwater life stages. Specifically increased turbidity can clog or abrade gill surfaces, adhere to eggs, hamper fry emergence (Phillips and Campbell 1961), bury eggs or alevins, scour and fill in pools and riffles, reduce primary productivity and photosynthesis activity (Cordone and Kelley 1961), and affect intergravel permeability and dissolved oxygen levels (Lisle and Eads 1991; Zimmermann and Lapointe 2005).

Fish behavioral and physiological responses indicative of stress include: gill flaring, coughing, avoidance, and increased blood sugar levels (Berg and Northcote 1985; Servizi and Martens 1992). Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning and egg and fry survival (Waters 1995). Changes in turbidity and suspended sediment levels associated with water operations may negatively impact fish populations temporarily when deposition of fine sediments fills interstitial substrate spaces in food-producing riffles, reducing the abundance and availability of aquatic insects and cover for juvenile salmonids (Bjornn and Reiser 1991). Suspended solids and turbidity generally do not acutely affect aquatic organisms unless they reach extremely high levels (*i.e.*, levels of suspended solids reaching 25 mg/L). At these high levels, suspended solids can adversely affect the physiology and behavior of aquatic organisms and may suppress photosynthetic activity at the base of food webs, affecting aquatic organisms either directly or indirectly (Alabaster and Lloyd 1980; Lloyd 1987; Waters 1995).

Increased turbidity can also affect fish by reducing feeding efficiency or success and stimulating behavioral changes. Sigler et al. (1984b) found that turbidities between 25 and 50 Nephelometric Turbidity Units (NTU) reduced growth of juvenile Coho salmon and steelhead, and Bisson and Bilby (1982) reported that juvenile Coho salmon avoid turbidities exceeding 70 NTUs. Turbidity likely affects Chinook salmon in much the same way it affects juvenile steelhead and Coho salmon because of similar physiological and life history requirements between the species. Newcombe and Jensen (1996) also found increases in turbidity could lead to reduced feeding rate and behavioral changes such as alarm reactions, displacement or abandonment of cover, and avoidance, which can lead to increased predation and reduced feeding. At high-suspended sediment concentrations for prolonged periods, lethal effects can occur.

Based on similar projects conducted by DWR and the Corps (*i.e.*, levee repair work and placement of riprap), construction activities are expected to result in periodic increases in localized turbidity levels up to or exceeding 75 NTUs. In the past, levee protection work on the Sacramento River has produced turbidity plumes that travel for several hundred feet downstream of the activity. However, once construction stops, water quality is expected to return to background levels within a few hours, depending on how high the percentage of fines in the material are. Adherence to erosion control measures and avoidance and minimization measures will minimize the amount of disturbed sediment from construction activities and will minimize the potential for post-construction turbidity changes should precipitation events occur after construction has been completed.

Generally, we expect that most fish will actively avoid the elevated turbidity plumes when possible, during construction activity. For those fish that do not or cannot avoid the turbid water, exposure is expected to be brief (*i.e*., minutes to hours) and is not likely to cause injury or death from reduced growth or physiological stress. This expectation is based on the general avoidance behaviors of salmonids and the requirement to suspend construction when turbidity exceeds Central Valley Regional Water Quality Control Board standards (2020 Corps BA). However, some juveniles that are exposed to turbidity plumes may be injured or killed by predatory fish that take advantage of disrupted normal behavior. Once fish move past the turbid water, normal feeding and migration behaviors are expected to resume. A low proportion of fish that are exposed to the area of increased turbidity are expected to be adversely affected by increased predation due to displacement and the lowered visibility caused by the suspended sediment. Proposed operations and maintenance will cause intermittent small-scale increases in turbidity over the lifetime of the proposed action. Small increases in turbidity are expected to result in minor, brief localized behavioral disturbances, and not expected to cause any injury or mortality to species.

Acoustic Impacts during Construction Activities

Acoustic effects are expected within the entirety of the Action Area, including the Lower American River.

Noise, motion, and vibrations produced by heavy equipment operation are expected at each site. The use of heavy equipment will occur outside the active channel, in addition to the infrequent, short-term use of heavy equipment in the wetted channel. Most listed fishes will be expected to move away and avoid interaction with instream machinery by temporarily relocating either upstream or downstream into suitable habitat adjacent to the worksite. As a result, we anticipate minimal localized effects to listed fishes from instream machinery acoustic impacts. Due to the large span of the project, the aggregated acoustic effects are expected to have adverse effects to listed fish.

The excavation and placement of rock below the waterline will produce noise and physical disturbance, which could displace juvenile and adult fish into adjacent habitats. Similarly, construction activities carried out in close proximity to the river channel have the potential to transfer kinetic energy through the adjoining substrates, disturb the water column, and cause behavioral changes to fish in the nearby area. These effects are expected to occur during construction activities and to cease once rock placement is completed.

Multiple studies have shown responses in the form of behavioral changes in fish due to human produced noise (Wardle et al. 2001, Slotte et al. 2004, Popper and Hastings 2009). Instantaneous behavioral responses may range from slight variations, a mild awareness, to a startle response. Fish may also vacate their normally occupied positions in their habitat for short or long durations. Depending on the behavior that is being disrupted, the short- and long-term negative effects could vary. Behavioral effects are likely to affect juvenile fish more than adults, as there are essential behaviors to their maturation and survival, such as feeding and sheltering, as adults generally use the action area only for migration and potentially spawning. Overall, construction could disrupt behavior in some instances, but because the proposed timing of activities resulting in underwater noise disturbances would be high when the fewest fish and least sensitive life stages are present, effects would be minimal. Proposed operations and maintenance will cause intermittent small-scale increases in noise over the lifetime of the proposed action, but will also occur during windows where fish are unlikely to be present.

Acoustic Impacts during Pile-Driving Activities

Pile-driving activities and associated effects are expected within the entirety of the Action Area, including the Lower American River.

Pile driving will occur both within the channel for cofferdam installation, and outside the channel for construction and monitoring efforts. Large posts will need to be driven to support walls of cofferdams, attach monitoring equipment to, and as supports for the Sacramento Weir. Piles that are driven into riverbed substrate propagate sound through the water, which can damage a fish's swim bladder and other organs by causing sudden rapid changes in pressure, rupturing or hemorrhaging tissue in the bladder (Gisiner 1998, Popper et al. 2006). The swim bladder is the primary physiological mechanism that controls a fish's buoyancy. A perforated or hemorrhaged swim bladder has the potential to compromise the ability of a fish to orient itself both horizontally and vertically in the water column. This can result in diminished ability to feed, migrate, and avoid predators. Sensory cells and other internal organ tissue may also be damaged by noise generated during pile driving activities as sound reverberates through a fish's viscera (Gaspin 1975). In addition, morphological changes to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings et al.1996). It is important to note that acute injury resulting from acoustic impacts should be scaled based on the mass of a given fish. Juveniles and fry have less inertial resistance to a passing sound wave and are therefore more at risk for non-auditory tissue damage (Popper and Hastings 2009). Fish can also be injured or killed when exposed to lower sound pressure levels for longer periods of time. Hastings (1996) found death rates of 50% and 56% for gouramis (*Trichogaster* sp.) when exposed to continuous sounds at 192 decibel (Db) (re 1 μPa) at 400 Hz and 198 dB (re 1 μPa) at 150 Hz, respectively, and 25% for goldfish (*Carassius auratus*) when exposed to sounds of 204 dB (re 1 μPa) at 250 Hz for 2 hours or less. Hastings (1995) also reported that acoustic "stunning," a potentially lethal effect resulting in a physiological shutdown of body functions, immobilized gourami within 8 to 30 minutes of exposure to the aforementioned sounds. While the effects to salmonids and sturgeon may not be identical, it is assumed that these effects would be similar for salmonids and sturgeon.

The Corps proposes to implement Interim Criteria for Injury of Fish Exposed to Pile Driving *Operations* (Popper 2006). This criteria uses a combined interim single strike criterion for pile driving received level exposure; a sound exposure level (SEL) of 187 dB re: 1 μPa^2 •sec and a peak sound pressure of 208 dB re: 1 μPa_{peak} as measured 10 m from the source. Using these criteria is expected to reduce the potential for permanent and lethal impacts to fish that are within the area and may be exposed to pile driving activities. Fish that are exposed to the area where pile driving is occurring are expected to be adversely affected by behavioral modification during increases in noise and vibration within the water column. While this will be a short-term effect for most fish, some injury or mortality is expected to occur due to the potential for use of pile driving over 5 or more construction seasons, and over such a large span of habitat. While pile-driving noise may cause some localized behavioral disturbances to a higher number of fish, injury or lethal effects are expected to occur to only a few fish over the course of project implementation.

Cofferdam Installation and Dewatering

Cofferdam installation and dewatering activities and associated effects are expected within the entirety of the Action Area, including the Lower American River.

Installation of cofferdams may be necessary during construction of a small proportion of sites, though the exact number is uncertain because full designs are not completed for all sites. Sites that may require cofferdams are generally sites that have soil being placed at low water areas to keep a more natural bank line or install a planting bench (as it is very difficult to place soil underwater). Cofferdams will be installed during the proposed work windows when fish will be less prevalent and would be in place for a single construction season. Cofferdams will remain closed during construction, eliminating the ability for fish to re-enter the area. Cofferdams will be either constructed of sand bags (placed by hand), or sheet pile (requiring pile driving, effects of which are described above), depending on the level of dewatering needed for construction.

Dewatering activities within the cofferdam areas would cause adverse effects to any fish isolated within the area. The amount of fish trapped within the area initially would be minimized with BMPs, but there is still the chance of a few juvenile fish being entrained within the cofferdam area. Dewatering activities pose the risk of increased turbidity, stress, desiccation, and possible impingement from pumping activity. Capture/relocation efforts are described below.

Fish that evade capture and remain in the construction area may be injured or killed from construction activities. This includes desiccation if fish remain in the dewatered area or death if fish are crushed by personnel or equipment. However, because experienced biologists will be collecting fish, most are expected to be removed from the area before construction. While BMPs will reduce effects, injury and mortality of a few fish are still likely due to the large scale of this project over several years of construction.

Fish Capture and Relocation Effects

Fish capture and relocation activities and associated effects are expected within the entirety of the Action Area, including the Lower American River.

Fish relocation may need to occur during implementation of the Proposed Action. Relocation will be needed during activities that require a cofferdam, but also may be needed during rescue efforts within the Sacramento Weir. For cofferdam installation, fish will be attempted to be gently “herded” out of the area before any direct handling occurs. If fish cannot be herded, they will be collected using seining or dip netting. Any adults present are expected to move out of the area of activity and avoid capture. Juveniles are more likely to be entrained or isolated in the coffer dammed work areas and any that avoid herding, would require capture and relocation prior to dewatering and construction activities. Cofferdams will be constructed immediately after fish are “herded” out of the area, with netting continuing to occur as the area is dewatered.

Fish relocation activities pose a risk of injury or mortality since any fish relocation or collection gear has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of unintentional injury and mortality attributable to fish relocation varies widely depending on the method used, ambient conditions, and the experience of the field crew. Elevated air and water temperatures during handling may cause added fish stress and increased mortality. Potential sub-lethal temperature effects on juvenile salmonids include slowed growth, delayed smoltification, desmoltification, and extreme physiological changes, which can lead to disease and increased predation (Myrick and Cech 2004). Since fish relocation activities will be conducted by qualified fisheries biologists following NMFS guidelines, injury and death is expected to be minimized. As multiple relocations may need to occur throughout implementation of the Proposed Action, a small proportion of juvenile fish injury and mortality is expected to occur at each work site that requires relocation. Currently relocation efforts are expected at 1 to 2 sites on the Sacramento River, the Arden Pond site on the American River, and at the location for the new Sacramento Weir. Proposed operations and maintenance may require intermittent fish rescues over the lifetime of the proposed action. For example, if there is a debris blockage within the fishway, fish may need to be captured and relocated if the debris cannot be quickly removed to restore passage.

Impingement

Impingement effects resulting from pumping activities are expected within the entirety of the Action Area, including the Lower American River.

Pumping activities are being proposed both for dewatering activities and for irrigation purposes during the Proposed Action. Impingement may occur when the approach velocity of the screen exceeds the swimming capability of a fish, creating substantial body contact with the surface of a fish screen.

Injury resulting from impingement may be minor and create no long-term harm to the fish, or result in injuries leading to mortality either immediately or at some time in the future after contact with the screen, including predation or infections from wounds and abrasions associated with the screen contact.

NMFS’ screening criteria (NMFS 2011) will be followed for all pumping activities of the Proposed Action. The NMFS’ criteria are such that they will reduce exposure time of fish to a screen and, therefore, the potential for impingement as fish move past it. Other aspects of the criteria include appropriate screen mesh sizing to prevent entrainment of juvenile salmonids. The efficacy of the screening criteria is untested on juvenile green sturgeon, however. As pumping activities will only be occurring in the action area which is low down in the river system, larval green sturgeon are unlikely to be present and therefore exposure to pumping that will risk impingement or entrainment is unlikely.

As the pumping activities will adhere to NMFS screening guidelines, injury to fish caused by impingement will be minimized. However, pumping activities may occur for several years during construction across large spans of the action area. A small portion of fish exposed to the pumping activities are expected to be injured or killed from impingement. Pumping activities will only occur during the initial planting period and are not proposed beyond the first 5 years of planting.

Stranding

Stranding effects are only expected to occur within the Sacramento Weir and Bypass, and are not expected in the Lower American River.

Rapid reductions in flow can adversely affect fish. Juvenile salmonids are particularly susceptible to isolation or stranding during rapid reductions in flow. Isolation can occur when the rate of reductions in stream flow inhibits an individual's ability to escape an area that becomes isolated from the main channel or dewatered (U.S. Fish and Wildlife Service 2006). The effect of juvenile isolation on production of Chinook salmon and steelhead populations is not well understood, but isolation is frequently identified as a potentially important mortality factor for the populations in the Sacramento River and its tributaries (Jarrett and Killam 2014; National Marine Fisheries Service 2009; U.S. Bureau of Reclamation 2008; U.S. Fish and Wildlife Service 2001; Water Forum 2005).

Juveniles typically rest in shallow, slow-moving water between feeding forays into swifter water. These shallower, low-velocity margin areas are more likely than other areas to dewater and become isolated with flow changes (Jarrett and Killam 2015). Accordingly, juveniles are most vulnerable to isolation during periods of high and fluctuating flow when they typically move into inundated side channel habitats. Isolation can lead to direct mortality when these areas drain or dry up or to indirect mortality from predators or rising water temperatures and deteriorating water quality.

Isolation is currently a potential stressor in the Sacramento Bypass. Juveniles seek slower flow habitat as resting stops when the bypass is inundated by higher flows. With normal flow scour, some areas can become isolated pools or even completely dewatered when flood flows reduce. CDFW monitoring reports show a range of numbers of different species and runs of anadromous fish observed and rescued in these efforts (Email communication, Shig Kubo June 21, 2019). The dependence of isolation risk on factors, such as rate of snowmelt and timing and rate of flood flows makes the quantification of stranding risk difficult. While stranding risk may be increased with the expansion of the Sacramento Weir and Bypass, the proposed fish passage facility will increase the amount of adults able to return to the Sacramento River, and juveniles able to reach the Tule Canal.

As the new stilling basin is designed to drain fully, no stranding is expected to occur within it. However, stranding is possible within the less hardened areas of the new bypass and fish transport channel where some scour and elevation change may occur over time. Rescues will be performed by the Corps or DWR as often as conditions allow. Conditions that may not allow rescues include elevated flows or rain events that would make it dangerous for personnel to enter the bypass. Cases of stranding adults and juveniles of all species is still likely to occur for the life of this project due to the natural process of erosion and creation of deeper pools within the bypass. The benefits of the increased adult passage occurring at the Sacramento Weir are expected to offset the impacts of stranding risks in the future.

The design of the fish passage facility is expected to minimize potential stranding risk within the bypass and allow a longer period of time for adults to make their way back into the mainstem river. The proposed changes to the existing Sacramento Weir stilling basin is expected to greatly reduce juvenile stranding within the current weir's stilling basin. While the expansion of the bypass and weir may cause increased stranding risk, it is expected that the other aspects of the weirs designs and new maintenance activities will reduce impacts and minimize overall stranding within the bypass and stilling basin. Stranding effects are only expected to occur within the Sacramento Weir and Bypass, and are not expected in the Lower American River.

Chemical Contamination

Chemical contamination effects could occur within the entirety of the Action Area, including the Lower American River.

Equipment refueling, fluid leakage, concrete pouring, and maintenance activities within and near the stream channel pose some risk of contamination and potential impacts to listed fish species. Concrete work will be performed during certain aspects the Project. Contact with uncured concrete may cause significant increase in the pH of the surrounding waters, negatively affecting aquatic life. Lime is a major component of cement and concrete work. It easily dissolves in water and drastically changes the pH of water increasing the alkalinity (pH 11-13), which causes burns on fish and kills other aquatic life. Project activities that cause concrete to contact water include raw concrete spills, disposal of concrete, dampening freshly laid concrete, and washing equipment. However, all projects will include the minimization measures outlined above in Section 1.3.15 *Fisheries Conservation Measures*, which address and minimize pollution risk from equipment operation. Therefore, water quality degradation from toxic chemicals associated with the rehabilitation projects is expected to be improbable. Chemical contamination effects could occur within the entirety of the Action Area, but is improbable and therefore extremely unlikely to occur.

Increased Vessel Traffic in the Action Area

Effects resulting from project-related increased vessel traffic are expected within the Sacramento River portions of the Action Area, but not within the Lower American River.

The proposed action would significantly increase vessel traffic during times where riprap is being transported to the construction sites. The impacts from project-related vessel traffic may lead to mortality or may induce changes in behavior that impair feeding, rearing, migration, and/or predator avoidance. The Proposed Action requires barge usage to transport riprap from as far away as the San Francisco Bay up to and throughout the Action Area on the Sacramento River. The increase in barge traffic to the multiple erosion protection sites will concurrently increase the number of salmonids and green sturgeon that will have possible encounters with the propellers of the tugboats pushing the barges.

As construction operations will be occurring at times to avoid peak migration of all listed species (July 1 through October 31), the interactions with the project-related barge traffic will be minimized to the extent possible. As barges will be traveling within the Delta and mainstem Sacramento Rivers, the channel width and depth should allow adult fish the opportunity to swim out of the path of the propellers and avoid injury. Smaller fish may not have the swimming capacity to evade the propeller and may be injured or killed. As barge trips could total up to 2,325 trips from the San Francisco area up to the action area and back down over a total of 5 years of construction, there will be an increased chance for injury or death to fish encountered in those areas. A small proportion of juvenile spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon are expected to be injured or killed during the construction phases of the Proposed Action due to propeller strikes caused from proposed action barge traffic.

Fish Passage Facility Operations

Fish passage effects are expected to be limited to the Sacramento River and Bypass.

Operation of the proposed fish passage structure would provide improved connectivity for ESA-listed fish species to enter the Sacramento River from the Yolo Bypass. As the Sacramento bypass has had a historic occurrence of stranding both adult and juvenile fish (Johnston et al. 2020), the facility and connection of the fish passage channel to Tule canal is expected to reduce both adult and juvenile stranding. This enhanced connectivity should increase individual survival, as well as potentially increase spawning success of fish that migrate through the Yolo Bypass. While the fish passage facility is not likely to completely remedy the existing stranding occurrences along the Sacramento Weir and Bypass, it is expected to considerably improve conditions and greatly reduce stranding. As such, fish rescues are anticipated to be less of a need as a result of this project component.

The fish passage facility is designed to reduce the frequency and likelihood of stranding that has historically occurred on these types of fish passage structures. The slide gate closure may cause impingement in rare cases, but as the gates will only be closed at very low water levels, fish are expected to generally be able to swim away from the gates during closing. While cases may be low, because this facility is expected to be operated for the next 50 years or longer, it is likely that a small number of adults and juveniles would be impinged on a gate at the new fish passage facility during the life of the project.

Potential issues that may occur with the facility include gate failures, debris blockages, or other damage that may fail to allow the facility to operate as intended. While O&M are expected to resolve these issues, adverse effects to fish may occur in the time it takes for such issues to be safely corrected. In these types of situations, passage delays through the facility are expected. Delays may include adults and juveniles becoming stranded within the Bypass. Risks to juveniles in this situation include impingement on debris/blockage if the facility is clogged with debris, and possible stranding if the facility is not operating correctly (Gregory et al. 1992). These situations may cause death or severe injury when they occur. For adults delayed by malfunction of the facility, they may have an opportunity to turn around and attempt passage through the Fremont Weir if it is operating. If the blockage is not able to be cleared in a timely manner, it may cause severe delays in spawning, death, straying, or inability to reach spawning grounds. While these types of occurrences are not expected annually, the Sacramento River has a high debris load, so this type of blockage is likely to happen several times over the life of the project.

The Corps' proposed action includes the adaptive management of the facility in order to reduce take, and maximize passage. The adaptive management plan will include flexible operations of the gates in coordination with NMFS technical staff, and is not expected to have any additional effects to species other than those described above.

2.5.2. Effects to Designated Critical Habitat

Critical habitat has been designated within the Action Area for spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon. The general PBFs of critical habitat within the Action Area are rearing and migratory corridors. Spawning habitat PBFs are present on the American river for steelhead.

Placement of Riprap

Effects from Riprap placement activities are expected within the entirety of the Action Area, including the Lower American River.

The continual input of riprap into the Sacramento and American rivers will permanently alter critical habitat in the system. Garland *et al.* (2002) found that juvenile salmonids are significantly less likely to be found in riprap habitats versus unaltered habitats. The study found that as substrate size decreased, likelihood of fish presence increased (until reaching sand substrate). Placement of riprap is expected to adversely affect the value of freshwater migratory and rearing habitat PBFs for juvenile salmonids and reduce the amount of useable rearing habitat. Placement of riprap is also expected to adversely affect the amount of salmonid spawning habitat available within the American River. No spawning habitat is present within the Sacramento River portions of the Action Area. Placement of riprap will also reduce sediment quality for green sturgeon and change the substrate type or size in areas it is placed, which could reduce food availability and effect water quality and flow. Instream rock placement will cause impacts to rearing habitat quality from reduced abundance of benthic aquatic macroinvertebrates within the footprint of the repairs, due to the placement of rock over the existing streambed. Increased sediment size also creates more habitat for predators to hide and ambush prey from, causing an increase in juvenile predation. These effects to aquatic macroinvertebrates are expected to be long-term as permanent bank armoring alters the natural streambed (USFWS, 2004). The amount of food available for adult and juvenile salmonids and sturgeon in the Action Area is therefore expected to be permanently decreased (habitat quantity and quality) where submerged riprap is placed.

In some areas, riprap will be buried and formed into a launchable trench to protect the levee in case of future erosion. While this type of construction is not anticipated to have negative impacts on salmonid habitat initially, it is designed to launch rock down the bank to protect it in case of scour. As the final design of this bank is a bare rock face, that design is also being analyzed as the future site design. These designs are intended to launch over the next 50 years, and vary in their durability to launch on a 10-year flood or higher flow in some scenarios. Due to expected changing water conditions from climate change (described in Section 2.6.5 below), high flow events are expected to occur more frequently, making the launching of these sites even more likely. Once launched, these sites will permanently lose exposed native soil, riparian vegetation, and native habitat function. This will cause permanent reduction in quality of migratory and rearing habitat. As sites may span for long distances (over 1 mile), or back up right to another site to span several miles, this reduction in quality of habitat may substantially reduce food availability throughout the entirety of the action area.

Another form of rock protection being used is launchable toe rock. This rock, while buried mostly under the planting benches, is also designed to launch to protect the levee from scour. The launching of this type of stone is likely to result in the loss of some of the mitigation planting bench. As this bench is being created to offset the loss of habitat and create some relief habitat among riprap, it is of high value in a system that is so constrained by levees already. As these benches are being constructed to offset the impacts of habitat loss, the lack of durability of this mitigation is concerning. As it cannot be accurately determined at what future time this planting bench will be damaged from launchable rock, the overall benefit of the mitigation becomes less certain. It is assumed that there will be some temporal benefits, but not new habitat created and maintained permanently.

Within the Sacramento River, up to 76.6 acres of permanent degradation of salmonid and sturgeon critical habitat from riprap placement is expected. Within the lower American River, an estimated range of 97.9 to 195.7 acres will have permanent habitat degradation due to rock placement. Due to the close proximity of all the sites, the degradation of rearing and migratory corridor habitat PBFs in the action area will result in reduced growth, reduced survival, and reduced fitness. While effects will be minimized by the use of BMPs such as soil-filled rock, replanting disturbed areas, and minimizing vegetation removal overall, the Corps also proposes to mitigate unavoidable habitat impacts with a combination of on-site planting bench creation, off-site mitigation, or purchase of conservation bank credit.

Toxic Substance Spills

Toxic substance effects could occur within the entirety of the Action Area, including the Lower American River.

Operation of power equipment, such as an excavator, in or near aquatic environments increases the potential for toxic substances to enter the aquatic environment and have negative effects on ESA-listed anadromous fish species and designated critical habitat (Feist et al. 2011). Spills of toxic substances could negatively affect the freshwater migratory corridor and freshwater rearing habitat PBFs.

Equipment refueling, fluid leakage, and maintenance activities within and near the stream channel pose some risk of contamination and potential impacts to listed fish species. The Proposed Action includes the development of a hazardous materials spill prevention and countermeasures plan. The Proposed Action includes daily inspections of all heavy equipment for leaks. With inclusion of these measures, the potential effects from hazardous materials entering the aquatic environment and adversely affecting designated critical habitat are not expected to occur.

Loss of Riparian Habitat Functions and Vegetation

Degradation of rearing and migratory habitat will occur, resulting from riparian habitat loss within the entirety of the Action Area, including the Lower American River.

During the development of the Recovery Plan for Central Valley Chinook Salmon and Steelhead (NMFS 2014), loss of riparian habitat and instream cover was identified as a primary stressor affecting the recovery of the species. This threat primarily affects the juvenile rearing and outmigration life stage of these species, from the upper reaches of their watershed of origin through the Delta.

Woody debris and overhanging vegetation within shaded riverine aquatic habitat provide escape cover for juvenile salmonids from predators as well as thermal refugia. Aquatic invertebrates are dependent on the organic material provided be a healthy riparian habitat and many terrestrial invertebrates also depend on this habitat. Studies by the California Department of Fish and Wildlife (CDFW) as reported in NMFS (NMFS 1997) demonstrated that a significant portion of juvenile Chinook salmon diet is composed of terrestrial insects, particularly aphids which are dependent on riparian habitat.

The Proposed Action will remove and reduce riparian habitat within designated critical habitat for spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon in the Action Area. The current amount of habitat estimated is presented in Table 9 below. While not all SRA habitat will be disturbed during project activities, as it is described being within the Action Area, a significant portion is likely to be impacted. These modifications to designated critical habitat are expected to reduce the PBFs of rearing habitat (reduced quantity and quality, increased predation, reduced cover, and reduced benthic invertebrate production), and will also adversely affect the PBFs of migratory habitat by decreasing the habitat quality. Potential adverse impacts to PBFs of rearing habitat include reduced benthic invertebrate production, disrupted migration, and/or displacement (resulting in increased predation).

Table 10. Current SRA habitat within the Action Area as described in the Corps 2020 BA

<table>
<tr><th>Reach</th><th>American River
Linear Feet (LF) of SRA</th><th>Reach</th><th>Sacramento River
Linear Feet (LF) of SRA</th></tr>
<tr><td>A</td><td>31,174</td><td>D</td><td>9,643</td></tr>
<tr><td>B</td><td>7,259</td><td>E</td><td>7,709</td></tr>
<tr><td rowspan="3">C</td><td rowspan="3">6,934</td><td>F</td><td>21,263</td></tr>
<tr><td>G</td><td>11,689</td></tr>
<tr><td>Sac Weir</td><td>1,500</td></tr>
<tr><td>Total</td><td>45,367</td><td>Total</td><td>51,804</td></tr>
</table>

Impacts to rearing habitat and migratory corridor PBFs are expected to occur through reduced riparian vegetation, both temporary and permanent. Loss of riparian vegetation is expected to result from maintaining temporary access points to the river, and covering vegetation with gravel/rock. While vegetation removal will be minimized to the maximum extent possible, large-scale riparian vegetation removal will be needed throughout the course of the construction sequences. The impacts to rearing habitat and migratory corridor PBFs from loss of riparian habitat, including that which provides SRA functions, is expected to cause short- and long-term loss in quality habitat. Degraded SRA habitat will affect migrating and rearing fish through loss of food input, cover, and cooling from shade. This is expected to result in reduced feeding/growth, increased predation, and reduced survival. Unavoidable adverse effects will be compensated through a combination of on-site, off-site, and/or mitigation bank credit purchases as described in 1.3.17 *Compensatory Mitigation* above.

Fish being exposed to the areas losing riparian habitat may be more susceptible to predators due to loss of cover and have changes to their food foraging behavior. Windell et al. (2017) focused on the growth and condition of juveniles as being affected by access to riparian habitats. Habitats that provide refuge from high water velocity or predators, without depleting food supply, function to increase growth rates by reducing energy demand to obtain a given food supply. Growth rate may then, influence migration timing and success, where a higher growth rate is associated with earlier smoltification and faster downstream migration (Beckman et al. 2007).

Impacts to existing vegetation will be avoided to the extent practicable. The loss of riparian vegetation may occur creating and maintaining temporary access points to the river, and placement of riprap or other bank armor. As the overall spatial aspect of the Proposed Action is extensive, the total loss of riparian vegetation is expected to be substantial. With the amount of vegetation potentially needing to be removed throughout such a long stretch of migratory corridor, the ability of the PBFs to support listed fish will diminish. Proposed O&M will cause intermittent small-scale removal of riparian vegetation to maintain maintenance roads over the lifetime of the proposed action. No overall loss is expected beyond standard maintenance trimming of vegetation. Proposed operations and maintenance will cause intermittent small-scale vegetation removal and trimming over the lifetime of the proposed action. Vegetation removal and trimming will only occur to maintain the access roads as described in the engineering designs for each site. No vegetation removal is anticipated beyond what is described in the proposed action (and will be determined during the PED phase for each site).

Permanent habitat loss is expected to occur at sites where rock is being placed within existing riparian habitat. Mitigation credits are being purchased or other NMFS-approved mitigation actions to offset impacts that are both temporary and permanent. The *Compensatory Mitigation section (1.3.17)* includes the mitigation ratios, which are site dependent. Planned repair sites are spaced out, such that preferable rearing and migratory corridor PBFs are available between bank repair sites, providing support for listed fish. In areas where bank repair occurs for longer reaches, on-site planting benches will provide support for rearing and migratory habitat through the action area. Degradation of rearing and migratory corridor PBFs of critical habitat will occur, resulting from riparian habitat loss within the entirety of the Action Area.

Increased Mobilization of Sediment

Effects of sediment mobilization are expected to occur within the entirety of the Action Area, including the Lower American River.

All project sites with waterside repairs will have temporary increases in turbidity and suspended sediment levels within the project work site and downstream areas. The re-suspension and deposition of instream sediments is expected to occur from construction equipment and rock entering the river. The deposition of sediment is expected to temporarily reduce food availability and feeding efficiency due to the natural substrate being coated with a new layer of sediment. Short-term increases in turbidity and suspended sediment levels associated with construction may negatively impact rearing habitat PBFs temporarily through reduced availability of food and reduced feeding efficiency. Short-term increases in turbidity and suspended sediment will also disrupt the ability of rearing habitat to support feeding fish resulting in avoidance or displacement from preferred habitat.

Incorporation of the BMPs described above in section 1.3.14 is expected to minimize the extent of adverse effects to critical habitat PBFs to a minimal level. Proposed operations and maintenance will cause intermittent small-scale increases in turbidity over the lifetime of the proposed action. While small increases in turbidity may cause some short-term, localized disturbances to habitat, it is not expected to cause any long-term impacts to habitat.

Acoustic Impacts

Effects of acoustic disturbance to critical habitat are expected within the entirety of the Action Area, including the Lower American River.

Impacts to freshwater rearing habitat and migratory corridor PBFs are expected to occur due to pile-driving activities. As a result, we anticipate some localized reduction in the quality of habitat within the Action Area during construction activities. Similarly, construction activities carried out in close proximity to the river channel have the potential to transfer kinetic energy through the adjoining substrates, disturb the water column, and temporarily generate increased turbulence and turbidity in the river (Kemp et al. 2011), affecting the ability of rearing and migratory PBFs to support fish.

Any excessive noise or vibrations may temporarily reduce usage of the habitat within the Action Area. Suitable habitat within to the worksite either upstream or downstream will likely be less utilized if machinery noise is present. Critical habitat effects from noise, motion, and vibration are expected to be temporary and minimal. Proposed O&M will cause intermittent small-scale increases in noise over the lifetime of the proposed action. While small increases in noise may cause some localized behavioral disturbances, they are not expected to cause any effects beyond what is described above.

Inaccessible Floodplain for Rearing

Inaccessible floodplain habitat effects are expected within the entirety of the Action Area, including the Lower American River.

The Proposed Action includes large-scale bank armoring within the Action Area. Bank armoring halts the meander migration and reworking of floodplains, which eventually reduces habitat renewal, diversity, complexity, and heterogeneity. This, in turn, has adverse effects on aquatic ecosystems, ranging from carbon cycling to altering salmonid population structures and fish assemblages (Schmetterling 2001; USFWS 2004). Riprapping decreases river sinuosity, which increases the river channel slope, increasing the bedload transport and possible bed degradation and scour near the toe of the riprapped bank (USFWS 2004).

Loss of floodplain habitat and loss of wetland function have been identified as primary stressors affecting the recovery of Central Valley salmonid species (NMFS 2014), and green sturgeon (NMFS 2018). This threat primarily affects the PBFs of juvenile rearing and outmigration life stage of these species, from the upper reaches of their watershed of origin through the Delta. Effects of the action that contribute to the Loss of Floodplain Habitat are likely to result in a probable change in fitness of reduced growth and/or reduced survival probability.

Although riverine floodplains support high levels of biodiversity and productivity, they are also among the most converted and threatened ecosystems globally (Opperman *et al.* 2010). In California, more than 90% of wetlands have been lost since the mid-1800s (Hanak *et al.* 2011, Garone 2013). Loss of Floodplain Habitat within the Central Valley is a result of controlled flows and decreases in peak flows, which have reduced the frequency of floodplain inundation resulting in a separation of the river channel from its natural floodplain. Channelizing the rivers and Delta has also resulted in a loss of river connectivity with the floodplains that otherwise provide woody debris and gravels, that aid in establishing a diverse riverine habitat, and that provide juvenile salmonid rearing habitat.

The importance of connectivity for juvenile Chinook salmon to floodplain rearing habitat has been observed in several river systems. Research on the Yolo Bypass, the primary floodplain on the lower Sacramento River, indicates that floodplain are key juvenile rearing habitats supporting significantly higher drift invertebrate consumption and therefore faster growth rates (Sommer *et al.* 2001, Katz et al. 2017). Otolith microstructure studies near the City of Chico recorded increased fall-run Chinook salmon growth, higher prey densities, and warmer water temperatures in off-channel ponds and non-natal seasonal tributaries compared to the main-channel Sacramento River (Limm and Marchetti 2009). Research of juvenile Chinook salmon on the Cosumnes River noted that ephemeral floodplain habitats supported higher growth rates for juvenile Chinook salmon than more permanent habitats in either the floodplain or river (Jeffres *et al.* 2008). This growth is important to first year and estuarine survival, factors that may be key influences of a Chinook cohort's success (Kareiva et al. 2000).

The Proposed Action will extend the useful life of over 20 miles of levees within listed species critical habitat, continuing blocking of access to historic floodplain rearing habitat PBFs. Although the proposed repairs include compensation for permanent impacts at each repair site (see section 1.3.16 above), extending the useful life of levees in the Action Area results in continued degraded quality and quantity of rearing habitat PBFs for juveniles.

Beneficial and Compensatory Effects of Proposed Mitigation Activities

Beneficial and compensatory effects of proposed mitigation effects are expected within the entirety of the Action Area, including the Lower American River.

The Proposed Action includes several aspects that will either restore lost habitat on-site, create new habitat off-site, or otherwise improve habitat for salmonids and green sturgeon. While many of these aspects will require construction and have impacts described above, there will be benefits to the habitat as well. The associated timing of the different aspects of mitigation proposed in the BA are planned to minimize temporal effects. As described above in section 2.1.2 *Compensation Timing*, reducing impacts to ensure a single generation is not exposed to multiple times. Ensuring that the riparian vegetation within migration corridors are returned to a functional level prior to, or within a few years of impacts occurring, ensures that fish exposed to impacts as juveniles, will not be exposed again as returning adults, which could compound the effects and significantly reduce growth and survival.

Planting benches with woody riparian vegetation and lower Tule vegetated benches are being included with the proposed action design when space within the levee prism (entirety of the levee) allows for it. These benches will allow for functional habitat within the levee repair, alleviate some of the effects of the riprap placement, and reduce the overall loss of riparian vegetation. This can provide improved PBFs, when compared to a bare rock slope alternative, for migratory corridor and juvenile rearing.

Beyond the on-site replanting, local mitigation sites are being proposed to compensate for unavoidable permanent effects. The large Arden Bar site being proposed is converting a bass pond into a useable side channel that will be used for juvenile rearing, migration, and potentially salmonid spawning habitat. This site creates 23.9 acres of high quality salmonid habitat that was previously poor quality. Another large mitigation site (100+ acres) is proposed, but as the exact site has not been chosen yet. While the final cite is not specified, effects of construction based on the bounds of the described anticipated site can be anticipated. A site of that size being returned to floodplain habitat can be expected to cause localized increases in turbidity during excavation and grading activities, increased noise, potential cofferdam placement, and other activities as described above. As this site is likely going to be dry during construction, effects to critical habitat are expected to be temporary and minimal. The site must be located on the Sacramento River mainstem to benefit all four NMFS species (as well as Delta Smelt for the USFWS). This large site is expected to produce high-quality juvenile rearing and migratory habitat for salmonids and sturgeon.

Another component of the Corps mitigation proposal is a research grant in the sum of $5 million. This grant is going to fund green sturgeon research to determine juvenile screening criteria, and begin the process of developing adult green sturgeon passage criteria. By determining accurate juvenile screening criteria, juvenile migratory habitat will greatly increase in safety, as pumping activities will not cause as high of a risk for rearing and migratory corridor PBFs. Being able to accurately determine successful passage mechanisms will increase the PBFs for passage and adult migration by ensuring proper criteria and minimizing delays to migration.

2.6. Cumulative Effects

"Cumulative effects" are 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 and 402.17(a)). 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 ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

2.6.1. Water Diversions and Agricultural Practices

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found along the Common Features GRR action area. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill multiple life stages of aquatic species, including juvenile listed anadromous species. For example, as of 1997, 98.5% of the 3,356 diversions included in a CV database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001).

Agricultural practices in the action area may adversely affect riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow. Grazing activities from cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation, as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into the receiving waters of the associated watersheds. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may adversely affect listed salmonid and green sturgeon reproductive success and survival rates (Daughton 2002; Dubrovsky et al. 1998).

2.6.2. Aquaculture and Fish Hatcheries

More than 32-million fall-run Chinook salmon, 2-million spring-run Chinook salmon, 1 million late fall-run Chinook salmon, 0.25 million winter-run Chinook salmon, and 2 million steelhead are released annually from six hatcheries producing anadromous salmonids in the CV. All of these facilities are currently operated to mitigate for natural habitats that have already been permanently lost as a result of dam construction. The loss of this available habitat resulted in dramatic reductions in natural population abundance, which is mitigated for through the operation of hatcheries. Salmonid hatcheries can, however, have additional negative effects on ESA-listed salmonid populations.

The high level of hatchery production in the CV can result in high harvest-to-escapements ratios for natural stocks. California salmon fishing regulations are set according to the combined abundance of hatchery and natural stocks, which can lead to over-exploitation and reduction in the abundance of wild populations that are indistinguishable and exist in the same system as hatchery populations. Releasing large numbers of hatchery fish can also pose a threat to wild Chinook salmon and steelhead stocks through the spread of disease, genetic impacts, competition for food and other resources between hatchery and wild fishes, predation of hatchery fishes on wild fishes, and increased fishing pressure on wild stocks as a result of hatchery production.

Impacts of hatchery fishes can occur in both freshwater and the marine ecosystems. Limited marine carrying capacity has implications for naturally produced fish experiencing competition with hatchery production. Increased salmonid abundance in the marine environment may also decrease growth and size at maturity, and reduce fecundity, egg size, age at maturity, and survival (Bigler et al. 1996). Ocean events cannot be predicted with a high degree of certainty at this time. Until good predictive models are developed, there will be years when hatchery production may be in excess of the marine carrying capacity, placing depressed natural fish at a disadvantage by directly inhibiting their opportunity to recover (NPCC 2003).

2.6.3. Increased Urbanization

Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions, particularly those which are situated away from waterbodies, will not require Federal permits, and thus will not undergo review through the ESA section 7 consultation process with NMFS.

Increased urbanization also is expected to result in increased recreational activities in the region. Among the activities expected to increase in volume and frequency is recreational boating. Boating activities typically result in increased wave action and propeller wash in waterways. This potentially will degrade riparian and wetland habitat by eroding channel banks and mid-channel islands, thereby causing an increase in siltation and turbidity. Wakes and propeller wash also churn up benthic sediments thereby potentially re-suspending contaminated sediments and degrading areas of submerged vegetation. This in turn will reduce habitat quality for the invertebrate forage base required for the survival of juvenile salmonids and green sturgeon moving through the system. Increased recreational boat operation is anticipated to result in more contamination from the operation of gasoline and diesel powered engines on watercraft entering the associated water bodies.

2.6.4. Rock Revetment and Levee Repair Projects

Cumulative effects include non-Federal riprap projects. Depending on the scope of the action, some non-Federal riprap projects carried out by state or local agencies do not require Federal permits. These types of actions and illegal placement of riprap occur throughout the action area. For example, most of the levees have roads on top of the levees that are maintained either by the county, reclamation district, owner, or by the state. Landowners may utilize and modify roads at the top of the levees to access part of their agricultural land. The effects of such actions result in continued fragmentation of existing high-quality habitat, and conversion of complex nearshore aquatic to simplified habitats that affect salmonids in ways similar to the adverse effects associated with this program.

2.6.5. Global Climate Change

The world is about 1.3°F warmer today than a century ago, the latest computer models predict that, without drastic cutbacks in emissions of carbon dioxide, and other gases released by the burning of fossil fuels, the average global surface temperature may rise by two or more degrees in the 21st century (IPCC 2001). Much of that increase likely will occur in the oceans, and evidence suggests that the most dramatic changes in ocean temperature are now occurring in the Pacific (Noakes 1998). Using objectively analyzed data Huang and Liu (2000) estimated a warming of about 0.9°F per century in the Northern Pacific Ocean.

Sea levels are expected to rise by 0.5 to 1.0 meters in the northeastern Pacific coasts in the next century, mainly due to warmer ocean temperatures, which lead to thermal expansion much the same way that hot air expands. This will cause increased sedimentation, erosion, coastal flooding, and permanent inundation of low-lying natural ecosystems (*e.g*., salt marsh, riverine, mud flats) affecting listed salmonid and green sturgeon PCEs. Increased winter precipitation, decreased snow pack, permafrost degradation, and glacier retreat due to warmer temperatures will cause landslides in unstable mountainous regions, and destroy fish and wildlife habitat, including salmon-spawning streams. Glacier reduction could affect the flow and temperature of rivers and streams that depend on glacier water, with negative impacts on fish populations and the habitat that supports them.

Summer droughts along the South Coast and in the interior of the northwest Pacific coastlines will mean decreased stream flow in those areas, decreasing salmonid survival and reducing water supplies in the dry summer season when irrigation and domestic water use are greatest. Global warming may also change the chemical composition of the water that fish inhabit: the amount of oxygen in the water may decline, while pollution, acidity, and salinity levels may increase. This will allow for more invasive species to overtake native fish species and impact predator-prey relationships (Peterson and Kitchell 2001, Stachowicz *et al.* 2002).

In light of the predicted impacts of global warming, the CV has been modeled to have an increase of between +2ºC and +7ºC by 2100 (Dettinger *et al.* 2004, Hayhoe *et al.* 2004, Van Rheenen *et al.* 2004, Stewart 2005), with a drier hydrology predominated by rainfall rather than snowfall. This will alter river runoff patterns and transform the tributaries that feed the CV from a spring and summer snowmelt dominated system to a winter rain dominated system. It can be hypothesized that summer temperatures and flow levels will become unsuitable for salmonid survival. The cold snowmelt that furnishes the late spring and early summer runoff will be replaced by warmer precipitation runoff. This will truncate the period of time that suitable cold-water conditions exist downstream of existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff. Without the necessary cold water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures downstream of reservoirs, such as Lake Shasta, could potentially rise above thermal tolerances for juvenile and adult salmonids (*i.e.* winter-run Chinook salmon and steelhead) that must hold and/or rear downstream of the dam over the summer and fall periods.

2.6.6. Rock Revetment and Levee Repair Projects

Cumulative effects include non-Federal riprap projects. Depending on the scope of the action, some non-Federal riprap projects carried out by state or local agencies do not require Federal permits. These types of actions and illegal placement of riprap occur within the Sacramento and American River watersheds. The effects of such actions result in continued fragmentation of existing high-quality habitat, and conversion of complex nearshore aquatic to simplified habitats that affect salmonids in ways similar to the adverse effects associated with the Common Features Project.

2.7. Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

In our *Rangewide Status of the Species* section, NMFS summarized the current status and likelihood of extinction of each of the listed species. We described the factors that have led to the current listing of each species under the ESA. These factors include past and present human activities, climatological trends, and ocean conditions that have been identified as influential to the survival and recovery of the listed species. Beyond the continuation of the human activities affecting the species, we also expect that ocean condition cycles and climatic shifts will continue to have both positive and negative effects on the species' ability to survive and recover. The *Environmental Baseline* section reviewed the status of the species and the factors that are affecting their survival and recovery in the Action Area. The *Effects of the Action* section reviewed the exposure of the species and critical habitat to the proposed action. NMFS then evaluated the likely responses of individuals, populations, and impacts to critical habitat. The *Cumulative Effects* section described future activities within the Action Area that are reasonably certain to have a continued effect on listed fish.

In order to estimate the risk to steelhead, spring-run Chinook salmon, winter-run, and green sturgeon as a result of the proposed action, NMFS uses a hierarchical approach. The condition of the ESU or DPS is summarized in the *Status of the Species* section of this opinion. We then consider how the populations in the Action Area are affected by the proposed action, as described in the *Environmental Baseline* section. Effects on individuals are summarized, and the consequence of those effects is applied to establish risk to the diversity group, ESU, or DPS.

In designating critical habitat, NMFS considers the PBFs (essential features) within the designated areas that are essential to the conservation of the species and that may require special management considerations or protection. Such requirements of the species include, but are not limited to: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, or rearing offspring, and generally; and (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of this species [see 50 CFR § 424.12(b)]. In addition to these factors, NMFS also focuses on the principal biological or physical constituent elements within the defined area that are essential to the conservation of the species. Primary constituent elements may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation.

2.7.1. Summary of Effects of the Proposed Action on the Sacramento River Winter-Run Chinook salmon ESU

Best available information indicates that the Sacramento River winter-run Chinook salmon ESU remains at a high risk of extinction. Key factors upon which this conclusion is based include: (1) the ESU is composed of only one population, which has been blocked from its entire historic spawning habitat; and (2) the ESU has a risk associated with catastrophes, especially considering the remaining population’s dependency on the cold-water management of Shasta Reservoir (Lindley *et al.* 2007). The most recent 5-Year Status Review for winter-run Chinook salmon demonstrated that the ESU had further declined, and that continued loss of historical habitat and the degradation of remaining habitat continue to be major threats (NMFS 2016a). NMFS concludes that the Sacramento River winter-run Chinook salmon ESU remains at high risk of extinction.

The Sacramento River winter-run Chinook Salmon ESU was first listed as threatened in 1989 under an emergency rule. In 1994, NMFS reclassified the ESU as an endangered species. This ESU is also listed as “endangered” under the State of California’s endangered species law (California Endangered Species Act or CESA). Currently, there is only one population, spawning downstream of Keswick Dam, making this species particularly vulnerable to environmental pressures. This vulnerability manifested during the recent drought when warm water releases from Shasta Reservoir contributed to egg-to-fry mortality rates of 85% in 2013, 94% in 2014, and 96% in 2015, the highest levels since estimates of that statistic began in 1996. Mortality decreased after the drought ended (76% and 56% mortality in 2016 and 2017, respectively), but the recovery criteria for this species, as written in the Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014), include re-establishing populations into historical habitats in Battle Creek and upstream of Shasta Dam to reduce extinction risk due to compromised spatial structure.

The progeny of a captive broodstock from LSNFH were reintroduced to Battle Creek in 2017 and 2018 (U.S. Fish and Wildlife Service 2018). This “Jumpstart Project” is expected to continue until a “Transition Plan” is developed that merges the Jumpstart Project with the Reinitiation Plan (U.S. Fish and Wildlife Service 2018). The watershed currently has limited capacity to support a winter-run Chinook salmon population due to effects of a non-federal hydropower facility on habitat quantity and quality. However, Reclamation proposes a commitment of $14 million over ten years to accelerate the implementation of the Battle Creek Salmon and Steelhead Restoration Project. This project and Reclamation’s commitment are expected to reestablish approximately 42 miles of prime salmon and steelhead habitat on the creek and another 6 miles on its tributaries. NMFS expects that this effort will support a second spawning population, improving the spatial structure of the ESU as anticipated in the recovery plan.

As described above, the risk to winter-run Chinook salmon posed by the proposed action is evaluated in the aggregate context of the species' status, the environmental baseline, cumulative effects, and effects from other activities that would not occur but for the Proposed Action and also reasonably certain to occur. Because the ESU is composed of one population, the effects of, and risks associated with, the proposed action at the population level also represent the risks at the ESU level. As the single population is within the Sacramento River, any reduction in habitat quality can be highly detrimental. The Action Area is the migratory corridor that is used by both adults and juveniles of the entire ESU. The continued blockage of access to historical floodplain habitat is a stressor that will be reinforced by the implementation of proposed action.

In NMFS' Recovery Plan (NMFS 2014), several elements of the proposed action are aligned with or directly implement recovery actions identified in the recovery plan. Examples include, but are not limited to:

- Providing and/or improving fish passage through the Yolo Bypass and Sutter Bypass allowing for improved adult salmonid re-entry into the Sacramento River (long-term)
- Ensure that riverbank stabilization projects along the Sacramento River utilize biotechnical techniques that restore riparian habitat, rather than solely using the conventional technique of adding riprap.
- Implement projects that promote native riparian (*e.g*., willows) species including eradication projects for nonnative species (*e.g*., Arundo, tamarisk).
- Improve instream refuge cover in the Sacramento River for salmonids to minimize predatory opportunities for striped bass and other non-native predators.

Summary of Impacts of the Proposed Action on Sacramento River Winter-Run Chinook Designated Critical Habitat

Critical habitat designation for Sacramento River winter-run Chinook salmon includes the Sacramento River from Keswick Dam (RM 302) to the westward margin of the Delta all waters westward to the Carquinez Bridge, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge from San Pablo Bay to the Golden Gate Bridge ((58 FR 33212 1993) June 16, 1993). The proposed Action Area encompasses over 10 miles of riverine and estuarine critical habitat for this ESU within the primary migratory corridor, affecting the functioning of many of its physical and biological features.

The Sacramento River portions of the action area encompass winter-run critical habitat and will be affected by the proposed action. The PBFs of this critical habitat have been highly degraded by past and ongoing actions. Ongoing private, state, and federal actions and future non-federal actions are likely to continue to impair the function of physical and biological features and slow or limit development of these features, with the exception of restoration actions, which will offset these effects to some degree.

Although the PBFs of critical habitat for Sacramento River winter-run Chinook salmon have been highly degraded, the addition of effects resulting from the proposed action are expected to be balanced out between the placement of new rock revetment with increased habitat features at adjacent sites within the project area. NMFS expects that while the bank repair described in the proposed action will result in diminished function of PBFs related to rearing and migration within designated critical habitat in the action area, the proposed conservation measures, passage improvements, and compensatory mitigation actions are expected to offset habitat function within the action area such that, on the whole, the function of physical and biological features of critical habitat will not be reduced appreciably.

2.7.2. Summary of Effects of the Proposed Action on the Central Valley Spring-run Chinook Salmon ESU

NMFS listed the CV spring-run Chinook salmon ESU as a threatened species in 1999 and reaffirmed the species' status in 2005 and 2016. The Central Valley technical recovery team estimated that there were once 18 or 19 independent populations along with a number of dependent populations within four distinct diversity groups: the northwestern California diversity group, the basalt and porous lava diversity group, the northern Sierra Nevada diversity group, and the southern Sierra Nevada diversity group (Lindley et al. 2004). The latter is no longer a functioning diversity group, but each one of the diversity groups supported multiple spring-run Chinook salmon populations historically, spreading risk within and among several Central Valley ecotypes.

Major concerns for this ESU are low numbers, poor spatial structure, and low diversity. At this time, demographically independent populations persist only in the northern Sierra Nevada diversity group (Mill, Deer, and Butte creeks, which are tributaries to the upper Sacramento River) (NMFS 2014).

NMFS (2016b) concluded that run sizes are declining over time in most of the CV spring-run Chinook salmon populations. Exceptions are the populations in Clear Creek, Battle Creek, and Butte Creek, which have seen recent growth. In particular, the number of spawners in the Battle Creek population, which was extirpated for decades, has increased 18% over the last decade and is trending towards a low to moderate risk of extinction. The population in Clear Creek has been increasing and is composed mostly of natural-origin fish, although (Lindley et al. 2004) classified this population as a dependent population (not expected to exceed the low-risk population size threshold of 2,500 fish). The Butte Creek spring-run Chinook salmon population has increased in part due to extensive habitat restoration and the accessibility of floodplain habitat in the Sutter-Butte Bypass for juvenile rearing in most years (Williams et al. 2016).

Based on the severity of the recent drought and the low escapements, as well as increased pre-spawn mortality in Butte, Mill, and Deer creeks in 2015, these CV spring-run Chinook salmon strongholds could deteriorate into high extinction risk in the coming years based on the population size or rate of decline criteria (NMFS 2016b). This predicted trend was validated in recent years through escapement data collected by CDFW for Mill and Deer creeks (California Department of Fish and Wildlife 2019). With adult returns below 500 individuals for the fourth consecutive year (2015-2018), these populations are at an increased risk of extinction (Lindley et al. 2007).

The recovery plan (NMFS 2014) listed a number of threats to the recovery of the Central Valley spring-run Chinook salmon ESU. Of these, passage barriers at Keswick and Shasta dams that block access to historical habitat in the upper Sacramento River watershed and barriers on Deer and Mill creeks that impede passage to existing habitats are ranked as very high stressors. The loss of rearing habitat in the lower and middle sections of the Sacramento River and the Delta and entrainment and predation in the Delta are also described as highly ranked stressors that are affected by the proposed action. Other threats include, but are not limited to operation of antiquated fish screens, fish ladders, and diversion dams; inadequate flows; and levee construction and maintenance projects that have greatly simplified riverine habitat and disconnected rivers from the floodplain (NMFS 2016b). The effects of the proposed action on individuals from this ESU include the reduction in quality of rearing habitat in the lower and middle sections of the Sacramento River resulting in increased predation.

As described above, the risk to the CV spring-run Chinook salmon posed by the proposed action is evaluated in the aggregate context of the species' status, the environmental baseline, cumulative effects, and effects from other activities that would not occur but for the Proposed Action and also reasonably certain to occur. As the Sacramento River portion of the Action Area is the main migratory corridor for all of the established spring-run populations (with the exception of the newly re-introduced San Joaquin river population), any reduction in habitat quality can be highly detrimental to the ESU. The Action Area is the migratory corridor that is used by both adults and juveniles, and continued blockage of access to historical floodplain habitat is a stressor that will be reinforced by the implementation of proposed action.

NMFS salmonid Recovery Plan (NMFS 2014), included several elements of the proposed action that are aligned with or directly implement recovery actions identified in the recovery plan. Examples include, but are not limited to:

- Providing and/or improving fish passage through the Yolo Bypass and Sutter Bypass allowing for improved adult salmonid re-entry into the Sacramento River (long-term)
- Ensure that riverbank stabilization projects along the Sacramento River utilize biotechnical techniques that restore riparian habitat, rather than solely using the conventional technique of adding riprap.
- Implement projects that promote native riparian (*e.g*., willows) species including eradication projects for nonnative species (*e.g*., Arundo, tamarisk).
- Improve instream refuge cover in the Sacramento River for salmonids to minimize predatory opportunities for striped bass and other non-native predators.

<u>Summary of Impacts of the Proposed Action on Central Valley Spring-run Chinook Salmon Designated Critical Habitat</u>

The geographical range of designated critical habitat for CV spring-run Chinook salmon includes stream reaches of the Feather, Yuba, and American rivers; Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks; and the Sacramento River downstream to the Delta, as well as portions of the northern Delta ((70 FR 52488 2005); September 2, 2005).

The majority of the proposed action area (the Sacramento River and the Lower portion of the American River) is within the designated critical habitat for CV spring-run Chinook salmon.

Individuals from all CV spring-run diversity groups must pass through the Lower Sacramento River in their migrations to and from the Pacific Ocean. The only exception is the experimental population that was recently reintroduced to the San Joaquin River, which will not have exposure to the long-term effects of the proposed action.

As described above, there have been many efforts to repair or restore the degraded condition of the physical and biological features of critical habitat for CV spring-run Chinook salmon over the last ten years. These actions have improved the freshwater spawning sites through water temperature management and spawning gravel augmentation; the migratory corridor through dam removal and fish passage improvements using fish ladders and through selective barrier installations such as at the Wallace Weir; freshwater rearing sites through habitat restoration projects and fish screen installation on water diversions; and estuarine habitat through habitat restoration.

Critical habitat for CV spring-Chinook salmon is highly degraded due to the effects of past and ongoing actions. Ongoing private, state, and federal actions and future non-federal actions are likely to continue to impair the function of physical and biological features and slow or limit development of these features, although restoration actions will counteract these effects to some degree. Climate change is expected to further degrade the suitability of habitats in the Central Valley through increased temperatures, increased frequency of drought, increased frequency of flood flows, overall drier conditions, and altered estuarine habitats. Proposed water management actions are expected to reduce some of these impacts by increasing water storage that can be released during summer months.

The proposed action is likely to affect a large continuous portion of the migration and rearing habitat within designated critical habitat for CV spring-run Chinook salmon. NMFS expects the proposed implementation of the Proposed Action will result in temporary diminished function of PBFs related to rearing and migration within designated critical habitat in the action area. The proposed conservation measures, passage improvements, and restoration actions are expected to improve habitat function within the action area such that, on the whole, the function of physical and biological features of critical habitat will not be appreciably reduced.

2.7.3. Summary of Effects of the Proposed Action on the California Central Valley Steelhead DPS

NMFS listed the CCV steelhead DPS as a threatened species in 1998 and reaffirmed the species' status in 2005 and 2016. Before dam construction, water development, and other watershed perturbations, steelhead were found from the upper Sacramento and Pit rivers (now inaccessible due to Shasta and Keswick dams) south to the Kings and possibly the Kern River systems, and in both east- and west-side Sacramento River tributaries (NMFS 2014). There may have been at least 81 independent populations, distributed primarily throughout the eastern tributaries of the Sacramento and San Joaquin rivers. Currently, steelhead spawn in the Sacramento, Feather, Yuba, American, Mokelumne, Stanislaus, and Tuolumne rivers and tributaries, including Cottonwood, Antelope, Deer, Clear, Mill, and Battle creeks. Spawning likely occurs in other streams, but the lack of a comprehensive Central Valley steelhead monitoring program makes the amount and extent of spawning difficult to know. Major concerns across the range include passage impediments and barriers, warm water temperatures for rearing, hatchery effects, limited quantity and quality of rearing habitat, predation, and entrainment.

Many watersheds in the Central Valley are experiencing decreased abundance of steelhead (NMFS 2016c). Dam removal and habitat restoration efforts in Clear Creek appear to be benefiting the DPS as observers have reported unclipped (naturally produced) steelhead in recent years. However, adult numbers are still low, a large percentage of the historical spawning and rearing habitat is lost or degraded, and smolt production is dominated by hatchery fish. Many planned restoration and reintroduction efforts have yet to be implemented or completed. Most natural origin steelhead populations are not monitored and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change and drought (NMFS 2016c).

The risk to the steelhead DPS posed by the proposed action is considered in the aggregate context of the species' status, the environmental baseline, cumulative effects, and effects from other activities that would not occur but for the Proposed Action and also reasonably certain to occur. Currently the CCV steelhead DPS is at moderate risk of extinction (NMFS 2016c). However, there is considerable uncertainty with regard to the magnitude of that risk, due in large part to the general lack of information and uncertainty regarding the status of many of its populations. Here, the combined risk to individual populations are evaluated to determine the risk to the DPS as a whole.

As described above, the risk to steelhead posed by the proposed action is evaluated in the aggregate context of the species' status, the environmental baseline, cumulative effects, and effects from other activities that would not occur but for the Proposed Action and also reasonably certain to occur. Because the DPS is composed of several populations within four diversity groups, the effects of and risks associated with the proposed action must be considered in the context of the distribution of populations across multiple diversity groups. As the Proposed Action is potentially affecting a major shared migratory corridor between all of the Sacramento-based Diversity groups, any diversity group populations migrating through the action area will be impacted by changes to the habitat. The Action Area is the main migratory corridor that is used by both adults and juveniles of the entire northern portion of the DPS, comprising 4 of the 5 diversity groups. The continued blockage of access to historical floodplain habitat is a stressor that will be reinforced by the implementation of proposed action.

Summary of Impacts of the Proposed Action on California Central Valley Steelhead Designated Critical Habitat

The geographical extent of designated critical habitat includes, but is not limited to, the following: Sacramento, Feather, and Yuba rivers; Clear, Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries; and the waterways of the Delta. With the exception of Clifton Court Forebay, the entirety of the proposed action area in the Central Valley is designated critical habitat for steelhead. The PBFs for CV spring-run Chinook salmon critical habitat include (1) freshwater spawning sites, (2) freshwater migratory corridors, (3) freshwater rearing sites, and (4) estuarine habitat.

Critical habitat for steelhead in the mainstem Sacramento River and the American River is highly degraded due to the effects of past and ongoing actions. Ongoing private, state, and federal actions and future non-federal actions are likely to continue to impair the function of physical and biological features and slow or limit development of these features, with the exception of restoration actions, which may counteract these effects to some degree.

While there is additional critical habitat in several tributaries outside of the action area, the proposed action would affect key migratory reaches and a significant portion of rearing habitat within the designated critical habitat for steelhead. Although the current conditions of steelhead critical habitat are significantly degraded, the habitat that remains in the Sacramento watershed is considered to have high intrinsic value for species conservation, as it is critical to ongoing recovery efforts.

2.7.4. Summary of Effects of the Proposed Action on sDPS of North American Green Sturgeon

The sDPS of North American green sturgeon is listed as threatened under the ESA (71 FR 17757 2006). North American green sturgeon (*i.e.*, both the northern and southern DPSs) range from Baja California to the Bering Sea along the North American continental shelf. During the late summer and early fall, subadults and non-spawning adult green sturgeon aggregate in estuaries along the Pacific coast (Emmett et al. 1991; Moser and Lindley 2007). (Israel et al. 2008) found that green sturgeon within the Central Valley of California are sDPS green sturgeon. In addition, acoustic tagging studies show that green sturgeon spawning in the Sacramento River are exclusively from the southern DPS (Lindley et al. 2011). This DPS structure and distribution is corroborated by observations of spawning site fidelity (NMFS 2018).

Southern DPS green sturgeon are known to range through the San Francisco Bay estuary, the Delta, and the Sacramento, Feather, and Yuba rivers. (Mora et al. 2018) estimated that 9% of historical habitat has been blocked by dams. In the Yuba River, green sturgeon have been documented as far upstream as the barrier to potential spawning habitat at Daguerre Point Dam (Bergman et al. 2011). Similarly, green sturgeon have been observed at the Fish Barrier Dam on the Feather River. On the Sacramento River, the upstream extent of spawning appears to lie somewhere below Anderson-Cottonwood Irrigation District Dam (RM 298). It is uncertain if there is suitable spawning habitat in upstream reaches to Keswick Dam; this habitat may be too cold at present, but if passage was restored, could allow the spawning distribution to shift upstream in response to climate change effects.

Mora (2016) demonstrated that green sturgeon spawning sites are concentrated into very few locations. Just three sites accounted for over 50% of the spawning activity in the Sacramento River in 2010-2012. A population or DPS with a high concentration of individuals in just a few spawning sites is vulnerable to increased extinction risk due to catastrophic events.

Current available information indicates that the southern DPS of green sturgeon is composed of a single independent population, which principally spawns in the mainstem Sacramento River, but also opportunistically in the Feather and Yuba Rivers. The concentration of spawning into a very few locations makes the species highly vulnerable to catastrophic events. The apparent extirpation from upstream reaches in the San Joaquin River narrows the range of available habitat, leaving little buffer to these potential impacts.

The green sturgeon recovery plan (NMFS 2018) describes criteria for determining green sturgeon population recovery and alleviation of threats. Demographic recovery criteria are population metrics that if achieved demonstrate population recovery and alleviation of threats. Recovery actions for green sturgeon generally include improving access to spawning habitat in the Sacramento, Feather and Yuba rivers and through the Yolo Bypass; improving water temperature and flow management to support juvenile recruitment; managing water quality to reduce exposure to contaminants that limit growth and survival; reducing poaching and creating operational guidelines for fish screens and water diversions in the Central Valley.

Overall, NMFS considers the risk of extinction to be moderate because, although threats due to habitat alteration are thought to be high and the number of spawning adults is relatively low, the scope of threats and the accuracy of the population abundance estimates are uncertain (NMFS 2018). However, the sDPS does not meet the definition of viable as an independent population having a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year timeframe. Additional information about green sturgeon will be critical to understanding the management needs for this species, especially with regard to robust abundance estimates and the characteristics and distribution of suitable habitats.

Given that the entire green sturgeon sDPS is represented by a single population, the discussion points above apply equally to both the population level analysis and that of the DPS as a whole. NMFS expects that the effects of the proposed action on abundance are likely to be moderate to low. When the Yolo Bypass is not activated, all juvenile green sturgeon in the DPS will be out-migrating through the action area. Any impacts to that area causing an increase of stressors, such as predation and reduced food availability, may have an exponential effect to the population due to limited spatial range of the species.

The action includes measures that may partially offset the stressors caused by the proposed action. The adult fish passage structure at the Sacramento Weir will reduce stranding within the Yolo Bypass and remove increased spawning delays if Fremont Weir is inoperable or impassable. The conservation measures targeted towards developing a green sturgeon HMMP and habitat impact model will significantly benefit our understanding of the species and the reality of impacts from future bank repair projects.

NMFS has finalized recovery planning for sDPS green sturgeon (NMFS 2018). Several elements of the proposed action are aligned with actions identified in the recovery plan, such as developing flow and temperature targets that support successful spawning, incubation and rearing habitat below impoundments. The proposed action also does not impede implementation of other key elements of the recovery plan, such as improving passage and water quality conditions in the Yuba and Feather Rivers and reducing non-point source contaminants in the Delta. Implementation of the proposed action is therefore not creating conditions that would preclude recovery of green sturgeon in the future.

<u>Summary of Impacts of the Proposed Action on sDPS of North American Green Sturgeon Designated Critical Habitat</u>

Green sturgeon critical habitat was designated on October 9, 2009 (74 FR 52300 2009). In marine waters, designated critical habitat is: areas 60 fathom (110 meters) depth isobath from

Monterey Bay to the U.S.-Canada border. In freshwater, designated critical habitat is: the mainstream Sacramento River downstream of Keswick Dam (including the Yolo and Sutter bypasses), the Feather River below Oroville Dam, the Yuba River below Daguerre Point Dam, and the Sacramento-San Joaquin Delta.

PBFs in freshwater that are present in the action area:

- Substrate type or size suitable for egg deposition and development, including cobble and gravel
- Water flow including magnitude, frequency, duration, seasonality, and rate-of-change
- Water quality including temperature, salinity, oxygen content
- Migratory pathway for safe and timely passage within riverine habitats

PBFs in estuarine habitats that are affected by the proposed action are:

- Migratory pathway for safe and timely passage of all life stages between riverine and estuarine habitats

Many of the physical and biological features of green sturgeon designated critical habitat are currently degraded or impaired and provide limited high quality habitat. Although the current conditions of green sturgeon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in both the Sacramento River watersheds and the Delta are considered to have high intrinsic value for the conservation of the species.

While the PBFs in the designated freshwater riverine and estuarine habitat are degraded under baseline conditions, they still function in providing access from the upper river habitat to the marine environment. NMFS expects the proposed action will result in diminished function of PBFs related to rearing and migration within designated critical habitat in the action area. The proposed conservation measures, passage improvements, research funding, and restoration actions are expected to offset the diminished habitat functions within the action area such that, on the whole, the function of physical and biological features of critical habitat will not be significantly reduced.

2.7.5. Status of the Environmental Baseline and Cumulative Effects in the Action Area

Salmon, steelhead and green sturgeon use the action area as an upstream and downstream migration corridor and for rearing. Within the action area, the essential features of freshwater rearing and migration habitats for salmon, steelhead and green sturgeon have been transformed from a meandering waterway lined with a dense riparian vegetation, to a highly leveed system under varying degrees of constraint of riverine erosional processes and flooding. Levees have been constructed near the edge of the river and most floodplains have been completely separated and isolated from the Sacramento River. Severe long-term riparian vegetation losses have occurred in this part of the Sacramento River, and there are large open gaps without the presence of these essential features due to the high amount of riprap. The change in the ecosystem as a result of halting the lateral migration of the river channel, the loss of floodplains, the removal of riparian vegetation, contribution from the riparian vegetation into the aquatic system, and IWM have likely affected the functional ecological processes that are essential for growth and survival of salmon, steelhead and green sturgeon in the action area.

The *Cumulative Effects* section of this BO describes how continuing and future effects, such as the discharge of point and non-point source chemical contaminant discharges, aquaculture and hatcheries, increased urbanization, and increased installation of rock revetment affect the species in the action area. These actions typically result in habitat fragmentation, and conversion of complex nearshore aquatic habitat to simplified habitats that incrementally reduces the carrying capacity of the rearing and migratory corridors.

The perpetuation of the current levee system will result in the continued diminished functioning of the aquatic and riparian ecosystems, which reduces the contributions of these habitats to the survival of rearing and migrating listed species, particularly salmonids. Given the extensive loss of upstream spawning grounds and the extreme modification of habitat in the Sacramento River and its tributaries, careful consideration of the impacts of future levee projects is needed.

2.7.6. Synthesis

Summary of Effects of the Proposed Action to Sacramento River Winter Run Chinook Salmon, CV Spring-run Chinook Salmon, CCV Steelhead, and sDPS Green Sturgeon Individuals

Effects of the levee repair on aquatic resources included both short- and long-term impacts. Short-term impacts include the impacts of construction during the repair (physical disturbances, increased turbidity, acoustic impacts, dewatering, fish relocation, impingement, and increased barge traffic. Long-term impacts include: the permanent physical alteration of the riverbank and riparian vegetation, continued blockage to the floodplain, stranding, and long-term levee and fish passage operations and maintenance.

1. Short-term Effects due to Construction

Effects associated with in-river construction work will result in temporarily altering in-river conditions. Any fishes that do not relocate during construction can be crushed or injured by construction equipment, rock placement, personnel, or may be affected behaviorally or physically from hydroacoustic impacts. However, only fishes that are holding adjacent to or migrating past the levee repair site will be directly exposed to construction activities. These construction type actions will occur during summer and early fall months, when the abundance of individual salmon, steelhead, and green sturgeon is low and is expected to result in correspondingly low levels of injury or death.

Other potential impacts due to construction include the releases of toxic substances and increases in turbidity. However, BMPs utilized are expected to prevent these impacts from adversely affecting salmonids or green sturgeon.

2. Long-term Effects Related to the Presence of Program Features

The effects of the proposed action could exacerbate many of the “Very Highly Ranked Threats” identified in the NMFS Recovery Plans to winter-run Chinook salmon, spring-run Chinook salmon and steelhead, and sDPS green sturgeon (NMFS 2014, NMFS 2018). Considering that site-specific actions will occur along primary migratory corridors of the Sacramento River, we expect that all Sacramento River Basin populations of these species are likely to be exposed and adversely affected by program actions. We do not expect the proposed action to affect the spatial structure or diversity of any of these species. Site-specific considerations, such as design configuration and planting densities, will determine the actual amount of on-site compensation that can be provided. The Corps future implementation will likely include replanting of vegetative features to provide habitat value for fish species. Some of this will be replaced as part of site design and construction, but there will be temporal gaps in function while the site plantings establish and grow.

Mitigative Effects of Proposed On-site and Off-site Conservation Measures

Section 1.2.7 of the Proposed Action describes the additional minimization and conservation measures (*i.e*., mitigation measures) that the Corps proposes to offset the unavoidable and residual adverse effects of the proposed levee repair actions. The Corp's Compensation Strategy incorporates alternatives; a mixture of local on-site mitigation, local off-site mitigation, research grant funding, and a large-scale restoration project in the Delta.

Summary of Long-term Effects to Species ESUs/DPSs as a Whole

Based on the reach-specific analysis of long-term project-related impacts to each analyzed species we determine that there will be appreciable adverse effects to each species in nearly all reaches and water surface elevations. Adverse effects at various water surface elevations, regions, and life stages are expected to last in many cases for several decades, affecting a high proportion and multiple generations of the species analyzed in this BO.

Most of the effects are related to long-term impacts to riparian habitat and IWM, as well as the continued lack of access to floodplain habitat. The perpetuating effects of the Corps Levee Vegetation Policy and riprap placement are clearly driving these effects.

Depending on final site designs, the effects of the proposed action could exacerbate stressors/threats to spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon. Through conscientious design in coordination with NMFS and the mitigation procedures included in the program, these impacts are expected to be minimized, with unavoidable impacts mitigated. Considering that site-specific actions will occur along primary migratory corridors of the Sacramento River, we expect that all Sacramento River Basin populations of these species have the potential to be exposed and adversely affected by program actions. With the nature and potential duration of the effects, we expect the proposed action to temporarily reduce the productivity of a portion of each species during construction exposed to a project site and for the first 5 years as re-vegetation occurs. However, based on the proposed action, unavoidable impacts will be mitigated, such that the program is not expected to reduce appreciably the likelihood of both the survival and recovery of the species.

Summary of Program Effects on Sacramento River Winter-run Chinook Salmon, Central Valley Spring-run Chinook Salmon, California Central Valley Steelhead, and sDPS Green Sturgeon Critical Habitat

Within the action area, the general relevant PBFs of the designated critical habitat for listed salmonids are spawning habitat, migratory corridors, and rearing habitat, and for green sturgeon, the six PBFs include food resources, water flow, water quality, migratory corridor, depth, and sediment quality.

As described in the project description, this consultation analyzed a number of repair designs, which involve vegetation removal, bank fill stone protection installation of rock revetment, and potentially limited replacement of on-site habitat features, resulting in loss of SRA habitat and IWM at the project sites. These actions are expected to temporarily or permanently reduce the quality of habitat for rearing and migrating juvenile salmonids, due to the removal of SRA habitat and IWM. SRA habitat and IWM are important for rearing and out-migrating juvenile salmonids, because they enhance the aquatic food webs and provide high-value feeding areas for juvenile salmonids. Removal of SRA habitat and IWM is expected to temporarily reduce the growth and survival for juvenile salmonids exposed to the project sites.

Similarly, SRA habitat and IWM are critical in providing shade and cooling water temperatures for salmonids. Therefore, the removal of SRA habitat and IWM associated with the repairs will degrade freshwater rearing and migratory corridors for listed salmonids by temporarily increasing temperatures. The removal of IWM will also increase the risk of predation for juvenile salmonids. The Proposed Action further perpetuates the confinement of rivers within their banks, reducing river connectivity with adjacent floodplains, which serve as optimal rearing habitat. The severity of these effects and whether they are temporary or permanent is dependent on the repair type chosen at each site.

Green sturgeon PBFs of food resources are expected to be adversely affected by the proposed program, as program features will cover the soft benthic substrate where green sturgeon forage for food with riprap, reducing food availability. The lack of scientific information regarding bank protection actions on green sturgeon makes the extent of effects difficult to quantify. Ongoing efforts through the green sturgeon HMMP will develop methodology for quantifying and mitigating these effects.

Based on the proposed action, unavoidable impacts will be mitigated, such that the program is not expected to appreciably diminish the value of designated critical habitat.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, sDPS North American green sturgeon, and California Central Valley steelhead or destroy or adversely modify their designated critical habitat.

2.9. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. “Harm” is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). “Incidental take” is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1. Amount or Extent of Take

While individual fish are expected to be present in the Action Area at the time of construction, and during seasonal rearing and migration, NMFS cannot, using the best available information, precisely quantify and track the amount or number of individuals that are expected to be incidentally taken (injure, harm, kill, etc.) per species as a result of the proposed action. This is due to the variability and uncertainty associated with the response of listed species to the effects of the proposed action, the varying population size of each species, annual variations in the timing of spawning and migration, individual habitat use within the Action Area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates, those elements of the project that are expected to result in incidental take, that are more predictable and/or measurable, with the ability to monitor those surrogates to determine the extent of take that is occurring.

The most appropriate threshold for incidental take is an ecological surrogate of habitat disturbance, which includes the loss of SRA cover and riparian habitat through the placement of rock revetment and removal of vegetation. This degradation is expected to result in reduction in the growth and survival of individuals from predation, or by causing fish to relocate and rear in other locations and reduction of the quality of the existing habitat.

Incidental take, in the form of harm resulting in behavioral modifications or fish responses to habitat disturbance are described as follows. Increased predation is expected to occur during the construction phase due to construction-related disturbance and shoreline activity. Long-term behavioral modifications and increased predation vulnerability resulting from loss and degradation of shoreline riparian habitat and shallow water habitat is also expected to occur throughout the life of the levee. Quantification of the number of fish exposed to noise, shoreline activities, and increases in predation vulnerability is not currently possible with available monitoring data. Observations of individual fish within the river channel are not possible due to water clarity and depth. However, all fish passing through or otherwise present in the Action Area during construction activities or over the long term during their adult and juvenile rearing and migratory life history stages will be exposed to the disturbed shoreline habitat created by the rehabilitation sites. Thus, the footprint of each rehabilitation site defines the area in which projected incidental take will occur for this project due to the effects of construction actions and the long-term habitat disturbance associated with each site. NMFS anticipates incidental take will be limited to the following:

1. Harm to rearing and migrating juveniles is expected within the project footprint for areas below the OHWM due to rock placement within the channel. Rock placement is expected to result in injury or death to a small number of juvenile fish in the action area where riprap placement is occurring below OHWM. Harm to rearing juvenile SR winter-run, CV spring-run Chinook salmon, and CCV steelhead, and adult and juvenile green sturgeon from the repair will be limited to a total habitat impact of 278.5 acres of below OHWM. Therefore, allowable take will be exceeded if rock placement below OHWM exceeds 76.7 acres within the Sacramento River projects area (mouth of the American River down to the bottom of the action area), 195.7 acres within the American River, or 6.2 acres within the Sacramento Weir and Bypass.

2. Harm to rearing juvenile spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon from increased turbidity in the footprint of the proposed project from construction activities, extending upstream and downstream 1,000 feet from the footprint of each individual site and 100 feet from the extent of the repair into the river channel. This disturbed habitat will affect the behavior of fish, including displacement, which is reasonably certain to result in increased predation, decreased feeding, and increased competition. NMFS does not expect any mortality or morbidity of these fish due to exposure to construction related turbidity. Quantification of the number of fish exposed to turbidity is not currently possible with available monitoring data. Observations of individual fish within the river channel are not possible due to water clarity and depth. However, all fish passing through or otherwise present during construction activities at the rehabilitation sites will be exposed to construction related turbidity events, particularly when the turbidity curtains are removed. Thus, the waterside footprint of each rehabilitation site plus the additional area of river channel where turbidity effects are expected to be observed defines the area in which projected take will occur for this project due to the effects of construction related turbidity. Allowable take will be exceeded if turbidity measured 1,000 feet downstream of the extent of the site exceeds double the upstream of site turbidity measurement.

3. Take in the form of harm, injury and death to listed fish, is expected due to pile driving. Activities will affect adults and juveniles through direct stress, injury, or death. Activities may also cause harm through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Allowable take will be exceeded if the single strike criteria exposure; a SEL of 187 dB re: 1 µPa2 •sec and a peak sound pressure of 208 dB re: 1 μPa_{peak} as measured 10 m from the source is exceeded.

4. Take in the form of harm, injury and death to listed fish, is expected due to dewatering, fish capture, and relocation activities. Activities will affect juveniles and adults through increased stress, injury, or death. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Allowable take will be exceeded if an excess of 2% of a species of fish handled annually are directly killed due to dewatering, capture and relocation activities.

5. Take in the form of harm, injury and death to listed fish, is expected due to fish impingement during pumping activities for riparian irrigation. Activities will affect juveniles through increased stress, injury, or death. Harm from stress or injury is also

expected to cause displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Allowable take will be exceeded if pumping activities occur outside the timeframes indicated below, or above the amounts of water indicated in Table 5.

Table 11. Estimated 3-5 year maintenance schedule for riparian habitat.

Monitoring Year	Watering (Years 1 & 2: March 15-November 15) (Year 3-5: April 1-October 31)
Year 1 (March 15-November 15)	50 gallons per plant or 3 inches of spray applied precipitation every 10 to 14 days
Year 2 (March 15-November 15)	30 gallons per plant or two inches of spray applied precipitation every week to 10 days
Year 3-5	10 gallons per plant or one inch of spray applied precipitation twice a week

6. Take in the form of injury or death to adults and juvenile CV spring-run, Sacramento River winter-run Chinook salmon, CCV steelhead, and sDPS green sturgeon due to stranding on the declining hydrograph within the 660 acres of the widened bypass (Personal Communication, Anne Baker, Army Corps of Engineers). This take is expected to occur when flows are at or above the 2 year flow level, following the spilling of river water and as the flood flows recede stranding these species in the Sacramento Bypass. Allowable take will be exceeded if stranding of any fish occurs more than every two years within the expanded side of the bypass.

7. Take in the form of harm, injury and death to listed fish, is expected due to fish rescue and relocation within the expanded Sacramento Bypass. Stranding will affect juveniles and adults through increased stress, injury, or death, including from attempted relocation. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Allowable take will be exceeded if an excess of 2% of a species of fish handled annually are killed due to handling subsequent to stranding.

8. Take in the form of harm, injury and death to listed fish, is expected due to increased barge traffic in the Sacramento River. Activities will affect juveniles and adults through increased stress, injury, or death. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Allowable take will be exceeded if total barge trips exceed 2,325 round trips through construction activities.

9. Take in the form of harm, injury and death to listed fish, is expected due to fish passage gate closure at the Sacramento Adult Fish Passage Facility. Activities will affect juveniles and adults through increased stress, injury, or death. Allowable take will be exceeded if gate closures causes the death of more than one ESA listed fish during each water year.

10. Take in the form of harm, injury and death to listed fish, is expected due to normal operations (including debris blockages, gate failure, and standard operations) of the

Sacramento Adult Fish Passage Facility. Activities will affect juveniles and adults through increased stress, injury, or death. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Harm to adults is also expected through delays in spawning and straying. Allowable take will be exceeded if operations issues are not restored within 24 hours of it being safe to do so (during times when the facility would be operating), or prior to the facility operating (for maintenance needing to be done in the dry season).

11. Harm to rearing juvenile spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and adult and juvenile green sturgeon from the loss of 278.5 acres of riparian habitat (see Table 11 below). This loss will affect juveniles through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Table 11 describes the anticipated area of disturbed habitat representing the ecological surrogate of incidental take at each site location for known project designs within the three main areas of the proposed action. Allowable take will be exceeded if impacts exceed 76.7 acres within the Sacramento River projects area (mouth of the American River down to the bottom of the action area), 195.7 acres within the American River, or 6.2 acres within the Sacramento Weir and Bypass.

Table 12. Maximum Acreages to be impacted in different Project areas.

Project Area	Permanent Acreage Impact below OHWM
Sacramento River	76.6
American River	195.7
Sacramento Weir and Bypass	6.2
TOTAL	278.5

2.9.2. Effect of the Take

In the BO, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

1. Measures shall be taken to minimize the impacts of the proposed bank protection construction.

2. Measures shall be taken to ensure necessary monitoring and Management Plans are developed.

3. Measures shall be taken to ensure that contractors, construction workers, and all other

parties involved with these projects implement the projects as proposed in the biological assessment and this BO.

4. Measures shall be taken to present NMFS with further information on launchable flood features and their effects on ESA listed species and their habitat.

5. Measures shall be taken to monitor incidental take of listed fish and the survival of on-site plantings, reporting of annual repair status, purchase of mitigation credits, and submissions of site-specific designs.

2.9.4. Terms and Conditions

The terms and conditions described below are non-discretionary, and the Corps or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The Corps or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1: "*Measures shall be taken to minimize the impacts of the proposed bank protection construction.*"

    a. The Corps shall participate in an existing Interagency Working Group or work with other agencies to participate in a new Bank Protection Working Group (BPWG) to coordinate stakeholder input into future flood risk reduction actions associated with the American River Common Features GRR. The BPWG will hold technical deliberations over proposed bank protection, including the need (basis of/for design), purpose and proposed designs (emphasis on avoidance and fish-friendly designs). Membership in the BPWG will be subject to agency decisions to participate, but should at a minimum include participation from resource agency staff (USFWS, NMFS, CDFW), CVFPB and SAFCA (local sponsors).

    b. The Corps shall coordinate with NMFS during site design as future flood risk reduction actions are designed to ensure conservation measures are incorporated to the extent practicable and feasible and projects are designed to maximize ecological benefits.

    c. The Corps shall ensure the widening of the Sacramento Bypass is designed and constructed to minimize stranding of fish at facilities of the weir and in the depressions of the bypass though grading or construction of drainage channels or other mechanisms as applicable.

    d. The Corps shall minimize the removal of existing riparian vegetation and IWM to the maximum extent practicable, and where appropriate, removed IWM will be anchored back into place or if not feasible, new IWM will be anchored in place.

e. The Corps shall install IWM along all projects associated with the American River Common Features GRR at 40 to 80% shoreline coverage at all seasonal water surface elevations in coordination with the IWG or the BPWG, where site engineering allows for it. The purpose is to maximize the refugia and rearing habitats for juvenile fish.

f. The Corps shall develop a vegetation design deviation for each site in consultation with NMFS to allow for the protection of existing vegetation in place and the planting of new low-risk vegetation on the lower slope of the levee system.

g. The Corps shall use vibratory hammers for pile driving as often as feasible to reduce impacts to aquatic species.

h. The Corps shall use NMFS approved aquatic sound attenuation devices for pile driving to reduce the transmission of sound through water. Attenuation devices can include bubble curtains, dewatered cofferdams, or others as approved by NMFS.

i. The Corps shall consider varying the elevation of planting benches and IWM to accommodate a wide variety of water years and ensure there is ample shoreline habitat in different flow scenarios.

j. The Corps shall monitor turbidity during in-water work activities to ensure levels stay below the allowable thresholds (turbidity measured 1,000 feet downstream of the extent of the site is not to exceed double the upstream of site turbidity measurement).

2. The following terms and conditions implement reasonable and prudent measure 2: "*Measures shall be taken to ensure necessary monitoring and management plans are developed.* "

   a. During design, and in coordination with the local sponsor, the Corps shall coordinate with NMFS to provide a detailed operation plan of the Sacramento Weir, to allow minimal fish stranding risk within the Sacramento Bypass following peak flows.

   b. The Corps shall include as part of the HMMP, a Riparian Corridor Improvement Plan with the overall goal of mitigating for the impacts to the ecological function and value of the existing levee system within the GRR study area. The Corps shall coordinate this plan with NMFS prior to the construction of any projects related to the GRS.

   c. The Corps shall update the O&M manual to incorporate the following measures: (1) an adaptive management plan for operations of the Sacramento Weir that allows for operations of flows in a manner that minimize fish stranding in the Sacramento Bypass, (2) integration of Sacramento Weir operations with the Yolo Bypass.

d. The HMMP measures shall be monitored by the Corps for 10 years following construction and the Corps shall update their O&M manual to ensure the HMMP is adopted by the local sponsor to ensure the goals and objectives of the conservation measures are met for the life of the project.

e. The HMMP shall include specific goals and objectives and a clear, NMFS-approved strategy for achieving full compensation for all project-related impacts on the affected species described above.

f. The HMMP shall include a compensatory mitigation accounting plan to ensure the tracking of compensatory measures associated with future American River Common Features GRR projects as described in the proposed action.

g. The Corps shall continue to coordinate with NMFS during all phases of construction, implementation, and monitoring by hosting annual meetings and issuing annual reports throughout the construction period as described in the HMMP.

h. The Corps shall host an annual meeting and issue annual monitoring reports for five years following completion of project construction. The purpose is to ensure that conservation features of the project are developing consistent with the HMMP.

i. The Corps shall update their O&M Manual to ensure that the mitigation elements are meeting the criteria established in the HMMP with the goal of meeting SAM values.

j. The Corps, in coordination with the local sponsor, shall ensure that the mitigation and monitoring plan for the Sacramento Bypass includes post-project monitoring of fish stranding. The monitoring plan shall be developed in coordination with NMFS.

k. USACE shall provide NMFS a detailed O&M plan for the Sacramento Weir and new Adult Fish Passage Facility. The O&M plan shall include instructions that minimize stranding and passage delays of fish. The plan shall also include maintenance to address scour and erosion within the new widened bypass in order to reduce fish stranding. The plan shall also include monitoring for any potential disconnected pools after water recedes from the bypass.

l. USACE shall provide NMFS a detailed O&M plan for all aspects of the proposed action, to ensure all sites are properly managed and the Design Deviation allowing vegetation to remain is followed. This plan shall be incorporated into the O&M manual for each site to ensure vegetation removal does not occur in the future.

m. USACE shall provide NMFS a Long Term Management Plan outlining the maintenance of all on-site and off-site mitigation. The plan shall include performance goals, monitoring plans, replanting plans, and an adaptive management plan for how mitigation will be addressed if the mitigation site fails.

3. The following terms and conditions implement reasonable and prudent measure 3: "*Measures shall be taken to ensure that contractors, construction workers, and all other parties involved with these projects implement the projects as proposed in the biological assessment and this BO*."

    a. The Corps shall provide a copy of this BO, or similar documentation, to the prime contractor, making the prime contractor responsible for implementing all applicable requirements and obligations included in these documents and to educate and inform all other contractors involved in the project as to the requirement of this BO. A notification that contractors have been supplied with this information will be provided to the reporting address below.

    b. A NMFS-approved Worker Environmental Awareness Training Program for construction personnel shall be conducted by the 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 afforded these animals under the ESA, and an explanation of the relevant terms and conditions of this BO. Written documentation of the training must be submitted to NMFS within 30 days of the completion of training.

4. The following terms and conditions implement reasonable and prudent measure 4: *"Measures shall be taken to present NMFS with further information on launchable flood features and their effects on ESA listed species and their habitat."*

    a. USACE shall initiate discussions to evaluate the durability of planting benches built on top of launchable flood features. If sites are demonstrated to have a likelihood to be lost during the life of the project, and appropriate mitigation plan will be proposed to rectify the loss of the mitigation. A decision will be presented to NMFS no later than December 31, 2021, or the effects will fall back to the uncertainty of the mitigation being durable and not count towards offsetting the effects of the project.

    b. USACE shall evaluate the probability of the launchable rock trenches launching. If fish habitat is deemed likely to be lost during the life of the project, an appropriate mitigation plan will be proposed to rectify the loss of the habitat. A decision will be presented to NMFS no later than December 31, 2021, or the effects will fall back to the worst-case scenario and assume that all launchable trenches will launch during the life of the project.

5. The following terms and conditions implement reasonable and prudent measure 5: *"Measures shall be taken to monitor incidental take of listed fish and the survival of on-*

site plantings, reporting of annual repair status, purchase of mitigation credits, and submissions of site-specific designs."

a. USACE shall incorporate appropriate monitoring technology into the fish passage facility to ensure passage of all species during a variety of hydrologic conditions. Appropriate monitoring technology shall be determined in discussion with NMFS, CDFW, and other resource agencies as appropriate to determine what technology will best provide data needed to demonstrate successful passage. This technology shall include PIT tag arrays, acoustic receivers, and other monitoring devices, such as VAKI, DIDSON, or AERIS.

b. USACE shall monitor conditions in each side of the new Adult Fish Passage Facility (both the channel and the ladder) to ensure NMFS passage criteria are being met.

c. The Corps shall initiate an interagency PIT Tag collaborative meeting. The goal of this meeting will be to establish a group where collected PIT tag data may be shared. This meeting shall commence prior to the first operation of the new Sacramento Weir Fish Passage Facility. The planning of the initial meeting shall be coordinated with CDFW and NMFS.

d. The Corps shall ensure the Sacramento Bypass is surveyed every year after overtopping events and maintain any large scour holes or erosion that may cause stranding risk or increase the likelihood of stranding within the expanded Sacramento Bypass.

e. USACE shall provide NMFS with a site-specific project description prior to advertising for construction contracts of any sites. The project description shall include a design at or beyond the 65% level, anticipated impacts, and proposed mitigation ratios for the site. NMFS must provide written approval that the site is consistent with this opinion prior to construction, NMFS will respond within 14 days of receiving site-specific documents.

f. USACE shall provide to NMFS (at the address below) a vegetation monitoring report at years 1, 2, 3, 5, and 8 post-construction no later than December 31st of each reporting cycle. This report shall provide information as to the success of the revegetation program and whether the conservation goals are being met at each site. If goals are not being met, then the report shall indicate what actions are being implemented to meet those goals.

g. USACE shall submit a report to NMFS of any incidental take that occurs as part of the project. This report shall be submitted no later than December 31 of each reporting cycle.

h. USACE shall contact NMFS within 24 hours of the new expanded Sacramento Weir overtopping for the first 5 years.

i. USACE shall ensure that the NMFS Central Valley Office is involved with the discussions, development, and tracking of the SAM model development and the proposed Green Sturgeon research.

j. All reports for NMFS shall be sent to:

Cathy Marcinkevage
California Central Valley Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento California 95814
FAX: (916) 930-3629
Phone: (916) 930-3600
ccvo.consultationrequests@noaa.gov

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. The Corps should integrate the 2017 California Central Valley Flood Protection Plan's Conservation Strategy into all flood risk reduction projects they authorize, fund, or carry out.

2. The Corps should prioritize and continue to support flood management actions that set levees back from rivers and in places where this is not technically feasible, repair in place actions should pursue landside levee repairs instead of waterside repairs.

3. The Corps should consult with NMFS in the review of ETL variances for future projects that require ETL compliance.

4. The Corps should develop ETL vegetation variances for all flood management actions that are adjacent to any Central Valley anadromous fish habitat.

5. The Corps should use all of their authorities, to the maximum extent feasible to implement high priority actions in the NMFS Central Valley Salmon and Steelhead Recovery Plan. High priority actions related to flood management include setting levees back from riverbanks, increasing the amount and extent of riparian vegetation along reaches of the Sacramento River Flood Control Project.

6. The Corps should encourage cost-share sponsors and applicants to develop floodplain and riparian corridor enhancement plans as part of their projects.

7. The Corps should continue to work with NMFS and other agencies and interests to support the improved growth, survival and recovery of native fish species in the Yolo

Bypass and other bypasses within the Sacramento River Flood Control Project, including restoring/improving fish passage.

8. The Corps should consider implementing post-construction bathymetry to monitor changes in benthic habitat.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

2.11. Reinitiation of Consultation

This concludes formal consultation for American River Watershed Common Features General Reevaluation Report Reinitiation 2020.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA , EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)]

This analysis is based, in part, on the EFH assessment provided by the United States Army Corps of Engineers and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fisheries Management Council and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The geographic extent of freshwater EFH is identified as all water bodies currently or historically occupied by Council-managed salmon as described in Amendment 18 of the Pacific Coast Salmon Plan (PFMC 2014). In the estuarine and marine areas, salmon EFH extends from the extreme high tide line in nearshore and tidal submerged environments within state territorial waters out to the full extent of the Exclusive Economic Zone (EEZ) (200 nautical miles or 370.4 km) offshore of Washington, Oregon, and California north of Point Conception. The proposed project occurs in the area identified as "freshwater EFH", as it is above the tidal influence where the salinity is below 0.5 parts per thousand.

The implementing regulations for the EFH provisions of the MSA (50 CFR part 600) recommend that the FMPs include specific types or areas of habitat within EFH as "habitat areas of particular concern" (HAPC) based on one or more of the following considerations: (1) the importance of the ecological function provided by the habitat; (2) the extent to which the habitat is sensitive to human-induced environmental degradation; (3) whether, and to what extent, development activities are, or will be, stressing the habitat type; and (4) the rarity of the habitat type. Based on these considerations, the Council designated five HAPCs: (1) complex channels and floodplain habitats; (2) thermal refugia; (3) spawning habitat; (4) estuaries; and (5) marine and estuarine SAV. HAPCs that occur within the proposed project area are (1) complex channels and floodplains, and (2) thermal refugia.

3.2. Adverse Effects on Essential Fish Habitat

The proposed action is considered to have multiple activities that affect EFH for Pacific salmon as described in Amendment 18 to the Pacific Coast Salmon FMP (PFMC 2014). The following aspects of the proposed action are expected to have adverse effects on the freshwater EFH in the Action Area of the project:

1) Bank Stabilization and Protection – The proposed project has components that will entail bank stabilization and protection activities in the Action Area which includes freshwater EFH. These activities include placement of rock armoring and removal of riparian vegetation. The alteration of riverine and estuarine habitat from bank and shoreline stabilization, and protection from flooding events can result in varying degrees of change in the physical, chemical, and biological characteristics of existing shoreline and riparian habitat. Human activities removing riparian vegetation, armoring, relocating, straightening and confining stream channels and along tidal and estuarine shorelines influences the extent and magnitude of stream bank erosion and down cutting in the channel. In addition, these actions have reduced hydrological connectivity and availability of off-channel habitat and floodplain interaction. Armoring of shorelines to prevent erosion and maintain or create shoreline real estate simplifies habitats, reduces the amount of intertidal habitat, and affects nearshore processes and the ecology of a myriad of species (Williams and Thom 2001). As described in

Amendment 18 in PFMC 2014, a river confined by adjacent development and/or flood control and erosion control structures can no longer move across the floodplain and support the natural processes that: 1) maintain floodplain connectivity and fish access that provide velocity refugia for juvenile salmon during high flows; 2) reduce flow velocities that reduce streambed erosion, channel incision, and spawning redd scour; 3) create side channels and off-channel areas that shelter rearing juvenile salmon; 4) allow fine sediment deposition on the floodplain and sediment sorting in the channel that enhance the substrate suitability for spawning salmon; 5) maintain riparian vegetation patterns that provide shade, large wood, and prey items to the channel; 6) provide the recruitment of large wood and spawning gravels to the channel; 7) create conditions that support hyporheic flow pathways that provide thermal refugia during low water periods; and 8) contribute to the nutrient regime and food web that support rearing and migrating juvenile salmon in the associated mainstem river channels. These activities are expected to adversely affect HAPCs for (1) complex channels and floodplains, and (2) thermal refugia.

2) Flood Control Maintenance – The proposed project will continue to prevent access to historic floodplain habitat by maintaining the levees constructed for flood protection. The protection of housing communities from flooding events can result in varying degrees of change in the physical, chemical, and biological characteristics of existing shoreline and riparian habitats. Maintaining the flood control levees results in the addition of rock armoring after any erosion event, regular (sometimes yearly) herbicide application, removal of riparian vegetation from the shoreline (also sometimes yearly), and other potentially harmful maintenance activities. Managing flood flows with flood control structures such as levees can disconnect a river from its floodplain eliminating off-channel habitat important for salmonids. Floodplains serve as a natural buffer to changes in water flow: retaining water during periods of higher flow and releasing it from the water table during reduced flows. These areas are typically well vegetated, lowering water temperatures, regulating nutrient flow and removing toxins. Juvenile salmon use these off channel areas because their reduced flows, greater habitat complexity, increased food availability, and shelter from predators may increase growth rates and their chance of survival. Artificial flood control structures have similar effects on aquatic habitat as does the efforts to stabilize banks and remove woody debris. The function of natural stream channels and associated riparian areas and the effects of flood control structures such as levees has been discussed in section 2.4.1 of this opinion. The HAPCs adversely affected include (1) complex channels and floodplains, and (2) thermal refugia.

3.3. Essential Fish Habitat Conservation Recommendations

The Corps should implement the following conservation measures to minimize the adverse effects described in section 3.2 above. In order to avoid or minimize the effects to HAPCs (1) and (2) described above, NMFS recommends the following conservation measures described in Amendment 18 to the Pacific Coast Salmon FMP:

1) *Bank Stabilization and Protection*

- Minimize the loss of riparian habitats as much as possible.
- Bank erosion control should use vegetation methods or “soft” approaches (such as beach nourishment, vegetative plantings, and placement of IWM) to shoreline

modifications whenever feasible. Hard bank protection should be a last resort and the following options should be explored (tree revetments, stream flow deflectors, and vegetative riprap).

- Re-vegetate sites to resemble the natural ecosystem community.
- Replace in-stream fish habitat by providing root wads, deflector logs, boulders, rock weirs and by planting shaded riverine aquatic cover vegetation.
- Use an adaptive management plan with ecological indicators to oversee monitoring and ensure mitigation objectives are met. Take corrective action as needed.
- Implement term and conditions 1(a-d), from the section 7 Opinion for this project.
- Minimize alteration of floodplains and wetlands in areas of salmon EFH.
- Determine cumulative effects of all past and current floodplain and wetland alterations before planning activities that further alter wetlands and floodplains.
- Promote awareness and use of the United States Department of Agriculture (USDA)'s wetland and conservation reserve programs to conserve and restore wetland and floodplain habitat.
- Promote restoration of degraded floodplains and wetlands, including in part reconnecting rivers with their associated floodplains and wetlands and invasive species management.

2) *Flood Control Maintenance*

- Retain trees and other shaded vegetation along earthen levees and outside levee toe.
- Ensure adequate inundation time for floodplain habitat that activates and enhances near-shore habitat for juvenile salmon.
- Reconnect wetlands and floodplains to channel/tides.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, for Pacific Coast salmon.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the Corps must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5. Supplemental Consultation

The Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. Data Quality Act Documentation and Pre-Dissemination Review

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the Corps. Other interested users could include the California Department of Water Resources (DWR) and Sacramento Area Flood Control District (SAFCA). Individual copies of this opinion were provided to the Corps, DWR, and SAFCA. The document will be available within two weeks at the NOAA Library Institutional Repository https://repository.library.noaa.gov/welcome. The format and naming adheres to conventional standards for style.

4.2. Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3. Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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Appendix B: Air Quality Modeling Results

Road Construction Emissions Model, Version 8.1.0

Daily Emission Estimates for -> 2020_SRErosion_Contract1

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)	CO2 (lbs/day)	CH4 (lbs/day)	N2O (lbs/day)	CO2e (lbs/day)
Grubbing/Land Clearing	2.70	30.46	23.90	21.31	1.31	20.00	5.33	1.17	4.16	0.06	5,376.75	1.17	0.06	5,423.35
Grading/Excavation	10.14	81.38	98.89	10.22	5.22	5.00	5.77	4.73	1.04	0.14	13,814.10	3.78	0.13	13,948.56
Drainage/Utilities/Sub-Grade	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
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)	10.14	81.38	98.89	21.31	5.22	20.00	5.77	4.73	4.16	0.14	13,814.10	3.78	0.13	13,948.56
Total (tons/construction project)	0.46	3.68	4.43	0.52	0.23	0.29	0.27	0.21	0.06	0.01	625.56	0.17	0.01	631.63

Notes: Project Start Year -> 2020

Project Length (months) -> 4

Total Project Area (acres) -> 2

Maximum Area Disturbed/Day (acres) -> 2

Water Truck Used? -> Yes

Phase	Total Material Imported/Exported Volume (yd^3/day) Soil	Asphalt	Daily VMT (miles/day) Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	14	0	40	0	1,000	40
Grading/Excavation	13	0	10	0	1,600	40
Drainage/Utilities/Sub-Grade	0	0	0	0	0	0
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.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming 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 -> 2020_SRErosion_Contract1

Project Phases (Tons for all except CO2e. Metric tonnes for CO2e)	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)	CO2 (tons/phase)	CH4 (tons/phase)	N2O (tons/phase)	CO2e (MT/phase)
Grubbing/Land Clearing	0.01	0.10	0.08	0.07	0.00	0.07	0.02	0.00	0.01	0.00	17.74	0.00	0.00	16.24
Grading/Excavation	0.45	3.58	4.35	0.45	0.23	0.22	0.25	0.21	0.05	0.01	607.82	0.17	0.01	556.78
Drainage/Utilities/Sub-Grade	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
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)	0.45	3.58	4.35	0.45	0.23	0.22	0.25	0.21	0.05	0.01	607.82	0.17	0.01	556.78
Total (tons/construction project)	0.46	3.68	4.43	0.52	0.23	0.29	0.27	0.21	0.06	0.01	625.56	0.17	0.01	573.01

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.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming 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.

Road Construction Emissions Model, Version 8.1.0

Daily Emission Estimates for -> 2020_SRErosion_Contract1				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	2.70	30.44	23.43	21.31	1.31	20.00	5.33	1.17	4.16	0.06	5,366.10	1.17	0.06	5,412.50
Grading/Excavation	10.14	81.37	98.60	10.22	5.22	5.00	5.77	4.73	1.04	0.14	13,807.44	3.78	0.13	13,941.77
Drainage/Utilities/Sub-Grade	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
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)	10.14	81.37	98.60	21.31	5.22	20.00	5.77	4.73	4.16	0.14	13,807.44	3.78	0.13	13,941.77
Total (tons/construction project)	0.45	3.68	4.42	0.52	0.23	0.29	0.27	0.21	0.06	0.01	625.24	0.17	0.01	631.30

Notes: Project Start Year -> 2020
Project Length (months) -> 4
Total Project Area (acres) -> 2
Maximum Area Disturbed/Day (acres) -> 2
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	14	0	40	0	1,000	40
Grading/Excavation	13	0	10	0	1,600	40
Drainage/Utilities/Sub-Grade	0	0	0	0	0	0
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.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming 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 -> 2020_SRErosion_Contract1				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	0.10	0.08	0.07	0.00	0.07	0.02	0.00	0.01	0.00	17.71	0.00	0.00	16.20
Grading/Excavation	0.45	3.58	4.34	0.45	0.23	0.22	0.25	0.21	0.05	0.01	607.53	0.17	0.01	556.51
Drainage/Utilities/Sub-Grade	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
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)	0.45	3.58	4.34	0.45	0.23	0.22	0.25	0.21	0.05	0.01	607.53	0.17	0.01	556.51
Total (tons/construction project)	0.45	3.68	4.42	0.52	0.23	0.29	0.27	0.21	0.06	0.01	625.24	0.17	0.01	572.71

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.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming 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.

Road Construction Emissions Model, Version 8.1.0

Daily Emission Estimates for -> 2020_SRErosion_Contract1

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)	CO2 (lbs/day)	CH4 (lbs/day)	N2O (lbs/day)	CO2e (lbs/day)
Grubbing/Land Clearing	1.57	36.07	7.32	20.40	0.40	20.00	4.47	0.31	4.16	0.06	5,366.10	1.17	0.06	5,412.50
Grading/Excavation	4.24	85.06	16.31	5.72	0.72	5.00	1.61	0.57	1.04	0.14	13,807.44	3.78	0.13	13,941.77
Drainage/Utilities/Sub-Grade	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
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)	4.24	85.06	16.31	20.40	0.72	20.00	4.47	0.57	4.16	0.14	13,807.44	3.78	0.13	13,941.77
Total (tons/construction project)	0.19	3.86	0.74	0.32	0.03	0.29	0.09	0.03	0.06	0.01	625.24	0.17	0.01	631.30

Notes:
Project Start Year -> 2020
Project Length (months) -> 4
Total Project Area (acres) -> 2
Maximum Area Disturbed/Day (acres) -> 2
Water Truck Used? -> Yes

Phase	Total Material Imported/Exported Volume (yd^3/day)		Daily VMT (miles/day)			
	Soil	Asphalt	Soil Hauling	Asphalt Hauling	Worker Commute	Water Truck
Grubbing/Land Clearing	14	0	40	0	1,000	40
Grading/Excavation	13	0	10	0	1,600	40
Drainage/Utilities/Sub-Grade	0	0	0	0	0	0
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.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming 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 -> 2020_SRErosion_Contract1

Project Phases (Tons for all except CO2e. Metric tonnes for CO2e)	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)	CO2 (tons/phase)	CH4 (tons/phase)	N2O (tons/phase)	CO2e (MT/phase)
Grubbing/Land Clearing	0.01	0.12	0.02	0.07	0.00	0.07	0.01	0.00	0.01	0.00	17.71	0.00	0.00	16.20
Grading/Excavation	0.19	3.74	0.72	0.25	0.03	0.22	0.07	0.03	0.05	0.01	607.53	0.17	0.01	556.51
Drainage/Utilities/Sub-Grade	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
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)	0.19	3.74	0.72	0.25	0.03	0.22	0.07	0.03	0.05	0.01	607.53	0.17	0.01	556.51
Total (tons/construction project)	0.19	3.86	0.74	0.32	0.03	0.29	0.09	0.03	0.06	0.01	625.24	0.17	0.01	572.71

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.

CO2e emissions are estimated by multiplying mass emissions for each GHG by its global warming 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.

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 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 type
Please use "Clear Data Input & User Overrides" button first before changing the Project Type or begin a new proje

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	2020_SRErosion_Contract1	
Construction Start Year	2020	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 constructi
Project Construction Time	4.30	months
Working Days per Month	22.00	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	0.22	miles
Total Project Area	2.00	acres
Maximum Area Disturbed/Day	2.00	acres
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	15.00	0.00	14.00
	Grading/Excavation	15.00	13.00	0.00
	Drainage/Utilities/Sub-Grade			
	Paving			
Asphalt	Grubbing/Land Clearing			
	Grading/Excavation			
	Drainage/Utilities/Sub-Grade			
	Paving			

Mitigation Options

On-road Fleet Emissions Mitigation	No Mitigation	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	No Mitigation	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 Standa

The remaining sections of this sheet contain areas that require modification when 'Other Project Type' is selecte

Note: The program's estimates of construction period phase length can be overridden in cells D50 through D53, and F50 through F5

Construction Periods	User Override of Construction Months	Program Calculated Months	User Override of Phase Starting Date	Program Default Phase Starting Date
Grubbing/Land Clearing	0.30	0.43	8/1/2020	1/1/2020
Grading/Excavation	4.00	1.72	8/11/2020	1/11/2020
Drainage/Utilities/Sub-Grade	0.00	1.51		5/12/2020
Paving	0.00	0.65		5/12/2020
Totals (Months)	4			

Note: You have entered a non-default starting date. Please provide starting date for all phases, or default values for other phases will be us

Note: Soil Hauling emission default values can be overridden in cells D61 through D64, and F61 through F6

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	40.00
Miles/round trip: Grading/Excavation	10.00			1	10.00
Miles/round trip: Drainage/Utilities/Sub-Grad				0	0.00
Miles/round trip: Paving				0	0.00

Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile	0.11	0.44	4.13	0.12	0.05	0.02	1,631.71	0.00	0.06	1,648.31
Grading/Excavation (grams/mile	0.11	0.44	4.13	0.12	0.05	0.02	1,631.71	0.00	0.06	1,648.31
Draining/Utilities/Sub-Grade (grams/mile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	0.04	0.36	0.01	0.00	0.00	143.89	0.00	0.00	145.36
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.48
Pounds per day - Grading/Excavation	0.00	0.01	0.09	0.00	0.00	0.00	35.97	0.00	0.00	36.34
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.00	1.60
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	0.00	0.00	0.01	0.00	0.00	0.00	2.06	0.00	0.00	2.08

Note: Asphalt Hauling emission default values can be overridden in cells D87 through D90, and F87 through F9

Asphalt 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				0	0.00
Miles/round trip: Grading/Excavation				0	0.00
Miles/round trip: Drainage/Utilities/Sub-Grad				0	0.00
Miles/round trip: Paving				0	0.00

Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile	0.11	0.44	4.13	0.12	0.05	0.02	1,631.71	0.00	0.06	1,648.31
Grading/Excavation (grams/mile	0.11	0.44	4.13	0.12	0.05	0.02	1,631.71	0.00	0.06	1,648.31
Draining/Utilities/Sub-Grade (grams/mile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tons per const. Period - Grading/Excavation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day - Drainage/Utilities/Sub-Grad	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-Grad	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 projec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Worker commute default values can be overridden in cells D113 through D11

Worker Commute Emissions	User Override of Worker Commute Default Values	Default Values	Calculated Daily Trips	Calculated Daily VMT
User Input				
Miles/ one-way trip	20			
One-way trips/day	2			
No. of employees: Grubbing/Land Clearin	25		50	1,000.00
No. of employees: Grading/Excavatio	40		80	1,600.00
No. of employees: Drainage/Utilities/Sub-Grad			0	0.00
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	1.08	0.11	0.05	0.02	0.00	371.46	0.01	0.00	373.08
Grading/Excavation (grams/mile	0.02	1.08	0.11	0.05	0.02	0.00	371.46	0.01	0.00	373.08
Draining/Utilities/Sub-Grade (grams/mile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	1.00	2.55	0.20	0.00	0.00	0.00	84.03	0.01	0.01	86.84
Grading/Excavation (grams/trip	1.00	2.55	0.20	0.00	0.00	0.00	84.03	0.01	0.01	86.84
Draining/Utilities/Sub-Grade (grams/trip	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	0.16	2.65	0.27	0.10	0.04	0.01	828.20	0.02	0.01	832.07
Tons per const. Period - Grubbing/Land Clearing	0.00	0.01	0.00	0.00	0.00	0.00	2.73	0.00	0.00	2.75
Pounds per day - Grading/Excavation	0.25	4.25	0.44	0.17	0.07	0.01	1,325.12	0.03	0.02	1,331.31
Tons per const. Period - Grading/Excavation	0.01	0.19	0.02	0.01	0.00	0.00	58.31	0.00	0.00	58.58
Pounds per day - Drainage/Utilities/Sub-Grad	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-Grad	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 projec	0.01	0.20	0.02	0.01	0.00	0.00	61.04	0.00	0.00	61.32

Note: Water Truck default values can be overridden in cells D145 through D148, and F145 through F148.

Water Truck Emissions	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
User Input					
Grubbing/Land Clearing - Exhaust	1		40.00		40.00
Grading/Excavation - Exhaust	1		40.00		40.00
Drainage/Utilities/Subgrade					0.00
Paving					0.00

Emission Rates	**ROG**	**CO**	**NOx**	**PM10**	**PM2.5**	**SOx**	**CO2**	**CH4**	**N2O**	**CO2e**
Grubbing/Land Clearing (grams/mile	0.11	0.44	4.13	0.12	0.05	0.02	1,631.71	0.00	0.06	1,648.31
Grading/Excavation (grams/mile	0.11	0.44	4.13	0.12	0.05	0.02	1,631.71	0.00	0.06	1,648.31
Draining/Utilities/Sub-Grade (grams/mile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	0.36	0.01	0.00	0.00	143.89	0.00	0.00	145.36
Tons per const. Period - Grubbing/Land Clearing	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.48
Pounds per day - Grading/Excavation	0.01	0.04	0.36	0.01	0.00	0.00	143.89	0.00	0.00	145.36
Tons per const. Period - Grading/Excavation	0.00	0.00	0.02	0.00	0.00	0.00	6.33	0.00	0.00	6.40
Pounds per day - Drainage/Utilities/Sub-Grad	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-Grad	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 projec	0.00	0.00	0.02	0.00	0.00	0.00	6.81	0.00	0.00	6.88

Note: Fugitive dust default values can be overridden in cells D171 through D173.

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	2.00		20.00	0.07	4.16	0.01
Fugitive Dust - Grading/Excavation	0.50		5.00	0.22	1.04	0.05
Fugitive Dust - Drainage/Utilities/Subgrade			0.00	0.00	0.00	0.00

Values in cells D183 through D216, D234 through D267, D285 through D318, and D336 through D369 are required when 'Other Project Type' is selecte

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
0.00			Model Default Tie	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.00			Model Default Tie	Excavators	1.52	20.23	14.93	0.72	0.67	0.03	3,095.67	1.00	0.03	3,129.04
0.00			Model Default Tie	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tie	Generator Sets	0.40	3.71	3.48	0.20	0.20	0.01	623.04	0.04	0.00	625.31
0.00			Model Default Tie	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Other General Industrial Equipmen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Other Material Handling Equipmen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.00			Model Default Tie	Signal Boards	0.34	1.81	2.16	0.08	0.08	0.00	295.88	0.03	0.00	297.39
0.00			Model Default Tie	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tie	Sweepers/Scrubbers	0.27	1.99	2.33	0.19	0.17	0.00	246.18	0.08	0.00	248.83
0.00			Model Default Tie	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	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' t

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	2.53	27.73	22.90	1.19	1.12	0.05	4,260.77	1.15	0.04	4,300.57
Grubbing/Land Clearing	tons per phase	0.01	0.09	0.08	0.00	0.00	0.00	14.06	0.00	0.00	14.19

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
0.00			Model Default Tie	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00			Model Default Tie	Cranes	0.89	4.14	10.55	0.43	0.40	0.01	1,093.39	0.35	0.01	1,105.18
0.00			Model Default Tie	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	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			Model Default Tie	Excavators	0.51	6.74	4.98	0.24	0.22	0.01	1,031.89	0.33	0.01	1,043.01
0.00			Model Default Tie	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tie	Generator Sets	0.40	3.71	3.48	0.20	0.20	0.01	623.04	0.04	0.00	625.31
2.00			Model Default Tie	Graders	1.43	9.16	14.00	0.78	0.72	0.01	1,209.88	0.39	0.01	1,222.88
0.00			Model Default Tie	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00			Model Default Tie	Off-Highway Trucks	1.32	7.58	12.58	0.46	0.42	0.03	2,544.52	0.82	0.02	2,571.93
1.00			Model Default Tie	Other Construction Equipment	0.49	4.12	5.24	0.28	0.25	0.01	598.80	0.19	0.01	605.27
2.00			Model Default Tie	Other General Industrial Equipmen	0.47	3.98	4.29	0.31	0.29	0.01	496.04	0.16	0.00	501.39
1.00			Model Default Tie	Other Material Handling Equipmen	0.30	3.74	2.79	0.14	0.13	0.01	556.35	0.18	0.01	562.34
0.00			Model Default Tie	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00			Model Default Tie	Rubber Tired Dozers	1.92	15.87	20.30	0.93	0.86	0.02	1,726.14	0.56	0.02	1,744.68
0.00			Model Default Tie	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.00			Model Default Tie	Signal Boards	0.34	1.81	2.16	0.08	0.08	0.00	295.88	0.03	0.00	297.39
3.00			Model Default Tie	Skid Steer Loaders	0.24	4.17	3.19	0.14	0.13	0.01	600.51	0.19	0.01	606.98
0.00			Model Default Tie	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00			Model Default Tie	Sweepers/Scrubbers	0.27	1.99	2.33	0.19	0.17	0.00	246.18	0.08	0.00	248.83
2.00			Model Default Tie	Tractors/Loaders/Backhoes	0.42	4.61	4.25	0.27	0.25	0.01	607.74	0.20	0.01	614.28
2.00			Model Default Tie	Trenchers	0.87	5.48	7.89	0.59	0.54	0.01	678.76	0.22	0.01	686.07
0.00			Model Default Tie	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' t

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
Grading/Excavation	pounds per day	9.88	77.09	98.00	5.04	4.66	0.13	12,309.11	3.75	0.11	12,435.55
Grading/Excavation	tons per phase	0.43	3.39	4.31	0.22	0.20	0.01	541.60	0.16	0.00	547.16

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
0.00			Model Default Tie	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Other General Industrial Equipmen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Other Material Handling Equipmen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	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' t

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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	tons per phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Paving 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
0.00			Model Default Tie	Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Cranes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Excavators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Graders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Other General Industrial Equipmen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Other Material Handling Equipmen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pavers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Pumps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rollers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Scrapers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	Trenchers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00			Model Default Tie	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' t

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
	Paving	pounds per day	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Paving	tons per phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Emissions all Phases (tons per construction period) =			0.44	3.48	4.39	0.23	0.21	0.01	555.66	0.17	0.00	561.36

Equipment default values for horsepower and hours/day can be overridden in cells D391 through D424 and F391 through F4

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		8
Forklifts		89		8
Generator Sets		84		8
Graders		175		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		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		8
Trenchers		81		8
Welders		46		8

END OF DATA ENTRY SHEET

Barge Emissions Calculations
ARCF 2016
Sacramento River Erosion Protection - Contract 1

Basic Assumptions	
CY per Barge[1]	909
CY Imported[3]	23,000
Miles/ hr per barge	5
Extra Empty Trips	2
Total Hrs per Day	10
lbs/ tons	2000
lbs/MT	2204.62

	San Rafael to Rio Vista (in SFNA)	San Rafael to Rio Vista (in BAAQMD)	Rio Vista to Sacramento Erosion
No. of Barge in Tow	4	4	1
Miles (one-way)	10.4	45	40
Total Tow-Hours	**17**	**75**	**218**

	PM10	**PM2.5**	**NOx**	**ROG**	**CO**	**SO2**	**CO2**	**CH4**	**N2O**	**CO2e (MT)**
Two-Engine Push Boat Emissions (lb/hr)	1.45	1.29	35.04	2.09	8.97	0.01	1417.70	0.06	0.01	1422.56
Tug Boat Emissions (lb/hr)	0.37	0.33	8.53	0.54	1.90	0.00	456.06	0.02	0.00	457.63
Total Emissions for Push Boat - In SFNA (Tons)	0.01	0.01	0.30	0.02	0.08	0.00	12.27	0.00	0.00	11.17
Total Emission for Push Boat- In BAAQMD (Tons)[2]	0.05	0.05	1.31	0.08	0.34	0.00	53.11	0.00	0.00	48.35
Total Emissions for Tug Boat - In SFNA (Tons)	0.04	0.04	0.93	0.06	0.21	0.00	49.80	0.00	0.00	45.33
Sum of Emissions in SFNA (Tons)	**0.05**	**0.05**	**1.24**	**0.08**	**0.29**	**0.00**	**62.08**	**0.00**	**0.00**	**56.5**

Notes: [1] https://ihsmarkit.com/country-industry-forecasting.html?ID=106593483 , one barge has the capacity of 1500 tons and assuming 1.65 tons/cy of quarry rock
[2] BAAQMD NOx Threshold is 54 lb/day (Not relevent to General Conformity)
[3] Assuming All Contracts are 1.4 miles long and that 5.32L Reach is only 690 feet long; 10.7 increase in volume

Appendix C: Clean Water Act, Section 404(b)(1) Evaluation

APPENDIX C

Clean Water Act Section 404(b)(1) Evaluation

Introduction

Background

The U.S. Army Corps of Engineers (USACE) proposes to implement flood risk management improvements to the Sacramento River East Levee at river mile 55.2 under the 2016 American River Watershed Common Features General Reevaluation Report (ARCF GRR). The purpose of the ARCF Project is to improve the levee infrastructure to reduce flood risk along the American and Sacramento Rivers. Improvements encompass approximately 22 miles of American River levees, 12 miles of the Sacramento River levee, and 5.5 miles of the Natomas Cross Canal levee in Natomas.

The ARCF GRR Draft and Final Environmental Impact Statement / Environmental Impact Report (EIS/EIR) (USACE 2016) previously analyzed several alternatives and found Alternative 2 to be the preferred alternative. ARCF Water Resources Development Act (WRDA) 2016: Sacramento River, Mile 55.2 Left Bank Protection Project (RM55.2L) (Proposed Action), a component of Alternative 2, includes the installation of bank protection features within the RM 55.2L reach.

Purpose and Need

The Sacramento Metropolitan area is one of the most at risk areas for flooding in the United States. There is a high probability that flows in either the American or Sacramento Rivers will stress the network of levees protecting the Sacramento area to the point that levees could fail. The consequences of such a levee failure could be catastrophic since the area of potential inundation is highly urbanized and the flooding could be up to 20 feet deep.

A Section 404(b)(1) Guidelines analysis first requires determination of the basic purpose of the project, a description of its fundamental function to ascertain whether it is ‘water dependent.’ The basic purpose of the Proposed Action is to reduce flood risk to metropolitan Sacramento. Because this purpose could be achieved by non-structural means that do not involve the levee – such as improved warning systems or improved traffic planning for emergency evacuations - the basic purpose of the project is not water dependent. Consistent with the Guidelines, because the basic purpose of the project is not water dependent, USACE has evaluated alternative locations and designs so as to minimize the potential adverse effects of the project while still achieving the objectives of the project.

According to the Guidelines, the overall project purpose is defined differently than the basic project purpose. The overall project purpose serves to identify alternatives and determine whether the alternatives satisfy USACE’s objectives for the project. The overall purpose of the Proposed Action is to improve existing infrastructure to better protect the large population of the greater Sacramento region from flooding.

Location

The site is located along the east (left) bank of the Sacramento River, in the Little Pocket area of the city of Sacramento, approximately 3 miles downstream of the Pioneer Bridge (Figure 1). The site begins immediately downstream (south) of the Westin Sacramento property and continues downstream approximately 1,150 feet. The Sacramento River is considered a perennial river.

Figure 1. RM 55.2L Bank Protection Project Location.

Range of Alternatives Considered

Alternative 1 - No Action

Under the No Action Alternative, the Proposed Action would not be constructed. As a result, this segment of the levee would remain susceptible to failure due to erosion and would continue to be a weak spot in the system. Levee failure at this location could lead to catastrophic flooding of the Little Pocket area of Sacramento, which includes a number of residences, as well as Interstate 5, a major transportation artery, which is located approximately 0.1 mile away from the levee. Numerous residences and businesses lie within the potential flood inundation area. Damage to infrastructure, utility systems, and commercial and residential interests would be significant. The Sacramento metropolitan area would continue to be subject to an unacceptably high risk of levee failure and subsequent catastrophic flooding. A flood in the Sacramento metropolitan area would have substantial repercussions that would affect the entire State; the national economy; and Federal, State, and local government operations and infrastructure.

Although the No Action Alternative would have no impacts on waters of the U.S. due to construction, it does not meet the project purpose since it does not address the flood risk in the project area, and is, therefore, not retained for evaluation in determining the least environmentally damaging practicable alternatives (LEDPA).

Alternative 2 – Offsite Alternative, Launchable Rock Trench

This measure includes construction of a launchable rock filled trench, designed to deploy once erosion has removed the bank material beneath it (Figure 2). All launchable rock trenches would be constructed outside of the natural river channel. As a result, launchable rock trenches would be above the ordinary high water mark (OHWM) and fill materials would not be placed into waters of the U.S. as part of trench construction. This location would be on the water side of the levee reach at 55.2L but would be higher on the bank and would be outside of the footprint of the Proposed Action, described below.

The vegetation would be removed from the footprint of the trench and the levee slope above the trench prior to excavation of the trench, approximately 0.8 acres (ac). The project construction would be done from the landside. The trench configuration would include a 2:1 landside slope and 1:1 waterside slope and would be excavated at the toe of the existing levee. All soil removed during trench excavation would be stockpiled for reuse or disposal. The bottom of the trench would be constructed close to the summer mean water surface elevation in order to reduce the rock launching distance and amount of rock required.

After excavation, the trench would be filled with riprap that would be imported from an offsite location. After rock placement the trench would be covered with a minimum of 3 feet of the stockpiled soil to allow for planting over the trench. Rock placed on the levee slope would be covered with the stockpiled soil. All disturbed areas would be reseeded with native grasses and small shrubs where appropriate. Some vegetation could be permitted over the trench if planted outside the specified vegetation free zone required by ETL 1110-2-583. This vegetation would likely be limited to native grasses, shrubs, and trees with shallow root systems to ensure that they do not limit the functionality of the trench during a flood event.

This action would result in adverse impacts vegetation and wildlife, visual resources, infrastructure, and water quality. There are numerous trees within the footprint of this alternative that would have to be removed, more trees than the Proposed Action. Over time, as the levee erodes trees would be destabilized and fall down and lead to Shaded Riverine Aquatic (SRA) habitat loss over time therefore, increasing the temperature of the water. This will permanently remove wildlife habitat, namely Swainson's Hawk nesting and bat roosting habitat. The visual resources of the site would be reduced for the residents on the land side of the levee and the recreationalists in the river channel. A pipe to a pump station would have to be replaced as erosion occurs or removed entirely. Water quality would be impacted due to continued erosion at the site. The levee is currently being eroded by fluvial and wave action of the Sacramento River and erosion would continue to occur removing approximately 1 acre of levee surface. Increased sedimentation and turbidity would likely be caused by the rock being launched, as designed. There would be no minimization or mitigation measures in place for this event. This alternative would not be able to be keyed into adjacent levee repair work, this could cause the hydrology and center of flow of the river channel to alter due to the levee being narrowed for 1,150 feet.

This action is considered a practicable alternative and will be retained and evaluated in determining the LEDPA.

Alternative 3 – Onsite Alternative, Bank Protection (Proposed Action)

The Proposed Action is to construct a 1,150-foot waterside rock berm to reduce the risk of levee failure due to erosion and increase slope stability. The Proposed Action includes rock bank protection and a riparian bench. The completed site would be planted with native vegetation to mitigate habitat lost through the construction process. The project footprint is 2.89 ac (at 90% designs). The entire site is below the OHWM (23.25 feet).

The rock bank protection will require the removal of up to 80 trees and may require tree trimming on the lower portion of the waterside slope because construction will occur from a barge in the river. A minimum of 2.5 feet thick layer of soil filled quarry stone (Class C) will be placed between 7 feet and 22 feet on the levee slope elevation. The planting bench will be at 7 feet on the levee slope. The top of the lower quarry stone (Class C) slope would begin at elevation 7 feet (NAVD88) and extend to the bottom of the channel. This bank protection measures includes a self-launching rock of an adequate volume to provide toe protection up to a maximum scour depth of 18 feet. A thickness of 5 feet was recommended for the launchable riprap toe design to provide erosion protection, bank stability, support the riparian bench, and launch rock for toe scour.

The bank protection design incorporates a low elevation bench into the channel along the length of the site. The bench is composed of a planting bench soil mix on Class C quarry stone that provides a surface that can support vegetation. The toe of the planting bench would set at an elevation of 7 feet and would slope upward at a 20H:1V slope towards upper quarry stone revetment. The 7-foot elevation is the average water surface elevation at the project site during the months of August, September, and October over a 67-year period of record (1948-2015). The landside edge of the bench would be approximately 2 feet higher than the river edge so that the bench will support a variety of native plant species. Plantings will consist of native species found in Central Valley riparian forests.

The general description of fill material, discharge site, and disposal method for the Proposed Action, is more specific than that for the project alternatives evaluated in 2015. This is a consequence of the Proposed Action having a more developed design than the project alternatives evaluated in 2015.

Adverse impacts to aquatic resources, such as fisheries, water quality, and SRA would be short term and less than significant. After construction is complete, sedimentation and turbidity levels would return to post construction conditions. Overtime, sediment will fill the spaces between the quarry stone and improve water quality by reducing sedimentation. As the sediment fills the quarry stone, habitat for bentic macroinvertebrates will be created. The planting bench will be maintained according to the Long Term Management Plan to ensure success of the revegetation of the site to provide habitat for fish, wildlife species, and maintain the water quality. The long term impact to the site would be a decrease in the overall tree and shrub density which will be reduced to the planting bench (0.22 acres).

This action is considered a practicable alternative and will be retained and evaluated in determining the LEDPA.

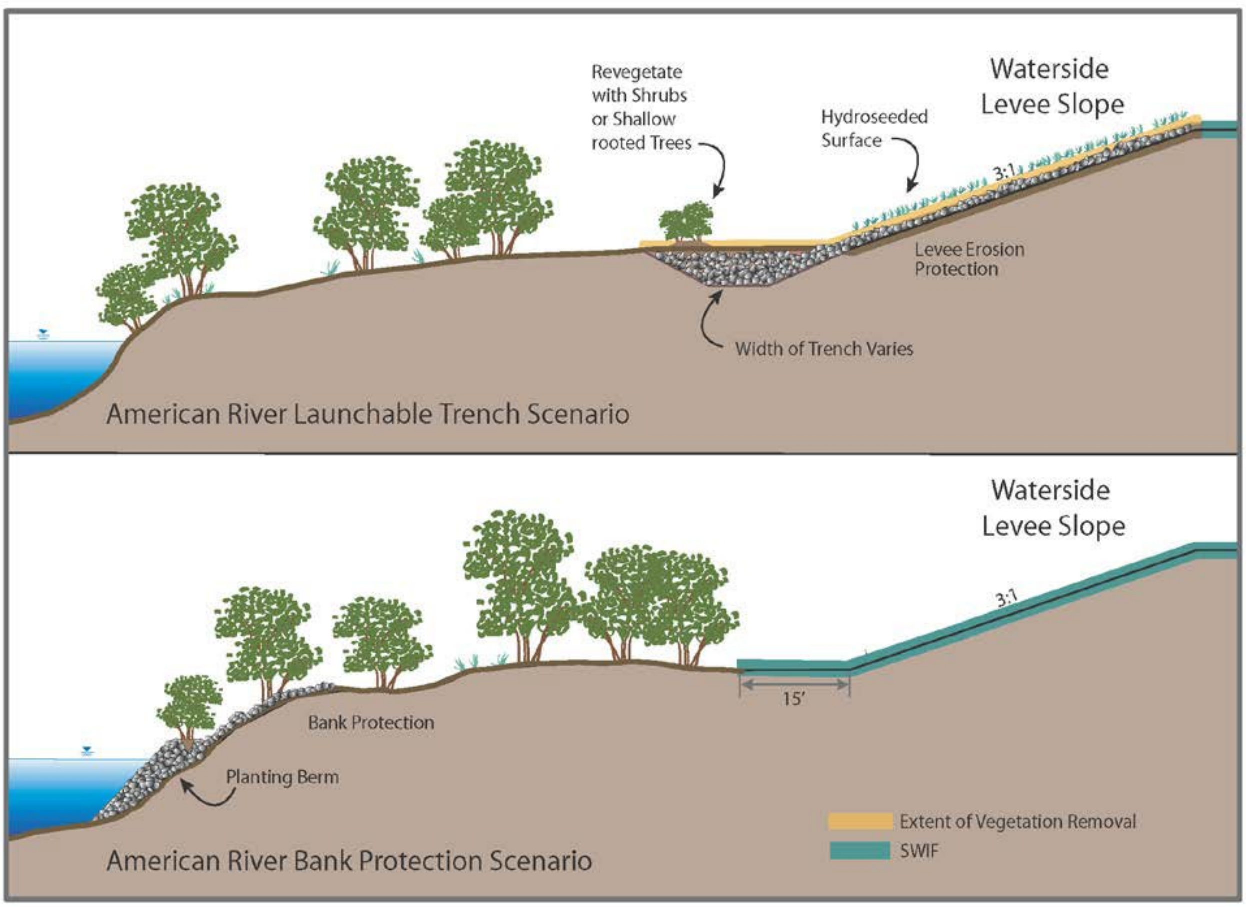

Figure 2. Bank Protection Measures Typical Design.

Alternatives Analysis

When the offsite alternative and onsite alternative were compared, the Proposed Action is the LEDPA and was selected.

The offsite alternative does not include work below the OHWM and would have adverse impacts on vegetation and wildlife, visual resources, infrastructure, and water quality. The impacts from the off-site alternative would be greater than the on-site alternative because of long-term impacts through the gradual loss of SRA, wildlife habitat, and the visual resources. Also the continued sedimentation into the river channel would culminate in a sudden launch of rock below the OHWM which would decrease the water quality without the ability to minimize or mitigate for those impacts.

The onsite alternative is considered the LEDPA because of the adverse impacts that would affect federally listed fishes, SRA, water quality, and benthic marcoinverterbrates would be short-term and have avoidance, minimization, and mitigation measures implemented to reduce the impacts to less than significant. The impacts would be less-than-significant in the long term with mitigation measures as well. Over the life span of the bank protection, 50 years, there would be a natural erosion and migration of fill occurring at the site; however, it would occur at a slightly slower rate than natural conditions if no bank protection were in place or if the offsite alternative was constructed. Riprap established along the waterside levee toe is designed to stay in place and prevent further erosion. Therefore, this alternative would not decrease water quality due to falling rocks.

Bank Protection Measures

The Proposed Action is part of the ARCF Project, therefore the basis of this consistency analysis is an evaluation of the consistency of the Proposed Action with the determinations of the 2015 404(b)(1) evaluation and the applicability of the findings of the 2015 404(b)(1) evaluation to the Proposed Action. The source materials are:

- USACE (2015) *Draft Section 404(b)(1) Water Quality Evaluation American River Common Features General Reevaluation Report*. Appendix E in USACE (2016) American River Watershed General Reevaluation Report, Final Environmental Impact Statement / Environmental Impact Report. December. Sacramento, California. State Clearing House Number 2005072046.

- USACE (2020) *American River Watershed Common Features WRDA 2016: Sacramento River, Mile 55.2 Left Bank Protection Project Draft Supplemental Environmental Assessment/Environmental Impact Report*. Sacramento, California. State Clearinghouse Number 2005072046.

Various measures to provide bank protection, which would result in various impacts, include: bioengineered techniques, reducing footprint, rock slope protections, and a combination of measures.

Bioengineered techniques, such as live siltation and rolled erosion control product, are not sufficient to provide the bank protection and roughness required due to the high current velocities in the Sacramento River. Roughness is the measure of a material’s resistance to the flow of water on the stream channel margins. The applicable project standard is to provide bank protection engineered to withstand a 200 year flood event. *This is consistent with the 2015 404(b)(1) evaluation.*

The footprint of the site has been reduced as much as possible while designing sufficient bank protection to withstand a 200 year flood event and tie in with adjacent levee reaches. The OHWM is at 23.25 feet on the levee slope, starting at 22 feet, the current upland vegetation provides adequate roughness to withstand modeled shear stresses of the design flow magnitude for the remaining 1.25 foot of levee above the rock placement. According to field observations and river surface comparisons between 2008 and 2018 completed by CBEC (a consultant firm), no erosion has occurred on the upland bench above 22 feet. Additional rocks at the upstream and downstream of the site are needed to tie in the rocks to stable ground. *This is consistent with the 2015 404(b)(1) evaluation.*

Rock slope protection is designed to provide roughness to the levee to withstand modeled shear stresses of the design flow magnitude. The minimum required toe protection below the planting bench is 5-feet thick with Class C quarry stone (18 – 36 inches large). Soil filled quarry stone will be used on the levee slope above the planting bench. Rock sizing and layer thickness are based on EM 1110-2-1601. Up to 25, 210 cubic yards (cy) of quarry stone will be needed for the project. The material would be imported from a licensed, permitted facility that meets all Federal and State standards and requirements. The material would be transported to the project site via river barge hauling. *This is consistent with the 2015 404(b)(1) evaluation.*

A combination of measures are being used to reduce impacts to water quality. The use of the quarry stone bank protection will allow for sediment traveling downstream to get trapped in the interstices between rocks. The planting bench incorporated into the levee design will be planted with native vegetation like willows and cottonwood and in-stream woody material will aid in shading the water for temperature control and as fish enhancement. *This is consistent with the 2015 404(b)(1) evaluation.*

<u>Comparisons</u>

Aquatic resources to be affected by the Proposed Action include shaded riverine aquatic habitat and shallow water habitat. Up to 80 trees would be removed from the water side levee and some trees may need to be trimmed, for a total loss of 1.258 canopy acreage (ac) of SRA. On site mitigation will account for .22 ac, the remaining acreage will be mitigated for offsite and be consistent with USFWS recommendations, to the extent possible. The total area of disturbance is 2.89 ac (at 90% designs). In water work accounts for 2.22 ac (surface area of launch rock) or 96,703square feet (sf). *This is consistent with the 2015 404(b)(1) evaluation.*

Fish, wildlife, and sensitive species and their habitats would be impacted by the Proposed Action (sensitive species are discussed in the following paragraph). A variety of fish and wildlife occur within the project footprint, including, Pacific lamprey (*Entosphenus tridentatus*), Sacramento splittail (*Pogonichthys macrolepidotus*), rainbow trout (*Oncorhynchus mykiss*), Wood Duck (*Aix sponsa*), Common Merganser (*Mergus merganser*), and American Kestrel (*Falco sparverius*). The implementation of mitigation measures and onsite mitigation would reduce the long term impacts to fish and wildlife to less than significant. There would be significant and unavoidable impacts to vegetation and wildlife in the short term. *This is consistent with the 2015 404(b)(1) evaluation.*

Sensitive species found in the project area would be affected by the Proposed Action. Species found within the project footprint that are federally listed under the Endangered Species Act include: delta smelt (*Hypomesus transpacificus*), green sturgeon (*Acipenser medirostris*) southern distinct population segment (sDPS), Sacramento River winter-run and Central Valley (CV) spring- and fall-runs Chinook salmon (*Oncorhynchus tshawytscha*), and CV distinct population segment (DPS) steelhead (*O. mykiss*). Species found within the project footprint that are listed within the State as rare, under the California Endangered Species Act, or as a Fully Protected species include: Swainson's Hawk (*Buteo swainsoni*), White-tailed Kite (*Elanus leucurus*), pallid bat (*Antrozous pallidus*), western red bat (*Lasiurus blossevillii*), Sanford's arrowhead (*Sagittaria sanfordii*), and wooly rose-mallow (*Hibisus lasicocarpos*). Onsite mitigation of SRA and shallow water habitat will compensate for some impacts to listed species. Shallow water habitat, for salmonids would be mitigated partially onsite with the riparian planting bench. 0.22 acres of delta smelt impacts would mitigated for with the onsite planting bench to replace SRA. Mitigation measures and Best Management Practices (BMPs) will be implemented to protect sensitive species to reduce impacts to less than significant in the short and long term. *This is consistent with the 2015 404(b)(1) evaluation.*

The Proposed Action is fully funded. This action is part of the American River Common Features Project which was included in the FY18 Bipartisan Budget Act (P.L.115-123) which funded $1.56B of the remaining design and construction efforts (full first cost). Receipt of full-funding accelerated project execution substantially and reduced the overall timeline to five years, with a targeted completion of all flood risk reduction features by January 2023. The construction schedule has construction of RM 55.2 improvements to be completed in 2021.

Logistically, there are no major encumbrances to completing the work. Local ordinances and real estate are not an issue for this site. Two docks that were going to be temporarily removed to accommodate construction were permanently removed by the Non-federal sponsors. A 24-inch pipe will be protected-in-place during construction.

Bank protection designs are specifically designed for individual erosion sites. Therefore, techniques used at other bank protection sites may not reduce the footprint while providing the required bank protection. Revegetation within the planting bench conforms to EP 1110-2-18 which provides guidelines to ensure that landscape planting and vegetation management provide aesthetic and environmental benefits without compromising the reliability of levees, floodwalls, embankment dams, and appurtenant structures. *This is consistent with the 2015 404(b)(1) evaluation.*

Other Considerations

The contractor is responsible for selecting a disposal site located outside the construction limits. This disposal site must have current permits for operation, meet the required environmental standards, and be approved in writing by the Corps. *This is consistent with the 2015 404(b)(1) evaluation.*

A 65% design hydraulic analysis was conducted. Erosion design and scour analysis were based on the output of the 2D HEC-RAS model for 1/325 Annual Exceedance Probability (AEP) which is the American River Common Features Design maximum flow for Sacramento River when 160,000 cubic feet per second is released from Folsom Dam on the Lower American River. The 2-Dimensional Hydraulic Engineering Center's River Analysis System (2D HEC-RAS) hydraulic model shows that adding rocks on the left back will not cause erosion on the right bank. The tree scour analysis is based on HEC-18 and computed the scour depth at 8 feet. The maximum toe scour depth is 18 feet for 1/325 AEP.

Placement of rock revetment along the riverbank below the OHWM would temporarily generate increased turbidity in the vicinity of the construction area. Additionally, placement of revetment could result in temporary sediment plumes, generated from the river bottom and levee side. The use of barges to install the revetment could cause additional turbidity in the immediate vicinity of the project. Turbidity curtains would be put in place before in-water construction begins. This would reduce the amount of suspended particulate and reduce turbidity. This mitigation measure would reduce impacts to water quality, fish, and downstream environments. After construction is complete reduced turbidity in the area may be noted because less exposed soil would erode and deposit into the river and overtime the spaces between the quarry stone would trap sediment. *This is consistent with the 2015 404(b)(1) evaluation.*

The Sacramento River at mile 55.2 consists of a sandy/silty bottom which has benthic marcoinverterbrates. The placement of rock under the OHWM would extend to the river bottom and cause temporary impacts to the river bottom. After the project is complete, the spaces between quarry stones would capture sediment traveling downstream, improving the water quality over time. Native benthic organisms would be expected to recolonize the area. *This is consistent with the 2015 404(b)(1) evaluation.*

To comply with water quality standards, prior to construction, the contractor would be required to prepare and implement a SWPPP and would obtain a National Pollution Discharge Elimination System permit (CWA 402), as applicable, and comply with all conditions of the permit. This plan would detail the construction activities to take place, BMPs to be implemented to prevent any discharges of contaminated stormwater into waterways, and inspection and monitoring activities that would be conducted. The placement of material below the OHWM requires compliance with Section 401 of the Federal Clean Water Act as amended, 33 USC 1251, et seq, prior to the start of construction. The American River Common Features project is located within the Central Valley Regional Water Quality Control Board's jurisdiction and is subject to the Basin Plan. The proposed project would implement BMPs to ensure that it will not violate State water quality standards identified in the Basin Plan. *This is consistent with the 2015 404(b)(1) evaluation.*

Appendix D: Public Involvement

INTRODUCTION

This Appendix provides responses to public and agency comments on the American River Watershed Common Features 2016 Project, Sacramento River Erosion Contract 1: River Mile 55.2L Left Bank Protection Draft Environmental Assessment/Environmental Impact Report (SEA/EIR) received during the public comment period.

PUBLIC COMMENT SUMMARY

The Draft SEA/EIR was posted with the State Clearinghouse (SCH # 2020070269) on July 13, 2020. The Draft SEA/EIR was circulated for 47 days for review by Federal, State, and Local agencies, organizations, and members of the public from July 11, 2020, through August 26, 2020. The Notice of Availability was published in the Sacramento Bee on July 16, 2020. The Draft SEA/EIR was made available on the Sacramento District, U.S. Army Corps of Engineers (USACE) website, sacleveeupgrades.com, and on the Central Valley Flood Protection Board (CVFPB) website. Hard copies of the Draft SEA/EIR were made available upon request.

USACE posted information about the Proposed Action on its website at www.sacleveeupgrades.com, which included summarized information on the Proposed Action, an electronic copy of the Draft SEA/EIR, a Frequently Asked Questions document, and instructions as to how to participate in the virtual public meeting. A virtual public meeting was held on July 27, 2020, to provide additional opportunities for comments on the Draft SEA/EIR. All comments received during the public review period were considered and incorporated into the Final SEA/EIR as appropriate.

Instead of holding the usual in-person meeting to take comments, due the restrictions on meeting sizes and health concerns during the COVID-19 pandemic, a virtual public meeting was held using WebEx software. During the virtual public meeting, attendees could utilize the chat function to ask questions or send comments to the meeting moderator. Meeting attendees were also given an opportunity to voice comments at the end of the presentation directly over the phone or through WebEx software. During the virtual public meeting, several clarifying questions were asked by members of the public regarding the project, impacts, and other ARCF projects. No comments were received during the public meeting. In addition to the virtual public meeting, comments could be submitted through mail or electronic mail.

During the Draft SEA/EIR public review period, written comments were submitted in letters and one email. The comments were submitted by the following commenters:

- (2) State agencies
- (1) Local/regional agencies
- (1) Non-profit
- (1) private citizen/company

COMMENTS AND RESPONSES

The following pages include all public comments received and the responses to those comments. The responses are annotated to refer back to the corresponding letters and comments that precede them.

DEPARTMENT OF TRANSPORTATION
DISTRICT 3
PLANNING DIVISION
703 B Street, MS-4130
Marysville CA 95901
PHONE (530) 634-7616
www.dot.ca.gov
TTY 711
www.dot.ca.gov

Making Conservation
a California Way of Life.

August 19, 2020

GTS# 03-SAC-2020-00723

Miles Claret
Department of Water Resources
3464 El Camino Avenue Room 150
Sacramento, CA 95821

Notice of Availability of Draft Supplemental Environmental Assessment/Environmental Impact Report for American River Watershed Common Features, Water Resources Development Act of 2016, Sacramento River Erosion Contract 1: River Mile 55.2 Left Bank Protection Project

Dear Mr. Claret,

Thank you for including the California Department of Transportation (Caltrans) in the review process for the project referenced above. Caltrans' new mission, vision, and goals signal a modernization of our approach to California's transportation system. We review this local development for impacts to the State Highway System (SHS) in keeping with our mission, vision, and goals for sustainability/livability/economy, and safety/health. We provide these comments consistent with the State's smart mobility goals that support a vibrant economy, and build communities, not sprawl.

Project Description

The Project proposes to construct an approximately 1,150-foot-long bank protection along the Sacramento River. The Project is located along the left bank (when facing downstream) of the Sacramento River just south of The Westin Sacramento in the Little Pocket area of the City of Sacramento. The following comments are based on the Notice of Availability of a Draft Supplemental Environmental Assessment and Environmental Impact Report provided:

Traffic Operations

The Project is proposing to utilize the Interstate 5 (I-5) interchange (IC) at Seamas Avenue for construction access with approximately 100 trailer truck round trips for transporting construction materials and equipment to this vicinity. The same approximate number of truck round trips will also be needed to remove construction materials and equipment after the work is completed.

The Seamas Avenue IC is a short-diamond type interchange with traffic signals controlling both ramp intersections. This segment of I-5 has 4-lanes in each direction on a horizontal curve layout that has recurring mainline congestion during the AM period. Currently, there is an ongoing construction project on I-5, from Hood-Franklin to I-80, that includes adding HOV (High Occupancy Vehicle) median lanes and other operational and multimodal improvements.

A-1 It is recommended that the Project's project manager coordinate with Caltrans District 3 Construction for interchange closure during the HOVL project. Currently, the mainline geometry had been reconfigured at this location and delineated with narrower lanes. The Caltrans project may also find it necessary to close portions of the Seamas Avenue IC during construction.

Please provide our office with copies of any further actions regarding the Project. We would appreciate the opportunity to review and comment on any changes related to this development. If you have any questions regarding these comments or require additional information, please contact Benjamin Garcia, Intergovernmental Review Coordinator, at (530) 741-4543 or by Benjamin.Garcia@dot.ca.gov.

Sincerely,

Alexander Fong

Alex Fong
Acting Branch Chief, Transportation Planning - South
Planning, Local Assistance, and Sustainability
California Department of Transportation, District 3

DELTA STEWARDSHIP COUNCIL
A California State Agency

980 NINTH STREET, SUITE 1500
SACRAMENTO, CALIFORNIA 95814
HTTP://DELTACOUNCIL.CA.GOV
(916) 445-5511

August 21, 2020

Miles Claret
California Department of Water Resources
Division of Flood Management
3464 El Camino Avenue Room 150
Sacramento CA 95821

Sent via email to: PublicCommentARCF16@water.ca.gov

RE: Comments on Draft Supplemental Environmental Assessment/Environmental Impact Report for American River Watershed Common Features, Water Resources Development Act of 2016, Sacramento River Erosion Contract 1: River Mile 55.2 Left Bank Protection Project

Dear Mr. Claret:

The Delta Stewardship Council (Council) appreciates the opportunity to comment on the American River Watershed Common Features, Water Resources Development Act of 2016 Project, Sacramento River Erosion Contract 1: River Mile 55.2 Left Bank Protection Project (Project) Draft Supplemental Environmental Assessment/Supplemental Environmental Impact Report (Draft Supplemental EA/EIR). The Project proposes to construct approximately 1,150-foot-long bank protection measures along the Sacramento River near the Little Pocket neighborhood. The Project will repair an erosion site, restoring structural stability and ensuring future levee integrity (Draft Supplemental EA/EIR p.9). The Project will also include an ecosystem restoration component in the form of a planted waterside bench. The levee system reduces risk and provides flood protection for the City of Sacramento.

Most of the levee improvements included in the Project were analyzed in the American River Watershed Common Features General Reevaluation Report (ARCF GRR) Environmental Impact Statement/Environmental Impact Report (EIS/EIR). The Draft Supplemental EA/EIR addresses project modifications and refinements since publication of the ARCF GRR EIS/EIR.

The Council previously submitted comments to the Central Valley Flood Protection Board (Flood Board) on the ARCF GRR EIS/EIR (see **Attachment 1**). That comment letter explained the Council's regulatory authority under the Sacramento-San Joaquin Delta Reform Act of 2009 (SBX7 1; Delta Reform Act (Wat. Code, § 85000 et seq.)); identified Water Code section 85225 requirements for the Flood Board to determine whether the Project is a covered action and, if so, file a certification of consistency with the Council before implementing the Project; and identified Delta Plan regulatory policies that would be potentially implicated by the Project.

Council staff appreciated the opportunity to discuss this Project and the covered action process with you and other project partners from the U.S. Army Corps of Engineers and Sacramento Area Flood Control Agency at a July 30, 2020 early consultation meeting for this Project. Early consultation represents a critical step in the process for determination of consistency with the Delta Plan for covered actions; it also provides a state or local public agency the opportunity to discuss the Project's possible impacts on and benefits to the coequal goals, the Council's regulatory processes, and implementation of the Delta Plan (including adaptive management plans and use of best available science).

Covered Action Determination and Certification of Consistency with the Delta Plan

As explained in the Council's comment letter on the ARCF GRR Draft EIS/EIR and noted in the Draft Supplemental EA/EIR (page 96), the Project appears to meet the definition of a covered action. As defined in Water Code section 85057.5 subdivision (a), a covered action is a plan, program, or project as defined in Public Resources Code section 21065 that meets all of the following conditions:

1. Will occur in whole or in part within the boundaries of the Delta (Wat. Code, § 12220) or Suisun Marsh (Pub. Resources Code, § 29101). *The Project would occur in part within the boundaries of the Delta.*
2. Will be carried out, approved, or funded by the State or a local public agency. *The Project would be approved by the Flood Board, which is a State agency.*
3. Will have a significant impact on the achievement of one or both of the coequal goals or the implementation of a government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta. *The Project would have a significant impact on the implementation of a government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta.*
4. Is covered by one or more of the regulatory policies contained in the Delta Plan (*Cal. Code Regs.,* tit. 23, §§ 5003-5015). *Delta Plan regulatory policies that may apply to the Project, as well as resulting site selection and implementation within the Delta, are discussed below.*

The State or local agency approving, funding, or carrying out a plan, program, or project must make a reasonable, good faith determination, consistent with the Delta Reform Act and Delta Plan regulatory policies, whether the plan, program, and/or project is a covered action and, if so, submit a certification of consistency with the Delta Plan to the Council prior to project implementation (Wat. Code, § 85225; Cal. Code Regs., tit. 23, § 5001(j)(3).) As described in Water Code, sections 85225.10 through 85225.25, the certification of consistency may be appealed to the Council.

Comments Regarding Delta Plan Policies and Potential Consistency Certification

The following section describes the Delta Plan regulatory policies that may apply to the Project. The Council offers this information to assist the Flood Board to prepare a certification of consistency for the Project.

General Policy 1: Detailed Findings to Establish Consistency with the Delta Plan

Delta Plan Policy **G P1** (Cal. Code Regs., tit. 23, § 5002) specifies what must be addressed in a certification of consistency by a state or local public agency for a plan, program, or project that is a covered action. This policy applies only after a proposed action has been determined by the agency to be a covered action because one or more of the Delta Plan regulatory policies (Cal. Code Regs., tit. 23, §§ 5003-5015) is implicated. The following policy requirements under G P1 may apply to the Project:

Mitigation Measures

Delta Plan Policy **G P1(b)(2)** (Cal. Code Regs., tit. 23, § 5002(b)(2)) requires that covered actions not exempt from the California Environmental Quality Act (CEQA) must include all applicable feasible mitigation measures adopted and incorporated into the Delta Plan as amended April 28, 2018 (unless the measure(s) are within the exclusive jurisdiction of an agency other than the agency that files the certification of consistency), or substitute mitigation measures that the agency that files the certification of consistency finds are equally or more effective. Mitigation measures in the Delta Plan's Mitigation Monitoring and Reporting Program (MMRP, Appendix O to the Delta Plan) are available at https://deltacouncil.ca.gov/pdf/delta-plan/2018-appendix-o-mitigation-monitoring-and-reporting-program.pdf.

B-1 The Draft Supplemental EA/EIR identifies significant impacts that require mitigation for visual resources, air quality, vegetation and wildlife, special status species, climate change, cultural resources, geological resources, hazardous wastes and materials, water quality and groundwater resources, noise, and recreation. The Flood Board should review Delta Plan Appendix O and ensure that the Final Supplemental EA/EIR includes all applicable feasible mitigation measures adopted and incorporated into the Delta Plan or identifies substitute mitigation measures that the agency finds are equally or more effective.

Best Available Science

Delta Plan Policy **G P1(b)(3)** (Cal. Code Regs., tit. 23, § 5002(b)(3)) states that actions subject to Delta Plan regulations must document use of best available science as relevant to the purpose and nature of the project. The Delta Plan defines best available science as “the best scientific information and data for informing management and policy decisions.” (Cal. Code Regs, tit. 23, § 5001(f).) Best available science is also required to be consistent with the guidelines and criteria in Appendix 1A of the Delta Plan (https://deltacouncil.ca.gov/pdf/delta-plan/2015-appendix-1a.pdf).

B-2 In the Final Supplemental EA/EIS, the Flood Board should include references to scientific papers or reports that support the use of best available science, as relevant, and discuss the design of in-stream woody material and planting benches to provide fish habitat.

Adaptive Management
Delta Plan Policy **G P1(b)(4)** (Cal. Code Regs., tit. 23, § 5002(b)(4)) requires that ecosystem restoration and water management covered actions include adequate provisions for continued implementation of adaptive management, appropriate to the scope of the action. This requirement is satisfied through 1) the development of an adaptive management plan that is consistent with the framework described in Appendix 1B of the Delta Plan (https://deltacouncil.ca.gov/pdf/delta-plan/2015-appendix-1b.pdf); and 2) documentation of adequate resources to implement the proposed adaptive management plan.

B-3 Adaptive management may be required for the Project given its ecosystem restoration component of a planted waterside bench (Draft Supplemental EA/EIR p.12). An adaptive management plan consistent with the framework referenced above will be required as part of a certification of consistency with the Delta Plan for the Project. Council staff in the Delta Science Program are available to provide early consultation on adaptive management upon request.

Ecosystem Restoration Policy 2: Restore Habitats at Appropriate Elevations

The Council’s comments on the Draft ARCF GRR EIS/EIR highlighted Delta Plan Policy **ER P2** (Cal. Code Regs., tit. 23, § 5006), which requires that habitat restoration must be consistent with Appendix 3 of the Delta Plan (available within Appendix B: https://deltacouncil.ca.gov/pdf/delta-plan/2013-appendix-b-combined.pdf). The elevation map included as Figure 4-6 (https://deltacouncil.ca.gov/pdf/delta-plan/figure-4-6-habitat-types-based-on-elevation.pdf) and Appendix 4 of the Delta Plan should be used as a guide for determining appropriate habitat restoration actions based on an area’s elevation. The Project includes a habitat restoration component of a planted waterside bench. The Flood Board should include information in the Final Supplemental EA/EIS that explains how the Project is an appropriate habitat restoration action considering the site elevation and projected sea level rise and anticipated changes in inflows.

B-4

Ecosystem Restoration Policy 4: Expand Floodplains and Riparian Habitats in Levee Projects

The Council's comments on the Draft ARCF GRR EIS/EIR highlighted Delta Plan Policy **ER P4** (Cal. Code Regs., tit. 23, § 5008), which requires levee projects to evaluate and, where feasible incorporate, alternatives to increase floodplains and riparian habitats. The policy also requires the evaluation of setback levees in several areas of the Delta, including urban levee improvement projects in the City of Sacramento, as shown in Appendix 8 to the Delta Plan. Delta Plan combined regulatory appendices are available online at https://deltacouncil.ca.gov/pdf/delta-plan/2013-appendix-b-combined.pdf. The Flood Board should consider including information in the Final Supplemental EA/EIR documenting how the Flood Board evaluated the feasibility of incorporating floodplain and riparian habitats into the
B-5 design and construction of the Project, including consideration of setback levees, where feasible.

The Flood Board should also include information in the Final Supplemental EA/EIR that explains and substantiates how other alternatives that would increase riparian habitats were evaluated and incorporated, where feasible.

Ecosystem Restoration Policy 5: Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species

Delta Plan Policy **ER P5** (Cal. Code Regs., tit. 23, § 5009) requires that covered actions fully consider and avoid or mitigate the potential for new introductions of, or improved habitat conditions for, nonnative invasive species, striped bass, and bass.

The Flood Board should consider including information in the Final Supplemental EA/EIR that explains how the Project would implement invasive non-native species mitigation measures,
B-6 that are equally or more effective than Delta Plan Mitigation Measure 4-1 (available at: https://deltacouncil.ca.gov/pdf/delta-plan/2018-appendix-o-mitigation-monitoring-and-reporting-program.pdf). The future certification of consistency for the Project should identify evidence in the record that the Flood Board has fully considered and avoided or mitigated improved habitat conditions for invasive, nonnative fish species.

Delta as Place Policy 2: Respect Local Land Use when Siting Water or Flood Facilities or Restoring Habitats

Delta Plan Policy **DP P2** (Cal. Code Regs., tit. 23, § 5011) reflects one of the Delta Plan's charges to protect the Delta as an evolving place by siting project improvements/facilities to avoid or reduce conflicts with existing or planned future land uses when feasible. Independent from state law related to local land use authority and CEQA requirements, DP P2 is a directive to state and local public agencies proposing covered actions, and it specifically requires flood management infrastructure to be sited to avoid or reduce conflicts with existing uses or those uses described or depicted in city and county general plans for their jurisdictions or spheres of influence when feasible, considering comments from local agencies and the Delta Protection Commission.

B-7 The Draft Supplemental EA/EIR identifies a variety of significant impacts to existing uses that could result from the Project, including temporary impacts on visual character and temporary and short-term recreational opportunities during construction, and vegetation removal. The Flood Board should consider including in the Final Supplemental EA/EIR information showing how the specific proposed flood management infrastructure, as well as rights-of-way, staging areas, borrow disposal areas, and other facilities supporting the Project would be sited to avoid or reduce these impacts.

Risk Reduction Policy 1: Prioritization of State Investments in Delta Levees and Risk Reduction

B-8 Delta Plan Policy **RR P1** (Cal. Code Regs., tit. 23, § 5012) calls for the prioritization of State investments in Delta flood risk management, including levee operation, maintenance and improvements. Delta Plan Policy RR P1 includes three high-level goals that are to be implemented across three benefit analysis categories. For the Project, Goal 1, *Protect existing urban and adjacent urbanizing areas by providing 200-year flood protection*, is particularly relevant. The Flood Board should consider including information in the Final Supplemental EA/EIR how the Project meets the priorities identified under RR P1.

In addition, as part of the Delta Levees Investment Strategy (DLIS), the Council is currently working to update the investment priorities set forth in RR P1. This process is currently anticipated to be completed in 2021-2022. In the interim, the priorities described under RR P1 remain in effect.

CEQA Regulatory Setting

B-9 For each resource section in which a Delta Plan policy is applicable, the Final Supplemental EA/EIR regulatory setting should describe the Delta Plan and reference specific applicable regulatory policies.

<u>Conclusion</u>

B-10 As the Flood Board has determined that the Project is a covered action (Draft Supplemental EA/EIR p. 96), the Flood Board should submit a certification of consistency with the Delta Plan to the Council. We encourage the Flood Board to continue to engage in early consultation with Council staff prior to developing and submitting a certification of consistency for the Project. Please contact Erin Mullin at Erin.Mullin@deltacouncil.ca.gov with any questions.

Sincerely,

Jeff Henderson, AICP
Deputy Executive Officer
Delta Stewardship Council

August 4, 2020

SENT VIA EMAIL

Mr. Miles Claret
Department of Water Resources
3464 El Camino Avenue, Room 150
Sacramento, CA 95821

U.S. Army Corps of Engineers
Sacramento District
1325 J Street, Room 1513
Sacramento, CA 95814

Draft Supplemental Environmental Assessment / Environmental Impact Report for the American River Watershed Common Features, Water Resources Development Act of 2016 Project, Sacramento River Erosion Contract 1: River Mile 55.2 Left Bank Protection (SAC201301442)

Dear Mr. Claret and U.S. Army Corps of Engineers:

Thank you for providing the Draft Supplemental Environmental Assessment / Environmental Impact Report (DSEA/EIR) for the American River Watershed Common Features, Water Resources Development Act of 2016 Project, Sacramento River Erosion Contract 1: River Mile 55.2 Left Bank Protection project to the Sacramento Metropolitan Air Quality Management District (Sac Metro Air District) for review. Sac Metro Air District staff comments follow.

C-1

The Air Quality Avoidance, Minimization, and Mitigation Measures section, pages 44-45, describes that "marine engine standards identified in the ARCF GRR EIS/EIR are not being applied to the activities included in the Proposed Action due to concerns about the availability of Tier 2 and 3 marine engines." The proposal is to include a mitigation fee payment in lieu of the marine engine standards. Sac Metro Air District recommends that all feasible on-site mitigation be included prior to using the mitigation fee option. On-site mitigation is preferred to reduce potential impacts to the neighboring communities. The Army Corps should include the marine engine standards as a mitigation measure for the project and determine through the bid/contracting process if Tier 2 and 3 marine engines are not available. If the selected contractor provides supporting documentation that Tier 2 and 3 marine engines are not feasible or available, the fee payment could then be used as an alternative mitigation measure.

Please contact me at 916-874-4881 or khuss@airquality.org if you have any questions regarding the Sac Metro Air District's recommendation.

Sincerely,

Karen Huss

Karen Huss
Associate Air Quality Planner/Analyst

Cc: Paul Philley, AICP, Sac Metro Air District
Kimberly Watts, U.S. Army Corps of Engineers

PO Box 1526 • Sacramento, CA • 95812
(916) 444-0022

August 26, 2020

Miles Claret
Department of Water Resources
3464 El Camino Avenue, Room 150
Sacramento, CA 95821
Email: PublicCommentARCF16@water.ca.gov

Public Affairs Office
US Army Corps of Engineers
1325 J Street, Room 1513
Sacramento, CA 95814
Email: spk-pao@usace.army.mil

RE: Draft Supplemental EA/EIR for the American River Watershed Common Features, Water Resources Development Act of 2016, Sacramento River Erosion Contract 1: River Mile 55.2 Left Bank Protection Project

Dear Madams and Sirs:

The following paragraphs constitute the comments of ECOS and its conservation arm, Habitat 2020 regarding the above referenced, compactly-titled project. ECOS is a coalition of environmental and social organizations working for social equity, public health and environmental sustainability in the Sacramento region, through land use planning, transportation planning, and habitat and agricultural preservation. Habitat 2020 is the conservation committee of ECOS whose members include the Audubon Society, California Native Plant Society, Friends of Swainson's Hawk, Save the American River Association, Save Our Sandhill Cranes, the Sierra Club, Stone Lakes National Wildlife Refuge Association, the Sacramento Area Creeks Council, International Dark Skies Assoc Sacramento Chapter, and Sacramento Heron and Egret Rescue.

The following changes to the mitigation measure and accompanying narrative are necessary to comply with CEQA.

D-1 1. <u>Strengthen Commitment Language in Mitigation Measures by Changing "Would" to "Must"</u>

The mitigation measures are worded in the conditional tense using the word "would." The word, "would" is a past-tense form of "will". It is also a conditional verb that indicates an action that would happen under certain conditions. Neither of these meanings is applicable as an action verb for mitigation measures under CEQA.

More importantly, “would” does not reflect a requirement that the Corps must carry out the specified mitigation measures.

All mitigation measures using the word would as the action verb must be replaced by the word “**must**”.

D-2 2. The Project fails to acknowledge and mitigate for all impacts on the Swainson’s Hawk, listed as threatened under the California Endangered Species Act

The project would undoubtedly reduce nesting habitat for Swainson’s Hawks and other protected raptor species, but the Supplemental EA/EIR does not quantify nor mitigate for that loss. The Sacramento River is a prime location for nesting Swainson’s Hawk and any removal of nesting habitat there is significant and requires mitigation at nearby permanently protected locations containing nesting habitat (tall trees). Trees that qualify for nesting sites take decades to grow so planting trees somewhere else does not address the loss.

The Sacramento River is a prime location for nesting Swainson’s Hawk and any removal of nesting habitat along the river is significant and requires mitigation at nearby permanently protected locations.

Last paragraph page 26, fourth sentence: There is no reason that with careful planning tree removal associated with the project could not occur outside of nesting season. The phrase “To the extent practical” is not necessary and should be stricken.

D-3 3. Narrow the Geographic Scope of Mitigation Measure SRA-1

With respect to Mitigation Measure SRA-1: Implement Measures to Avoid, Minimize, and Compensate for Effects on Shaded Riverine Aquatic Habitat” the option of conservation bank credit purchases for mitigation of lost shade trees on the levee is an easy-escape provision that allows for mitigation in an area unrelated to the area of impact. With respect to this supplemental environmental impact report it is inconsistent with CEQA for mitigation to be outside the area of impact

The mitigation measure must delineate or otherwise identify the area which is acceptable for mitigation of this project. It should be close enough to the area of impact that the population of species affected by the project will benefit from the mitigation measure.

The second bullet of Mitigation Measure SRA-1 on page 37 and on page xii should read:

> USACE ***must*** compensate for SRA habitat losses ***proximate to the area of impact along the east bank of the Sacramento River***. USACE ***must*** compensate for lost habitat using NMFS-approved mitigation actions at a 1:1 ratio if mitigation occurs prior to construction, 2:1 ratio during construction, or a 3:1 ratio after construction.

Even then, the mitigation measure is deficient and unenforceable, and therefore inconsistent with CEQA, for failing to state when the mitigation measures must be implemented. It allows implementation of mitigation measures to be postponed indefinitely.

The mitigation measure must delineate or otherwise identify the area which is acceptable for mitigation of this project. It should be close enough to the area of impact that the population of species affected by the project will benefit from the mitigation measure. A mitigation location 50 miles distant will not mitigate for impacts on the population of species impacted by the project.

.

Finally, the last sentence of this section on page 38 should read:

> If any additional avoidance, minimization and mitigation measures are recommended, they ***must be implemented***.

D-4 4. Mitigation Measure Veg-2 on Page xxi is Overly Broad and Needs Clarification

Consistent with the comments under section 2 above, the Veg-2 Mitigation Measure on page xxi and page 70 of the document requires clarifying editing:

> To compensate for the removal of riparian habitat (1.258 acres), replacement habitat ***must*** be created at a ratio of 2:1 to account for the temporal loss of habitat while newly created habitat is growing. Species selected to compensate for the riparian corridor removal ***must*** be consistent with the approved list of trees, shrubs, and herbaceous plants native to the Great Valley Mixed Riparian Forest. The replacement habitat ***must*** be created in accordance with the ARCF GRR HMMAMP, which includes conceptual mitigation proposals, performance standards, and adaptive management tasks. After construction has been completed, 0.22 acres of riparian vegetation ***must*** be planted in the planting bench. The remaining compensation for the temporal loss of riparian vegetation and SRA habitat ***must be planted along the east bank of the Sacramento River proximate to the area of impact and must*** be protected in perpetuity. These

sites ***must*** be selected and designed in coordination with NMFS and USFWS as part of the consultation under the Endangered Species Act.

Again, the Mitigation Measure is deficient and noncompliant with CEQA for failure to state when the mitigation measure must be implemented nor the location of the mitigation. As written, implementation of the mitigation measure may be postponed indefinitely. This measure is therefore unenforceable and thus noncompliant with CEQA.

The mitigation measure must delineate or otherwise identify the area which is acceptable for locating mitigation habitat this project. It should be close enough to the area of impact that the population of species affected by the project will benefit from the mitigation measure. A mitigation location 20 miles distant, for example, will not mitigate for impacts on the population of species impacted by the project.

D-5 5. <u>Consideration of Further Study to Identify Proximate Mitigation Sites</u>

If the lead agency believes that the above recommended wording of mitigation measures SRA-1 and VEG-2 is not feasible, then the Supplemental EIR needs to be revised to provide clear and demonstrable evidence in support of that conclusion before the project's environmental documentation becomes final. The elimination of potential mitigation sites along the Sacramento River because those potential sites may require levee "improvements" at some future date is not, of and by itself, a legitimate reason for eliminating potential proximate mitigation sites.

We urge that you give these comments serious consideration. Please feel free to contact us if you have further questions.

Sincerely,

Ralph Propper	Robert Burness	Sean Wirth
President, ECOS	Habitat 2020 Co-Chair	Habitat 2020 Co-Chair

Watts, Kimberly J (Kim) CIV USARMY CESPK (USA)

From:	Stalker, Tyler M CIV USARMY CESPK (USA) on behalf of SPK-PAO SPK
Sent:	Wednesday, August 26, 2020 9:34 AM
To:	Watts, Kimberly J (Kim) CIV USARMY CESPK (USA); Claret, Miles@DWR
Cc:	Caden, Patrick CIV USARMY CESPK (USA)
Subject:	FW: SREL Mile 55.2 Left Bank Protection - Comment

FYSA. We received this comment last night.

Respectfully,
Tyler

Tyler M. Stalker
Deputy Chief of Public Affairs
U.S. Army Corps of Engineers, Sacramento District
Office: 916-557-5107
Mobile: 916-396-2831

-----Original Message-----
From: Todd Lemmons [mailto:todd@nordicind.com]
Sent: Tuesday, August 25, 2020 5:04 PM
To: SPK-PAO SPK <SPK-PAO@usace.army.mil>; PublicCommentARCF16@water.ca.gov
Subject: [Non-DoD Source] SREL Mile 55.2 Left Bank Protection - Comment

Hi,

E-1 We would like to request that access for materials and equipment for this site be allowed by both barge and land. Requiring access to the site for equipment and materials by barge only will reduce and or eliminate competition of bidders.

Thanks,

Todd Lemmons

Nordic Industries, Inc.

Project Manager

530-308-1330

RESPONSES TO COMMENTS

Draft Supplemental Environmental Assessment/Environmental Impact Report
American River Watershed Common Features Water Resources Development Act 2016
Project, Sacramento River Erosion Contract 1: River Mile 55.2 Left Bank Protection
Sacramento, California

A. Letter from the California Department of Transportation, District 3 (Caltrans), dated August 19, 2020

A-1: The Proposed Action will have construction materials and equipment delivered and removed via barges on the Sacramento River, no bank protection material or large equipment is to be delivered from the land side. Landside access will be limited to personally owned vehicles, restroom facilities, fencing, and tree removal vehicles and equipment.

B. Letter from the Delta Stewardship Council (DSC), dated August 21, 2020

B-1: Comment noted. Delta Plan Appendix O was reviewed and considered during preparation of the Final Supplemental EA/EIR.

B-2: The Proposed Action was designed in accordance to the latest USACE engineering design standards. References for the instream-woody material (IWM) design has been added to the Final SEA/EIR. The location of the riparian planting bench is established by the Standard Assessment Method (SAM) model which establishes a prime interface for the specified habitat. The exact location is tempered and adjusted for specific locational variables by the professional contributions of the project development team and historic precedent.

B-3: Comment noted. Appendix I to the American River Common Features (ARCF) General Reevaluation Report (GRR) Environmental Impact Statement / Environmental Impact Report (EIS/EIR) is the Habitat Mitigation Monitoring and Adaptive Management Plan (HMMAMP), which provides a framework for mitigation monitoring, performance standards, and adaptive management for on and off-site mitigation for the ARCF 2016 Project, including the Proposed Action. Additionally, a site-specific habitat management plan will be created for the Proposed Action that defines performance standards, monitoring objectives, and adaptive management actions that must be followed to ensure the on-site planting bench is successful and meets the mitigation requirement. CVFPB intends to include this habitat management plan as part of a future certification of consistency with the Delta Plan for the Proposed Action.

B-4: The riparian planting bench design is described in Section 2.3.1 of the Final SEA/EIR. The specific size, elevation, and slope of the planting bench were determined as a result of several interagency Project Development Team (PDT) meetings that included USACE, Department of Water Resources (DWR), Sacramento Area Flood Control Agency (SAFCA), U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS). The 7-foot bottom elevation of the planting bench is set to the average low flow water surface elevation in the Sacramento River in August, September, and October. The planting bench slopes upwards to a top elevation of approximately 8-feet. The purpose of targeting this specific elevation is to provide near shore aquatic habitat to special-status fish species during lower river stages that are common in summer and fall. The rock revetment design and the planting bench design would both be resilient to sea level rise. There is significantly more flow area above the elevation of the top of the revetment; therefore, there would be less pressure against the bank, and erosion is not expected. If flood stages increase slightly due to sea level rise, the design elevation of the top of revetment would not be affected because the larger flow area above that elevation is adequate to quickly dissipate pressure to protect the bank from erosion. The design of the elevation of the planting bench was set to ensure survival of young plants and to support natural recruitment of native vegetation even during low flow periods. As sea level rises in the future, it is expected that young plants will have developed into mature and healthy vegetation, which will encourage soil to accumulate along the river bank where new vegetation recruitment will occur.

B-5: The Proposed Action incorporates a riparian planting bench (see Section 2.3.1 of the Final SEA/EIR) that will be planted, monitored, and maintained to support a diverse riparian habitat community. Given the urban location of the Proposed Action, levee setback alternatives are not feasible. Additional information regarding the feasibility of levee setback alternatives can be found in the ARCF GRR EIS/EIR.

B-6: Management of invasive plant species for on and off-site mitigation as part of ARCF 2016 is defined in the HMMAMP. A site-specific habitat management plan will be created for the on-site mitigation as part of the Proposed Action, which will include management actions related to invasive plant species. (Please see response to Comment B-3.) The presence of invasive, nonnative fish species is part of the existing condition. The riparian planting bench will provide near shore mosaic flood plain aquatic habitat and refuge for native juvenile fish species, thereby reducing the risk that native fish species would be adversely impacted by invasive, nonnative fish species that are already present in the Sacramento River. This type of habitat feature/improvement has been shown to improve survivability amongst sub-yearling salmonids in channelized river systems such as the Lower Sacramento River.

B-7: The Proposed Action includes improvements to existing levee infrastructure and does not include expansion or changes to the footprint of these facilities or acquisition of private property beyond the existing flood control infrastructure. Additional information addressing the environmental analysis of the Proposed Action, including impacts to visual character, recreation, and vegetation removal, can be found in the Chapter 3 of the ARCF GRR EIS/EIR and in Chapter 3 of the Final SEA/EIR.

B-8: The Proposed Action would improve levees and protect existing urban development in an area defined as a "very high priority" (the highest priority category) for risk reduction improvements in Chapter 7 of the Delta Plan. The geotechnical design criteria adopted for the Proposed Action follow published USACE and DWR Urban Levee Design Criteria (ULDC). A 200-year water surface profile was used in the design analysis to evaluate project compliance with geotechnical criteria under DWR's ULDC 200-year level of protection.

Additional information addressing the project purpose can be found in Chapter 1 of ARCF GRR EIS/EIR and in Chapter 1 of the Final SEA/EIR.

B-9: As described in Chapter 3 of the Final SEA/EIR, supplemental information on existing conditions, including environmental and regulatory setting, is provided for resource topics only where necessary to support the supplemental impact analysis. Otherwise, the document relies on the regulatory setting as described in the ARCF GRR EIS/EIR and is not repeated.

B-10: Comment noted. As stated in Chapter 5 of the Final SEA/EIR, CVFPB will submit a certification of consistency with the Delta Plan for the Proposed Action.

C. Letter from Sacramento Metropolitan Air Quality Management District (SMAQMD), dated August 4, 2020

C-1: The referenced text has been deleted and Mitigation Measure AIR-5 from the ARCF GRR EIS/EIR has been included to address this comment.

D. Letter from the Environmental Council of Sacramento (ECOS), dated August 26, 2020

D-1: Mitigation Measures in draft NEPA/CEQA documents are usually written using “would” to convey the conditional nature of the environmental commitments. If a FONSI is prepared, it will contain non-conditional language and all of the agency’s mitigation commitments. The Final SEA/EIR Mitigation Measures have been updated to reflect the non-conditional commitment of USACE and CVFPB to carry out the mitigation measures.

D-2: Impacts to special-status species, including Swainson’s hawk (SWHA), are discussed in Section 3.2.2 of the Final SEA/EIR. Tree removal from construction activities would reduce the amount of habitat available to SWHA and could destroy active nests, resulting in loss of eggs and young. Mitigation Measures VEG-1, VEG-2, SRA-1, and BIRD-1, will reduce impacts on Swainson’s Hawks to be less-than-significant by implementing measures to avoid impacts to active nests and by providing on and off-site riparian habitat mitigation to replace habitat loss caused by construction.

Mitigating for project impacts by protecting locations that already contain nesting habitat is not feasible given the scale and types of mitigation required for the overall ARCF 2016 Project, including the Proposed Action. Additionally, protecting nesting habitat does do not serve the same functional lift as replacement because the trees removed due to construction are not being replaced which results in a net negative habitat loss. Therefore, because protection is infeasible in some locations, replacement is the best mitigation strategy and prevents a net habitat loss.

Impacts to vegetation and wildlife habitat are discussed in Section 3.2.9 Vegetation and Wildlife, which states that 1.258 acres of canopy are to be removed from the site and includes Mitigation Measures VEG-1, VEG-2, and SRA-1 to avoid, minimize, and mitigate for long-term impacts to riparian habitat and wildlife to a less than significant level. VEG-2 also states that “replacement habitat would be created at a ratio of 2:1 to account for the temporal loss of habitat while newly created habitat is growing." The acreage to be removed has been added to the discussion of impacts to Swainson's Hawks and other birds as well as a cross-reference to Section 3.2.9 to guide readers to further discussion on habitat impacts and mitigation. Mitigation Measures VEG-1 and VEG-2 were added to the list of mitigation measures in Section 3.2.2.

Additionally, as described in Section 3.2.9, the ARCF GRR EIS/EIR concluded that short-term impacts to vegetation and wildlife habitat would be significant and unavoidable because it would take many years for riparian habitat to become fully mature and provide the same value as existing riparian habitat. Long-term impacts to vegetation and wildlife habitat would be reduced the less than significant because once the vegetation has fully grown, the on-site and off-site mitigation areas would provide similar or greater habitat value compared to what was impacted by construction. Language has been added to Section 3.2.9 to clarify short-term and long-term impacts as stated above.

Habitat mitigation described in VEG-2 and SRA-1 will be implemented consistent with ARCF GRR EIS/EIR Appendix I, *Habitat Mitigation Monitoring and Adaptive Management Plan* (HMMAMP) and in coordination with NMFS and USFWS according to the Biological Opinions issued under the Endangered Species Act (GRR EIS/EIR Appendix J) for the ARCF 2016 Project, including the Proposed Action. The HMMAMP states that the compensation objective for the ARCF 2016 Project is to directly mitigate project impacts by establishing successful and diverse habitats that provide an ecological value consistent with mature existing habitat conditions in the study area. HMMAMP Section 2.2 provides a framework for accomplishing compensation objectives.

USACE, CVFPB, DWR, and SAFCA are dedicated to providing quality mitigation for shaded riverine aquatic habitat (SRA) and riparian habitat losses due to the Proposed Action and for all other components of the ARCF 2016 Project. The offsite mitigation will occur as close to the project impacts as feasible considering site availability and the scale of mitigation required for the overall ARCF 2016 Project. USACE, CVFPB, and SAFCA are seeking compensatory mitigation opportunities on or adjacent to the main stem of the Sacramento River within a 20 mile radius (27 river miles), ideally, but sites within a 50 mile radius (55 river miles) may need to be utilized. Coordination with USFWS and NMFS to identify and design the mitigation sites is currently ongoing. USACE, CVFPB, and SAFCA are seeking to implement mitigation to address impacts associated with the ARCF 2016 Project by 2025. However, the specific timing of implementing the mitigation is uncertain due to potential challenges with acquiring the necessary real estate on a scale that can provide mitigation for impacts anticipated from multiple contracts being constructed as part of the ARCF 2016 Project. If mitigation cannot be fulfilled onsite and offsite, mitigation requirements may be completed by purchasing credits from USFWS approved mitigation banks or in-lieu fee programs.

The vegetation removal is planned to occur in the winter (outside of the breeding bird season); however, during construction unforeseen circumstances may arise that require additional tree trimming or removal. In the event of this situation, USACE will implement measures described in BIRD-1 including conducting nesting bird surveys and establishing protective buffers around active nests.

D-3: Please refer to Comment D-1 above for NEPA and CEQA language for draft documents.

HMMAMP Section 1.9 Location of Mitigation and Compensation Sites states that it is appropriate to select on and off-site mitigation areas within the ARCF 2016 study area rather than purchasing credits at a mitigation bank. However, there are significant barriers to providing nearby off-site mitigation on the scale required for the overall ARCF 2016 Project, so purchasing mitigation bank credits is an option, if available and approved by USFWS and NFMS. Some barriers for implementing the offsite mitigation include land availability, land use, land elevations, existing habitat, and existing infrastructure, such as roads and utilities.

SRA and riparian habitat losses will be mitigated as prescribed in the mitigation measures, which have been approved by USFWS and NMFS and are in the HMMAMP and the ARCF 2016 NMFS Biological Opinion. Reconsultation is currently on going with USFWS and NMFS, any new stipulations in the BOs, to be issued in early 2021, will be incorporated into the Proposed Action and mitigation, as feasible. Mitigation sites are being identified and analyzed by USACE, CVFPB, DWR, SAFCA, NFMS, and USFWS to mitigate for impacts anticipated from multiple contracts, including the Proposed Action, to be performed under the ARCF 2016 Project on the Sacramento River.

Reaches of the East bank of the Sacramento River that are in close proximity to the Proposed Action site are within the ARCF Project study area. Reaches within the ARCF Project study area have been categorized into three tiers of flood risk. Tier 1 need repairs as soon as possible, Tier 2 might need repair in the next 50 years, and Tier 3 needs no repair. Tier 3 sites are generally well vegetated and do not need habitat modification, Tier 2 sites are still being evaluated and it would be an improper use of funding to create a mitigation site in an area that may be removed at a later date. Tier 1 sites are subject to ARCF Project actions and are being designed to include onsite mitigation. For these reasons, mitigation on the East bank of the Sacramento River within close proximity to the proposed action are not feasible.

USACE, CVFPB, DWR, and SAFCA are dedicated to providing quality mitigation for riparian and SRA habitat losses. This mitigation will occur as close to the project impacts as feasible. USACE, CVFPB, and SAFCA are seeking mitigation opportunities on or adjacent to the main stem of the Sacramento River within a 20 mile radius (27 river miles), ideally, but sites within a 50 mile radius (55 river mile) may need to be utilized. Coordination with USFWS and NMFS to identify and design the mitigation sites is currently ongoing. USACE, CVFPB, and SAFCA are seeking to implement mitigation by 2025. However, the specific timing of the mitigation is unknown due to potential challenges with acquiring the necessary real estate on a scale that can provide mitigation for impacts anticipated from multiple contracts being constructed as part of the ARCF 2016 Project. If some mitigation cannot be accomplished onsite, mitigation requirements may be completed by purchasing credits from USFWS and/or NMFS approved mitigation banks or in-lieu fee programs.

D-4: Please refer to Comment D-1 above for NEPA and CEQA language for draft documents.

The riparian habitat losses will be mitigated as prescribed in the mitigation measures, which have been approved by USFWS and NMFS. Mitigation sites are being identified and analyzed by USACE, CVFPB, DWR, SAFCA, NFMS, and USFW to mitigate for impacts anticipated from performance of multiple contracts under the American River Watershed Common Features Project.

Regarding timing, location, and implementation of off-site mitigation, please see responses to Comments D-2 and D-3.

D-5: Please refer to responses to D-1, D-2, and D-3 for NEPA and CEQA language and discussion of the timing, location, and implementation of mitigation measures.

E. Comment from Nordic Industries, Inc., dated August 25, 2020

E-1: Access to the site has been limited to barge traffic for delivery of equipment and material to reduce the impacts to riparian habitat and recreation. Large trucks accessing the site would necessitate construction of ramps and additional riparian habitat removal which is inconsistent with the USACE's obligation to protect to the riparian corridor.

Appendix E: Summary of Environmental Commitments

Table E. Summary of Environmental Commitments (Mitigation Measures, etc.) for the Proposed Project (Alternative 2).

ID #	Description
	Special Status Species
BIRD-1	USACE will implement the following measures to minimize potential effects on active nests of Swainson's Hawk, White-tailed Kite, Purple Martin and other migratory birds: • Before on-site project activities begin, all construction personnel will participate in a USFWS-approved worker environmental awareness program. A qualified biologist shall inform all construction personnel about the life history of Swainson's hawk and other relevant species, as well as the importance of nest sites. • A breeding season survey shall be conducted for active Swainson's hawk nests within 0.5 mile of construction activities, including grading. A survey shall also be conducted for active nests of white-tailed kite and purple martin within 500 feet of construction activities and active nests of other migratory birds within 100 feet of construction activities. Swainson's hawk surveys shall be completed during at least two of the following survey periods: January 1 to March 20, March 20 to April 5, April 5 to April 20, and June 10 to July 30 with no fewer than three surveys completed in at least two survey periods and with at least one survey occurring immediately prior to project initiation (Swainson's Hawk Technical Advisory Committee 2000). Other bird nest surveys could be conducted concurrent with Swainson's hawk surveys, with at least one survey to be conducted no more than 48 hours from the initiation of project activities. If the biologist determines that the area surveyed does not contain any active nests, construction activities, including removal or pruning of trees and shrubs, could commence without any further mitigation. • For any active migratory bird nest found, a protective buffer shall be established and implemented until the nest is no longer active. The size of the buffer shall be determined based on the species, nest stage, type and intensity of project disturbance in the nest vicinity, presence of visual buffers, and other variables that may affect susceptibility of the nest to disturbance. A qualified biologist shall monitor the nest during project activities to confirm effectiveness of the buffer and adjust the buffer as needed to ensure project activities do not adversely affect behavior of adults or young. • Where feasible, tree and shrub removal and other clearing, grading, and construction activities that remove vegetation would not be conducted during the nesting season (generally February 15 through August 31, depending on the species and environmental conditions for any given year).

ID #	Description
VELB-1	USACE would implement the following measures in accordance with the *Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle* (USFWS 2017), to reduce effects on valley elderberry longhorn beetle, in the event that any are found on the project site: • Fencing. All areas to be avoided during construction activities shall be fenced and/or flagged as close to construction limits as feasible. • Avoidance area. To the extent feasible, activities that may damage or kill an elderberry shrub (e.g., trenching, paving, etc.) shall be avoided within 20 feet from the drip-line of the shrub. • Worker education. A qualified biologist shall provide training for all contractors, work crews, and any onsite personnel on the status of valley elderberry longhorn beetle, its host plant and habitat, the need to avoid damaging elderberry shrubs, and the possible penalties for noncompliance. • Construction monitoring. A qualified biologist shall monitor the work area at appropriate intervals to assure that all avoidance and minimization measures are implemented. • Timing. To the extent feasible, activities within 165 feet of an elderberry shrub shall be conducted outside of the valley elderberry longhorn beetle flight season (March - July). • Trimming. To the extent feasible, elderberry shrub trimming shall occur between November and February and avoid the removal of any branches or stems greater than or equal to 1 inch in diameter. • Chemical Usage. Herbicides shall not be used within the drip-line, and insecticides shall not be used within 100 feet of an elderberry shrub. All chemicals shall be applied using a backpack sprayer or similar direct application method. • Mowing. Mechanical weed removal within the drip-line of elderberry shrubs shall be limited to the season when adults are not active (August - February) and shall avoid damaging the shrub. • Transplanting. To the extent feasible, elderberry shrubs shall be transplanted when the shrubs are dormant (November through the first two weeks in February) and after they have lost their leaves. Exit-hole surveys would be completed immediately before transplanting. A qualified biologist shall be on-site for the duration of transplanting activities to assure compliance with avoidance and minimization measures and other conservation measures. Compensation. Effects shall be compensated at ratios ranging from 1:1 to 3:1, depending on the compensation approach and circumstances of the affected shrubs. Affected area would be re-vegetated with appropriate native plants.

ID #	Description
BAT-1	The 2016 ARCF GRR EIS/EIR did not identify a significant impact associated with special- status bats. Therefore, the following is a new mitigation measure. USACE will implement the following measure to avoid and minimize effects on special status bats. • Wherever feasible, USACE would conduct construction activities outside of the active season for bats (generally April 1 to August 31). • If removal of trees must occur during the bat pupping season, within 30 days prior to tree removal activities, all trees to be removed will be surveyed by a qualified biologist for the presence of features that may function as special status bat maternity roosting habitat. Trees that do not contain special status maternity roosting habitat may be removed. For trees that contain suitable special status bat maternity roosting habitat, surveys for active maternity roosts shall be conducted by a qualified biologist in trees designated for removal. The surveys shall be conducted from dusk until dark. • If a special-status bat maternity roost is located, appropriate buffers around the roost sites shall be determined by a qualified biologist and implemented to avoid destruction or abandonment of the roost resulting from tree removal or other project activities. The size of the buffer shall depend on the species, roost location, and specific construction activities to be performed in the vicinity. No project activity shall commence within the buffer areas until the end of the pupping season (September 1) or until a qualified biologist confirms the maternity roost is no longer active. If construction activities must occur within the buffer, a qualified biologist will monitor activities either continuously or periodically during the work, as determined by the qualified biologist. The qualified biologist will be empowered to stop activities that, in the biologist's opinion, threaten to cause unanticipated adverse effects on specials status bats. If construction activities are stopped, CDFW would be consulted to determine appropriate measures to implement to avoid adverse effects. • For trees containing cavities, cracks, crevices, or deep bark fissures are planned for removal or trimming (irrespective of time of year), such trees must be trimmed and/or removed in a two-phase removal system conducted over two consecutive days. The first day (in the afternoon), limbs and branches will be removed, using chainsaws only. Removal activities must avoid limbs with cavities, cracks, crevices, or deep bark fissures, and remove only branches and limbs without those features. On the second day, the entire tree will be removed. A qualified biologist will monitor removal of these trees.
PLANT-1	USACE will implement the following measures to minimize potential effects on Sanford's arrowhead and wooly rose-mallow: • Preconstruction surveys will be conducted by a qualified botanist in suitable habitat to determine the presence of any special status plants. Surveys will be conducted at an appropriate time of year during which the species are likely to be detected, likely be during the blooming period. • If special status plant species are found during preconstruction surveys, the habitat would be marked or fenced as an

ID #	Description
	avoidance area during construction. A buffer of 25 feet would be established. If a buffer of 25 feet is not possible, the next maximum possible distance would be fenced off as a buffer. If special status plant species cannot be avoided during construction, USACE would coordinate with the resource agencies to determine additional appropriate mitigation measures.
FISH-1	To avoid and minimize effects on listed fish species, the following measures will be implemented: • In-water construction activities (e.g., placement of rock revetment) will be limited to the work window of July 1 through October 31. The in-water work window could be extended to November 15 with NMFS approval. If USACE needs to work outside of this window, it would consult with USFWS and NMFS. • Erosion control measures (BMPs) will be implemented, including a Storm Water Pollution Prevention Plan and Water Pollution Control Plan, to minimize the entry of soil or sediment into the American River. BMPs will be installed, monitored for effectiveness, and maintained throughout construction operations to minimize effects on federally listed fish and their designated critical habitat. Maintenance will include daily inspections of all heavy equipment for leaks. • USACE will participate in an existing Interagency Working Group or work with other agencies to participate in a new Bank Protection Working Group to coordinate stakeholder input into future flood risk reduction actions associated with the ARCF 2016 Project, Sacramento River Contract 1, RM 55.2L. • USACE will coordinate with NMFS during pre-construction engineering and design as future flood risk reduction actions are designed to ensure that conservation measures are incorporated to the extent practicable and feasible and projects are designed to maximize ecological benefits. • USACE will include a Riparian Corridor Improvement Plan as part of the project, with the overall goal of maximizing the ecological function and value of the existing levee system in the Sacramento metropolitan area. • USACE will implement HMMAMP with an overall goal of ensuring that the conservation measures achieve a high level of ecological function and value. The HMMAMP would include: o Specific goals and objectives and a clear strategy for maintaining all project conservation elements for the life of the project. o Measures to be monitored by USACE for 10 years after construction. USACE will update its O&M manual to ensure that the HMMAMP is adopted by the local sponsor to ensure that the goals and objectives of the conservation measures are met for the life of the project. o Specific goals and objectives and a clear strategy for achieving full compensation for all project-related impacts on listed fish species. • USACE will continue to coordinate with NMFS during all phases of construction, implementation, and monitoring by hosting annual meetings and issuing annual reports throughout the construction period as described in the HMMAMP.

ID #	Description
	• USACE will seek to avoid and minimize adverse construction effects on listed species and their critical habitat to the extent feasible, and will implement on-site and off-site compensation actions as necessary. • For identified designated critical habitat, where feasible, all efforts will be made to compensate for impacts where they have occurred or in close proximity. USACE will develop and implement a compensatory mitigation accounting plan to ensure the tracking of compensatory measures associated with implementation of the Proposed Action. USACE will continue to coordinate with NMFS during all phases of construction, implementation, and monitoring by hosting meetings and issuing annual reports throughout the construction period. • USACE will minimize the removal of existing riparian vegetation and IWM to the maximum extent practicable. Where appropriate, removed IWM will be anchored back into place, or if not feasible, new IWM will be anchored in place. • USACE will ensure that the planting of native vegetation would occur as described in the HMMAMP. All plantings must be provided with the appropriate amount of water to ensure successful establishment. • USACE will provide a copy of the BOs, or similar documentation, to the prime contractor, making the prime contractor responsible for implementing all requirements and obligations included in the documents and for educating and informing all other contractors involved in the project as to the requirements of the BOs. • A NMFS-approved Worker Environmental Awareness Training Program for construction personnel will be conducted by the NMFS-approved biologist for all construction workers before the start of construction activities. Written documentation of the training will be submitted to NMFS within 30 days of the completion of training. • USACE will consider installing IWM of at least 40 percent shoreline coverage at all seasonal water surface elevations in coordination with the Interagency Working Group or the Bank Protection Working Group. The purpose is to maximize the refugia and rearing habitats for juvenile fish. • USACE will protect in place all riparian vegetation on the lower waterside slope of any levee, unless removal is specifically approved by NMFS, following completion of project construction. The following conservation measure from the 2015 NMFS Biological Opinion on the ARCF GRR is also incorporated into the Proposed Action: Screen any water pump intakes, as specified by the 2011 NMFS screening specifications. 68F water pumps will maintain an approach velocity of 0.2 feet per second or less. Screen openings will be for a perforated plate: circular or square openings shall not exceed 3/32 inch (2.38 millimeters [mm]), measured on a side, and slotted or rectangular screen face openings must not exceed 1.75 mm (approximately 1/16 inch) in the narrow direction. Screen material shall provide a minimum of 27 percent open area.

ID #	Description
SRA-1	USACE will implement the following avoidance, minimization, and compensation measures. • For identified designated critical habitat of listed fish species, where feasible, all efforts will be made to compensate for impacts where they have occurred, or elsewhere in the Sacramento or American River Basins. Impacts on designated critical habitat, SRA habitat, and instream components combined and the compensation value of replacement habitat will be based on the interagency-approved SAM model used throughout the Sacramento River basin and Sacramento–San Joaquin Delta flood control system. • USACE will incorporate compensation for SRA habitat losses either by constructing off-site compensation sites, purchase of credits at a NMFS-approved conservation bank, where appropriate, or by implementing a combination of the two, and by funding a research grant for green sturgeon. USACE would compensate for lost habitat using NMFS-approved mitigation actions at a 1:1 ratio prior to construction, 2:1 ratio during construction, or a 3:1 ratio if mitigation actions occur after construction. SRA habitat compensation sites will be established in coordination with NMFS and USFWS as part of consultation under Section 7 of the Endangered Species Act for the ARCF GRR, consistent with the American River Parkway Plan, and in coordination with the Sacramento County Department of Parks and Recreation. On-site created SRA habitat acreage will also be counted toward offsetting lost SRA habitat. • Compensation sites will be monitored, and vegetation will be replaced as necessary based on performance standards in the ARCF GRR HMMAMP.
	Air Quality
AIR-1	SMAQMD requires that all projects, regardless of their significance, implement the following measures to minimize the generation of fugitive PM dust. The Basic Construction Emission Control Practices shall include measures to control fugitive PM dust pursuant to SMAQMD Rule 403, as well as measures to reduce construction-related exhaust emissions. USACE shall require its contractors to comply with the basic construction emission control practices listed below for all construction-related activities occurring in SMAQMD jurisdiction. • Water all exposed surfaces two times daily or more, as needed. Exposed surfaces include but are not limited to: soil piles, graded areas, unpaved parking areas, staging areas, and access roads. • Cover, or suitably wet soils and other materials on haul trucks transporting soil, sand, or other loose material on the site. Cover any haul trucks that travel along freeways or major roadways. • Use wet power vacuum street sweepers to remove any visible trackout mud or dirt onto adjacent public roads at least once a day. Use of dry power sweeping is prohibited. • Limit vehicle speed on unpaved roads to 15 miles per hour. • Complete pavement of all roadways, driveways, sidewalks, parking lots to be paved as soon as possible.

ID #	Description
	• Minimize idling time either by shutting equipment off when not in use or reducing the time of idling to 5 minutes (required by CCR, Title 13, Sections 2449[d][3] and 2485). Provide clear signage that posts this requirement for workers at the entrances to the site. Maintain all construction equipment in proper working condition according to manufacturer's specifications. Have the equipment checked by a certified mechanic and determined to be running in proper condition before it is operated.
AIR-2	SMAQMD recommends that construction projects that would exceed or contribute to the mass emissions threshold for PM10 implement the Enhanced Fugitive PM Dust Control Practices, as applicable to the project. As the construction activities for the Proposed Action will involve substantial material movement activities and will be located in proximity of residential receptors, USACE shall require its construction contractors to implement the Enhanced Fugitive PM Dust Control Practices listed below to help reduce potential fugitive PM dust emissions. <u>Soil Disturbance Areas</u> • Water exposed soil with adequate frequency for continued moist soil; however, do not overwater to the extent that sediment flows off the site. • Suspend excavation, grading, and/or demolition activity when wind speeds exceed 20 miles per hour. • Install wind breaks (e.g., plant trees, solid fencing) on windward side(s) of construction areas. • Plant vegetative ground cover (fast germinating native grass seed) in disturbed areas as soon as possible and water appropriately until vegetation is established. <u>Unpaved Roads (Entrained Road Dust)</u> Install wheel washers for all exiting trucks or wash off all trucks and equipment leaving the site. Treat site accesses with a 6- to 12-inch layer of wood chips, mulch, or gravel to a distance of 100 feet from the paved road to reduce generation of road dust and road dust carryout onto public roads. Post a publicly visible sign with the telephone number and person to contact at USACE regarding dust complaints. This person will respond and take corrective action within 48 hours. The phone number of SMAQMD also will be visible to ensure compliance.
AIR-3	USACE shall require its contractors to use a fleet-wide average of 90 percent Tier 4 emissions vehicles for off-road construction equipment and on-road haul trucks must be equipped with 2010 or newer engines. In order to demonstrate compliance with this requirement: • The construction contractor shall submit to USACE and SMAQMD a comprehensive inventory of all off-road construction equipment, equal to or greater than 50 horsepower, that would be used an aggregate of 40 or more hours during any portion of the construction project. • The inventory shall include the horsepower rating, engine model year, and projected hours of use for each piece of

ID #	Description
	equipment. The construction contractor shall provide the anticipated construction timeline including start date, and the name and phone numbers of the project manager and the on-site foreman. This information shall be submitted at least 4 business days prior to the use of subject heavy-duty off-road equipment. The SMAQMD Construction Mitigation Tool can be used to submit this information. The inventory shall be updated and submitted monthly throughout the duration of the project, except for any 30-day period in which no construction activity occurs. • The construction contractor shall provide a plan for approval by USACE and SMAQMD demonstrating that the heavy-duty off-road vehicles (50 horsepower or more) to be used in the construction project, including owned, leased, and subcontractor vehicles, will achieve a project-wide fleet average of 90 percent Tier 4 emissions vehicles. This plan shall be submitted in conjunction with the equipment inventory. Acceptable options for reducing emissions may include use of late model engines, low-emission diesel products, alternative fuels, engine retrofit technology, after-treatment products, and/or other options as they become available. • SMAQMD's Construction Mitigation Tool can be used to identify an equipment fleet that achieves this reduction. The construction contractor shall ensure that emissions from all off-road diesel-powered equipment used in the project area do not exceed 40 percent opacity for more than 3 minutes in any 1 hour. Any equipment found to exceed 40 percent opacity (or Ringelmann 2.0) shall be repaired immediately. Non-compliant equipment will be documented and a summary provided monthly to USACE and SMAQMD. A visual survey of all in-operation equipment shall be made at least weekly. A monthly summary of the visual survey results shall be submitted throughout the duration of the project, except for any 30-day period in which no construction activity occurs. The monthly summary shall include the quantity and type of vehicles surveyed, as well as the dates of each survey. • Use the Construction Mitigation Tool to track PM_{10} emissions and mileage traveled by on-road trucks, reporting results to USACE and SMAQMD on a monthly basis.

ID #	Description
AIR-4	USACE shall implement the measures listed below to reduce NOx construction-related emissions. Pursuant to air district thresholds of significance, if the projected construction-related emissions exceed the NOx threshold of significance, based on the equipment inventory and use, USACE shall contribute to SMAQMD's and/or BAAQMD's off-site mitigation fee program sufficiently to offset the amount by which the project's NOx emissions exceed the threshold. If emissions for the ARCF 2016 Project in any given year would exceed the de minimis threshold of 25 tons per year, USACE and CVFPB would enter into an agreement with SMAQMD and/or BAAQMD to purchase offsets for all NOx emissions in any year that projected emissions would exceed the threshold. The determination of the estimated mitigation fees shall be conducted in coordination with SMAQMD and/or BAAQMD before any ground disturbance occurs for any phase of project construction. (Estimated fees for the Proposed Action are $23,500 to SMAQMD for emissions in the SVAB and $37,350 to BAAQMD for emissions in the SFBAAB.) All mitigation fees shall be paid prior to the start of construction activity to allow air districts to obtain emissions reductions for the proposed project. If there are changes to construction activities (e.g., equipment lists, increased equipment usage or schedules), USACE and CVFPB shall work with SMAQMD and BAAQMD to ensure emission calculations and fees are adjusted appropriately.
AIR-5	USACE shall encourage the use of U.S. Environmental Protection Agency (EPA) adopted Tier 3 and Tier 4 standards for newly built marine engines in 2008. The Tier 3 standards reflect the application of technologies to reduce engine PM and NOX emission rates. Tier 4 standards reflect application of high-efficiency catalytic after-treatment technology enabled by the availability of ultra-low sulfur diesel. USACE will use Tier 2 and 3 marine engines standards where available to reduce marine exhaust emissions. Due to uncertainty as to the availability of Tier 4 marine engines within the required project timeline, this mitigation measure does not require the use of Tier 4 marine engines. However, should they become available during the appropriate construction periods, the use of these engines will be required in order to further lower project emissions.
Climate Change	
GHG-1	Additional measures that will be implemented to further reduce the project's contribution from generation of GHGs include the following measures will also be implemented to the extent feasible to minimize GHG emissions: • Encourage and provide carpools, shuttle vans, transit passes and/or secure bicycle parking for construction worker commutes. • Recycle at least 75% of construction waste and demolition debris. • Purchase at least 20% of the building materials and imported soil from sources within 100 miles of the project site. • Minimize idling time either by shutting equipment off when not in use or reducing the time of idling to no more than 3 minutes (5-minute limit is required by the state airborne toxic control measure [Title 13, sections 2449(d)(3) and 2485 of the California Code of Regulations]). Provide clear signage that posts this requirement for workers at the entrances to the

ID #	Description
	site. • Maintain all construction equipment in proper working condition according to manufacturer's specifications. The equipment must be checked by a certified mechanic and determined to be running in proper condition before it is operated. • Use equipment with new technologies (repowered engines, electric drive trains). • Perform on-site material hauling with trucks equipped with on-road engines (if determined to be less emissive than the off-road engines). • Use an ARB approved low carbon fuel for construction equipment. (NOx emissions from the use of low carbon fuel must be reviewed and increases mitigated.) Purchase GHG offset for program-wide GHG emissions (direct emissions plus indirect emissions from on-road haul trucks plus commute vehicles) exceeding SMAQMD significance thresholds applicable at the time of construction. Carbon offset credits shall be purchased from programs that have been approved by SMAQMD.
Cultural Resources	
CR-1	A Programmatic Agreement has been executed for the ARCF Project. A HPTP will be developed if the proposed action is found to result in adverse effects to historic properties.
CR-2	In accordance with the procedures described in Sections 9.2 and 9.3.9 of the ARCF HPMP, an archaeological monitoring and discovery plan was included in the Identification and Evaluation Report and distributed to consulting Native American Tribes in April 2020. No comments were received. SHPO had no comment on the monitoring and discovery plan. This plan identifies the locations of known Historic Properties as well as sensitive areas designated for archaeological monitoring and includes methods and procedures for monitoring and the procedures to be followed in the event of a discovery of archaeological materials or human remains. Consultation with Native American Tribes concerning Tribal Monitoring is ongoing.
CR-3	In accordance with the procedures described in Section 9.1 of the ARCF HPMP, USACE shall require the contractor to provide a cultural resources and tribal cultural resources sensitivity and awareness training program for all personnel involved in project construction, including field consultants and construction workers. The training shall be developed in coordination with an archaeologist meeting Secretary of the Interior Professional Qualifications Standards for Archaeology, as well as culturally affiliated Native American tribes. USACE may invite Native American representatives from interested culturally affiliated Native American tribes to participate. The training shall be conducted before any project-related construction activities begin in the APE and shall include relevant information regarding sensitive cultural resources and Tribal Cultural Resources, including applicable regulations, protocols for avoidance, and consequences of violating Federal and State laws and regulations. The training shall also describe appropriate avoidance and impact

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	minimization measures for cultural resources and Tribal Cultural Resources that could be located in the APE and shall outline what to do and who to contact if any potential cultural resources or Tribal Cultural Resources are encountered. The training shall emphasize the requirement for confidentiality and culturally appropriate treatment of any discovery of significance to Native Americans and shall discuss appropriate behaviors and responsive actions, consistent with Native American tribal values.
CR-4	If an inadvertent discovery of cultural materials (e.g., unusual amounts of shell, animal bone, any human remains, bottle glass, ceramics, building remains), Tribal Cultural Resources, sacred sites, or landscapes is made at any time during project-related construction activities, USACE in consultation with CVFPB and other interested parties, shall develop appropriate protection and avoidance measures where feasible. These procedures shall be developed in accordance with the ARCF PA and ARCF HPMP, which specifies procedures for post-review discoveries. Additional measures, such as development of HPTPs prepared in accordance with the PA and HPMP, may be necessary if avoidance or protection is not possible.
CR-5	California Native American Tribes that are traditionally and culturally affiliated with the geographic area in which the project is located may have expertise concerning their Tribal Cultural Resources (California PRC Section 21080.3.1). Consistent with the California Natural Resources Agency Tribal Consultation Policy, culturally affiliated Tribes shall be consulted concerning Tribal Cultural Resources that may be impacted, if these types of resources are discovered prior to or during construction. Consultation with culturally affiliated Tribes shall focus on identifying measures to avoid or minimize impacts on any such resources discovered during construction. If Tribal Cultural Resources are identified in the APE prior to or during construction, the following performance standards shall be met before proceeding with construction and associated activities that may result in damage to or destruction of Tribal Cultural Resources: • Each identified Tribal Cultural Resource will be evaluated for CRHR eligibility through application of established eligibility criteria (CCR 15064.636), in consultation with interested Native American Tribes. • If a Tribal Cultural Resource is determined to be eligible for listing in the CRHR, USACE, in consultation with CVFPB, will avoid damaging the Tribal Cultural Resource in accordance with California PRC Section 21084.3, if feasible. If CVFPB determines that the project may cause a substantial adverse change to a Tribal Cultural Resource and measures are not otherwise identified in the consultation process, the following are examples of mitigation steps capable of avoiding or substantially lessening potential significant impacts to a Tribal Cultural Resource or alternatives that will avoid significant impacts to a Tribal Cultural Resource. These measures may be considered to avoid or minimize significant adverse impacts: i. Avoid and preserve resources in place, including, but not limited to, planning construction to avoid the resources and protect the cultural and natural context, or planning greenspace, parks, or other open space, to

ID #	Description
	incorporate the resources with culturally appropriate protection and management criteria. ii. Treat the resource with culturally appropriate dignity, taking into account the Tribal cultural values and meaning of the resource, including, but not limited to, the following: a. Protect the cultural character and integrity of the resource. b. Protect the traditional use of the resource. c. Protect the confidentiality of the resource. d. Establish permanent conservation easements or other interests in real estate, with culturally appropriate management criteria for the purposes of preserving or using the resources or places. e. Protect the resource.
CR-6	To minimize adverse effects from encountering human remains during construction, CVFPB shall implement the following measures: In accordance with the California Health and Safety Code, if human remains are uncovered during ground-disturbing activities, CVFPB shall consult with USACE, and USACE shall immediately halt potentially damaging excavation in the area of the burial and notify the Sacramento County Coroner and a professional archaeologist to determine the nature of the remains. The coroner is required to examine all discoveries of human remains within 48 hours of receiving notice of a discovery on private or State lands (California Health and Safety Code Section 7050.5[b]). If the coroner determines that the remains are those of a Native American, he or she must contact the NAHC by phone within 24 hours of making that determination (California Health and Safety Code Section 7050[c]). After the coroner's findings have been made, the archaeologist and the NAHC- designated MLD, in consultation with the landowner, shall determine the ultimate treatment and disposition of the remains. Upon the discovery of Native American human remains, USACE, in coordination with CVFPB, shall require that all construction work must stop within 100 feet of the discovery until consultation with the MLD has taken place. The MLD shall have 48 hours to complete a site inspection and make recommendations to the landowner after being granted access to the site. A range of possible treatments for the remains, including nondestructive removal and analysis, preservation in place, relinquishment of the remains and associated items to the descendants, or other culturally appropriate treatment may be discussed. California PRC Section 5097.98(b)(2) suggests that the concerned parties may mutually agree to extend discussions beyond the initial 48 hours to allow for the discovery of additional remains. The following site protection measures employed by CVFPB shall include: o record the site with the NAHC or the appropriate Information Center; and. o record a document with the county in which the property is located. CVFPB or CVFPB's authorized representative shall rebury the Native American human remains and associated

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	grave goods with appropriate dignity on the property in a location not subject to further subsurface disturbance. If the NAHC is unable to identify an MLD, or if the MLD fails to make a recommendation within 48 hours after being granted access to the site, CVFPB or CVFPB's authorized representative may reinter the remains in a location not subject to further disturbance. If CVFPB rejects the recommendation of the MLD and mediation by the NAHC fails to provide measures acceptable to CVFPB, CVFPB shall implement mitigation to protect the burial remains. Construction work in the vicinity of the burials shall not resume until the mitigation is completed.
Recreation	
REC-1	USACE and CVFPB will implement the following measures to reduce temporary, short- term construction effects on recreational facilities in the Project Area: • Provide marked detours for pedestrian routes. Detours should be developed in consultation with the City of Sacramento Bicycle and Pedestrian Coordinator at least 10 days before the start of construction activities, as applicable. Post signs that clearly indicate closure routes at major entry points for trails, and will provide a contact number to call for questions or concerns. • Post signs at major entry points for trails, and boat launch ramps at the Westin Hotel and the Sacramento Yacht Club clearly indicating closures of trails and estimated duration of closures. Information signs will notify the public of alternate parks and recreation sites, including boat launch ramps, and will provide a contact number to call for questions or concerns. • Upon completion of levee improvements, coordinate with the City of Sacramento to restore access and repair any construction-related damage to recreational facilities to pre- project conditions.
REC-2	• Post signs at the Westin Hotel and the Sacramento Yacht Club to clearly indicate the estimated duration of in-water work windows and construction duration. • Buoys will be placed at the upstream and downstream ends of the construction site to warm boaters of the in-water work. • Notify the Coast Guard, in accordance with the Rivers and Harbors Act, of in-water work from barges moored in the river. Notification will include in-water work windows and construction duration.
Visual Resources	
VIS-1	USACE will require its construction contractors to ensure that all temporary lighting related to security of the staging areas to be shielded or directed to avoid or minimize any direct illumination onto light-sensitive receptors located outside of the Project Area.
Noise	

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NOI-1	USACE and CVFPB will require construction contractors to implement measures at each work site to avoid and minimize construction noise and vibration effects on sensitive receptors. Prior to the start of construction, a noise control plan will be prepared to identify feasible measures to reduce construction noise when necessary. The measures in the plan will apply to construction activities within 500 feet of a sensitive receptor, including, but not limited to, residences. These measures, to the extent practicable and feasible may include, but are not limited to, the following: • provide written notice to residents within 1,000 feet of the construction zone, advising them of the estimated construction schedule. This written notice would be provided within 1 week to 1 month of the start of construction at that location; • display notices with information including, but not limited to, contractor contact telephone number(s) and proposed construction dates and times in a conspicuous location, such as on construction site fences; • schedule the loudest and most intrusive construction activities during daytime hours (7:00 a.m. to 7:00 p.m.); • require that construction equipment be equipped with factory-installed muffling devices, and that all equipment be operated and maintained in good working order to minimize noise generation; • locate stationary noise-generating equipment as far as practicable from sensitive receptors; • limit unnecessary engine idling (i.e., more than 5 minutes) as required by State air quality regulations; • employ equipment that is specifically designed for low noise emission levels; • employ equipment that is powered by electric or natural gas engines, as opposed to those powered by gasoline fuel or diesel; • if the construction zone is within 500 feet of a sensitive receptor, place temporary barriers between stationary noise equipment and noise sensitive receptors or take advantage of existing barrier features, such as existing terrain or structures to block noise transmission; • if the construction zone is within 500 feet of a sensitive receptor, prohibit use of backup alarms and provide an alternate warning system, such as a flagman or radar-based alarm that is compliant with State and Federal worker safety regulations; • locate construction staging areas as far as practicable from sensitive receptors; and • design haul routes to avoid sensitive receptors. In addition to noise reduction measures, to the extent feasible and practicable, the primary construction contractors shall employ vibration-reducing construction practices compliant with applicable noise-level rules and regulations. These practices must comply with vibration standards established for construction vibration-sources by applicable agencies (City of Sacramento and Sacramento County), depending on the jurisdictional location of the affected receptor(s). Project construction specifications will require the contractor to limit vibrations to less than 0.2-inch per second PPV and less than 72 VdB within 50 feet of any building. If construction will occur within 50 feet of any occupied building, the contractor

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	would prepare a vibration control plan prior to construction. The plan would include measures to limit vibration, including but not limited to the following: • avoid vibratory rollers and packers near sensitive areas; • route heavily loaded trucks away from residential streets. and if no alternatives are available, select routes with the fewest homes; • a voluntary pre- and post-construction survey would be conducted to assess potential architectural damage from levee construction vibration at each residence within 75 feet of the proposed construction area. The survey would include visual inspection of the structures that could be affected and include supporting documentation of structures by means of photographs and video. This documentation would be reviewed with the individual owners prior to any construction activities for their awareness and concurrence. Post-construction monitoring of structures shall be performed to identify (and repair, if necessary) damage, if any, from construction vibrations. Any damage shall be documented, reviewed with the individual property owners and supported by photographs and video; and • place vibration monitoring equipment at the property line adjacent to large equipment and, with owner approval, at the back of the residential structures adjacent to the large equipment. Vibration measurements must be recorded daily.
Vegetation and Wildlife	
VEG-1	Project designs will be refined to reduce impacts on vegetation and wildlife to the extent practicable. Refinements implemented to reduce the loss of riparian habitat will include reducing the impact footprint, constructing bank protection rather than launchable rock trench whenever feasible, and designing planting benches. Where practicable, trees will be retained in locations where the bank protection and planting bench is constructed. Trees will be protected in place along the natural channel during the placement of rock. Additional plantings will be installed on the newly constructed bench to provide habitat for fish and avian species. The planting bench will be used where practicable to minimize impacts on fish and wildlife species. The on-site habitat will be created in accordance with the ARCF GRR HMMAMP, which includes conceptual mitigation proposals, performance standards, and adaptive management tasks.
VEG-2	USACE will implement the following measures to compensate for riparian habitat degradation: To compensate for the removal of riparian habitat (1.258 acres), replacement habitat will be created at a ratio of 2:1 to account for the temporal loss of habitat while newly created habitat is growing. Species selected to compensate for the riparian corridor removal will be consistent with the approved list of trees, shrubs, and herbaceous plants native to the Great Valley Mixed Riparian Forest. The replacement habitat will be created in accordance with the ARCF GRR HMMAMP, which includes conceptual mitigation proposals, performance standards, and adaptive management tasks. After construction has been completed, 0.22 acres of riparian vegetation will be planted in the planting bench. The

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	remaining compensation for the temporal loss of riparian vegetation and habitat will be off-site and would occur at locations that will be protected in perpetuity. These sites will be selected and designed in coordination with NMFS and USFWS as part of the consultation under the Endangered Species Act.
Water Quality	
WATERS-1	If the project is implemented, in compliance with the Clean Water Act, USACE will compensate for fill of State and federally protected waters to ensure the project causes no net loss of functions and values. Water quality certification pursuant to Section 401 of the Clean Water Act (CWA) will be obtained from the Central Valley RWQCB before starting project activities. Any measures determined necessary during the permitting processes will be implemented, such that there is no net loss of functions and values of jurisdictional waters. Mitigation may be accomplished through habitat replacement, enhancement of degraded habitat, off-site mitigation at an established mitigation bank, contribution of in-lieu fees, or other method acceptable to the regulatory agencies, ensuring there is no net loss of waters of the United States. If compensation is provided through permittee-responsible mitigation with additional NEPA documentation, a mitigation plan would be developed to detail appropriate compensation measures determined through consultation with USACE and Central Valley RWQCB. These measures would include methods for implementation, success criteria, monitoring and reporting protocols, and contingency measures to be implemented if the initial mitigation fails.
Geological Resources	
GEO-1	Prior to the start of earthmoving activities, USACE and CVFPB will obtain coverage under the State Water Resources Control Board (SWRCB) NPDES stormwater permit for general construction activity (Order 2009-0009-DWQ), including preparation and submittal of a project- specific SWPPP at the time the NOI to discharge is filed. The SWPPP shall identify and specify the following: • the use of an effective combination of robust erosion and sediment control BMPs and construction techniques that shall reduce the potential for runoff and the release, mobilization, and exposure of pollutants, including legacy sources of mercury from project-related construction sites. These may include but would not be limited to temporary erosion control and soil stabilization measures, sedimentation ponds, inlet protection, perforated riser pipes, check dams, and silt fences; • the implementation of approved local plans, non-stormwater management controls, permanent post-construction BMPs, and inspection and maintenance responsibilities; • the pollutants that are likely to be used during construction that could be present in stormwater drainage and non-stormwater discharges, including fuels, lubricants, and other types of materials used for equipment operation;

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	• the means of waste disposal; • spill prevention and contingency measures, including measures to prevent or clean up spills of hazardous waste and of hazardous materials used for equipment operation, and emergency procedures for responding to spills; • personnel training requirements and procedures that shall be used to ensure that workers are aware of permit requirements and proper installation methods for BMPs specified in the SWPPP; and • the appropriate personnel responsible for supervisory duties related to implementation of the SWPPP. Where applicable, BMPs identified in the SWPPP will be in place throughout all site work, construction/demolition activities, and will be used in all subsequent site development activities. BMPs may include, but are not limited to, such measures as those listed below. • work window- conduct earthwork during low flow periods (July 1 through November 30); • to the extent possible, stage construction equipment and materials on the landside of the levee in areas that have already been disturbed; • minimize ground and vegetation disturbance during project construction by establishing designated equipment staging areas, ingress and egress corridors, spoils disposal and soil stockpile areas, and equipment exclusion zones prior to the commencement of any grading operations; • stockpile soil on the landside of the levee reaches, and install sediment barriers (e.g., silt fences, fiber rolls, and straw bales) around the base of stockpiles to intercept runoff and sediment during storm events. If necessary, cover stockpiles with geotextile fabric to provide further protection against wind and water erosion; • install sediment barriers on graded or otherwise disturbed slopes as needed to prevent sediment from leaving the project site and entering nearby surface waters; • install plant materials to stabilize cut and fill slopes and other disturbed areas once construction is complete. Plant materials will include an erosion control seed mixture or shrub and tree container stock. Temporary structural BMPs, such as sediment barriers, erosion control blankets, mulch, and mulch tackifier, will be installed as needed to stabilize disturbed areas until vegetation becomes established; • conduct water quality tests specifically for increases in turbidity and sedimentation caused by construction activities; • prepare a Spill Prevention Control and Countermeasures Plan (SPCCP). A SPCCP is intended to prevent any discharge of oil into navigable water or adjoining shorelines. The contractor will develop and implement an SPCCP to minimize the potential for adverse effects from spills of hazardous, toxic, or petroleum substances during construction and operation activities. The SPCCP will be completed before any construction activities begin. Implementation of this measure will comply with State and Federal water quality regulations. The SPCCP will

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	describe spill sources and spill pathways in addition to the actions that would be taken in the event of a spill (e.g., an oil spill from engine refueling would be immediately cleaned up with oil absorbents). The SPCCP will outline descriptions of containments facilities and practices such as doubled-walled tanks, containment berms, emergency shut-offs, drip pans, fueling procedures and spill response kits. It will also describe how and when employees are trained in proper handling procedure, spill prevention, and response procedures; • a copy of the approved SWPPP shall be maintained and available at all times on the construction site; and USACE and CVFPB will also prepare a SPCCP. A SPCCP is intended to prevent any discharge of oil into navigable water or adjoining shorelines. The contractor will develop and implement a SPCCP to minimize the potential for adverse effects from spills of hazardous, toxic, or petroleum substances during construction and operation activities. The SPCCP will be completed before any construction activities begin. Implementation of this measure will comply with state and Federal water quality regulations. The SPCCP will describe spill sources and spill pathways in addition to the actions that would be taken in the event of a spill (e.g., an oil spill from engine refueling would be immediately cleaned up with oil absorbents). The SPCCP will outline descriptions of containments facilities and practices such as doubled-walled tanks, containment berms, emergency shut-offs, drip pans, fueling procedures, and spill response kits. It will also describe how and when employees are trained in proper handling procedures and spill prevention and response procedures.
Hazardous Wastes and Materials	
HAZ-1	USACE will require that Project Areas be tested for contaminants prior to construction. Any hazardous materials found would be disposed of in accordance with all Federal, State, and local regulations at an approved disposal site. Where construction activities would occur in close proximity to sites identified as RECs in the Phase I ESA (HDR 2019), a Phase II site investigation should also be conducted.

Appendix F. Revisions to the Draft Supplemental Environmental Assessment/Environmental Impact Report

This appendix presents corrections and revisions made to the proposed project's Draft Supplemental Environmental Assessment/Environmental Impact Report (SEA/EIR). This appendix does not identify administrative changes to the SEA/EIR text which do not affect the analysis contained in the SEA/EIR; for example, updates to the public review process. New text is indicated with an <u>underline</u> and text to be deleted is indicated by a ~~strike through~~. Text changes are presented in the page order in which they appear in the SEA/EIR.

The changes identified below are clarification, amplifications, and updates of the information and analysis contained in the SEA/EIR. None of the changes identified below results in a significant impact that was not already identified in the SEA/EIR. Furthermore, none of the impacts identified in the SEA/EIR were found to be substantially more severe as the result of the following changes. For these reasons, recirculation of the SEA/EIR is not warranted.

Mitigation Measures

Page viii – xxiii, Table 1. Summary of Environmental Commitments (Mitigation Measures, etc.) for the Proposed Project (Alternative 2) has been moved to Appendix E.

2.0 Alternatives

Page 12, the end of the second paragraph has the following sentence inserted:

<u>The location of the riparian planting bench was established by the Standard Assessment Method (SAM) model which establishes a prime interface for the specified habitat. The exact location was tempered and adjusted for specific locational variables by the professional contributions of the project development team and historic precedent.</u>

Page 13, the second paragraph is revised as follows:

The trees will be ~~anchored into the 15 foot thick quarry stone toe~~ <u>placed into the quarry stone below the planting bench</u> by the root ball and one half of the tree length, keyed into the quarry stone below the riparian bench, with canopies extended into the water column just below the waterside edge of the riparian bench, and oriented in a downstream direction. <u>The counterweight by the planting bench and quarry stone will provide adequate protection for the logs to withstand buoyancy and drag forces from incoming flows and debris.</u> The downstream orientation of the IWM is to mimic the natural orientation of downed trees along river systems. The IWM will be placed at 5- to 10- foot spacing in alternating groups of 3 to 5 trees. Tree branches will be oriented to protrude out from the riparian bench at the summer mean water surface elevation to provide a visual indication to river users of the presence of the bench. <u>The State of Washington's Stream Habitat Restoration Guidelines, Appendix G (2012), were used to inform the design of the IWM.</u>

Page 13, the last paragraph is revised as follows:

Tree removal and site preparation will occur from the ~~waterside~~ <u>top of the levee</u>.

Page 14, the end of the second paragraph has the following inserted:

Tree removal vehicles and equipment will also access the site from the landside.

Page 16, the second paragraph is revised as follows:

Tree removal is expected to begin in ~~December 2020~~ late January 2021 and conclude by February 14, 2021. Tree removal may however need to be delayed to August 2021, in order to avoid incidental take of nesting migratory birds including Swainson's Hawks or until winter 2021/2022. Mitigation Measures, described in Section 3, to avoid and minimize impacts to other species will be followed. Construction is likely to occur in two phases. The first phase would include mobilization, Best Management Practices (BMP) installation, and out of water earthwork and improvements. This phase will start in late June or early July 2021 as the winter high flow recedes and the likelihood of rainfall reduces. The Contractor will submit a mobilization/demobilization work plan prior to starting the work. The second phase of construction will occur from July 1 to October 31, 2021. This will include the construction of the planting benches and launchable rock toe. It will also include installation of the temporary erosion control seeding of disturbed areas. Any alterations to the levee prism should be repaired prior to November 1, and all in water work should be complete by October 31. If the tree removal is delayed to winter 2021/2022, construction of the bank protection would occur in 2022 instead. Table 3, below, describes the anticipated primary construction phases, including tree removal, construction, and planting. Table 4 describes the wildlife work windows.

The following table is inserted below Table 3:

Table 4. Wildlife Work Windows

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RM 55.2L											
								Bird Work Window Sept 1 – Feb 14			
								Bat Work Window Sep 1 – Mar 31			
						Fish Work Window Jul 1 – Oct 31					

Page 17, the following sentence is removed from the first paragraph:

~~Once construction is complete, the site would be turned over to the non-Federal partners, who would be responsible for the long term operation and maintenance (O&M) of the site, including repair, rehabilitation, and replacement of all project features.~~

Page 17, the second paragraph is revised as follows:

The RM 55.2L Project site is comprised of portions of eight separate parcels that are privately owned. ~~Following implementation of the Proposed Action,~~ The project components, including onsite habitat mitigation, will be managed and maintained by USACE for an interim period until the site is turned over to the local maintaining agency (LMA) or non-federal sponsor (NFS) for long-term operation and maintenance. The LMA for the project area is currently DWR's Maintenance Area (MA) 9, and it is likely that the CVFPB and SAFCA would return the project to MA 9 for long term maintenance. O&M will be conducted in accordance with the monitoring indicators stipulated in the management plan.

Page 18, the first sentence of the last paragraph is revised as follows:

Adaptive management will commence upon completion of the habitat mitigation project and continue as necessary to ensure the success of the on-site habitat mitigation ~~of the short-term maintenance period and continue as necessary~~.

3.0 Affected Environment and Environmental Consequences

Page 20, part of the first paragraph of 3.1.5 Transportation and Circulation is revised as follows:

The only vehicles with access to the site from area roadways will be the personal vehicles of construction crew members ~~using their POVs and~~, occasional deliveries, and vehicles and equipment associated with tree removal.

Page 22, the first paragraph of 3.2 is revised as follows:

For resources on which the Proposed Action may have significant effects, mitigation measures ~~are proposed as identified in~~ from the ARCF GRR EIS/EIR, which have been previously adopted, are incorporated into the Proposed Action.

Page 26, the end of the third paragraph is revised as follows:

Tree removal, 1.258 acres, from construction activities will reduce the amount of habitat available to these species and could destroy active nests, resulting in the loss of eggs and young.

Page 26, the end of the fourth paragraph is revised as follows:

The studies focused on finding nesting birds protected by the State of California such as Swainson's Hawk and White-tailed Kite, and other birds protected under the Migratory Bird Treaty Act (MBTA), per Mitigation Measure BIRD-1. In April 2020, a pair of Swainson's Hawks were observed building a nest in a tree adjacent to the project area. They may return to the nest or another raptor, protected under MBTA, may occupy the nest during the 2021 nesting season. The implementation of mitigation measures will reduce impacts to nesting birds, including the 0.22 onsite planting bench. Further discussion of vegetation removal can be found in Section 3.2.9.

Page 26, the end of the last paragraph is revised as follows:

To the extent practical, tree removal associated with the Proposed Action will occur during the non-nesting season to avoid removing vegetation with active nests (~~August 16~~ September 1 – ~~January 31~~ February 14). Additionally, avoidance, minimization, and compensation for ~~SRA~~ habitat removal will occur (as described in Mitigation Measure VEG-1, VEG-2, and SRA-1 and Section 3.6 of the ARCF GRR EIS/EIR).
Page 27, the second to last paragraph is revised as follows:

Impacts to delta smelt were calculated according to the 2015 USFWS BO. Effects to delta smelt will result in ~~0.65~~ 2 acres of spawning habitat impacts. The planting bench will create 0.22 acre of on-site mitigation (SRA habitat); therefore, ~~0.43~~ 1.78 acres of off-site mitigation is needed for spawning habitat impacts. The remainder of the mitigation will be offset as recommended in the USFWS BO, to be issued this year (2020) or early next year, 2021. Shallow water habitat impacts were calculated at +0.19 acre. The impact is ~~not negative~~ positive due to the onsite planting bench; therefore, off-site mitigation is not needed for shallow water habitat impacts according to the 2015 BO for delta smelt.

Impacts to salmonids and green sturgeon will result in 3.21 ~~3.27~~ acres of habitat ~~effects~~ impacts to each species. ~~2.89 acres of onsite mitigation would be completed for salmonids. The remaining mitigation acreage would occur offsite as recommend by the forthcoming NMFS BO.~~ Mitigation bank credits have been purchased to mitigate impacts to green sturgeon. The planting bench will mitigate for 0.22 ac of impacts to salmonids onsite, while the remaining 2.99 acres will be mitigated off-site as described in Mitigation Measure SRA-1. USACE is exploring mitigation opportunities at a large-scale mitigation area within a radius of 50 miles (55 river miles) on or adjacent to the main stem of the Sacramento River. USACE, CVFPB, DWR, and SAFCA are dedicated to providing quality mitigation SRA and riparian habitat losses due to the Proposed Action and for all other components of the ARCF 2016 Project. The offsite mitigation will occur as close to the project impacts as feasible considering site availability and the scale of mitigation required for the overall ARCF 2016 Project. Salmonid impacts could also be mitigated by the purchase of Green Sturgeon mitigation bank credits, as the mitigation bank also benefits salmonids.

Page 27, the following table is insert at the bottom of the page:

Table 5. Mitigation Acreage for Special Status Species

Species	**Onsite**	**Offsite**	**Bank Credits**	**TOTAL**
Delta Smelt	0.22	1.78		2
Salmonids	0.22	2.99		3.21
Green Sturgeon			3.21	3.21
Western Yellow-Billed Cuckoo	0.22	1.038		1.258

Note: Table values do not include mitigation ratio application.

Page 35, the first bullet point under Mitigation Measure FISH-1 is revised as follows:

- In-water construction activities (e.g., placement of rock revetment) will be limited to the work window of July 1 through October 31. The in-water work window could be extended to November 15 with NMFS approval. If USACE needs to work outside of this window, it will consult with USFWS and NMFS.

Page 37, the first sentence of the second bullet point under Mitigation Measure SRA-1 is revised as follows:

USACE will incorporate compensation for SRA habitat losses either by constructing off-site compensation sites, purchase of credits at a NMFS-approved conservation bank, where appropriate, or by implementing a combination of the two, and by funding a research grant for green sturgeon.

Page 38, the following Mitigation Measures have been inserted after Mitigation Measure SRA-1:

Mitigation Measure VEG-1: Avoid and Minimize Impacts to Riparian Habitat

Refer to Section 3.2.9 for full text of this mitigation measure.

Mitigation Measure VEG-2: Compensate for Riparian Habitat Removal.

Refer to Section 3.2.9 for full text of this mitigation measure.

Page 41, the end of the last paragraph is revised as follows:

Avoidance, minimization, and mitigation measures identified as Mitigation Measures AIR-1, AIR-2, AIR-3, ~~and~~ AIR-4, and AIR-5 will be implemented to reduce this impact to a less-than-significant level.

Page 43, the last paragraph is revised as follows:

The following measures are consistent with mitigation identified in the ARCF GRR EIS/EIR. Exhaust emission mitigation has been adjusted to reflect mitigation and offset requirements associated with the General Conformity determination for the ARCF projects. ~~Marine engine standards identified in the ARCF GRR EIS/EIR are not being applied to the activities included in the Proposed Action due to concerns about the availability of Tier 2 and 3 marine engines. The air quality modeling for the Proposed Action assumed use of 1997 to 2002 marine engines. Mitigation fee payment is proposed in lieu of the marine engine standards identified in the ARCF GRR EIS/EIR and would be effective to reduce impacts to a less-than-significant level.~~ Tables 10 and 11 show estimated emissions of the Proposed Action, after implementing the avoidance, minimization, and mitigation measures shown below in AIR-1 through AIR-5~~4~~. Tables 12 and 13 show estimated emissions of the ARCF 2016 projects that would be constructed in 2021, after implementing avoidance and minimization measures shown below in AIR-1 through AIR-3.

Page 47, the following is inserted after Mitigation Measure AIR-4:

Mitigation Measure AIR-5: Implement Marine Engine Standards

USACE shall encourage the use of U.S. Environmental Protection Agency (EPA) adopted Tier 3 and Tier 4 standards for newly built marine engines in 2008. The Tier 3 standards reflect the application of technologies to reduce engine PM and NOX emission rates. Tier 4 standards reflect application of high-efficiency catalytic after-treatment technology enabled by the availability of ultra-low sulfur diesel.

USACE will use Tier 2 and 3 marine engines standards where available to reduce marine exhaust emissions. Due to uncertainty as to the availability of Tier 4 marine engines within the required project timeline, this mitigation measure does not require the use of Tier 4 marine engines. However, should they become available during the appropriate construction periods, the use of these engines will be required in order to further lower project emissions.

Page 52, the following paragraph is inserted after the first paragraph:

USACE determined that the Sacramento River East Levee Unit 115 will not be adversely affected by the Proposed Action, resulting in a finding of No Adverse Effect for the project. SHPO concurred with this determination in a letter dated September 2, 2020.

Page 53, the first paragraph is removed

~~USACE has not concluded determinations of NRHP eligibility based on consultation with SHPO and other ARCF PA Parties and therefore the impact analysis presented in this document does not reflect consensus findings under Section 106 of the NHPA as implemented through the ARCF PA. In accordance with the ARCF PA, confirmation of NRHP eligibility and findings of effect and appropriate mitigation would be made through consultation between USACE, SHPO, and other ARCF PA Parties as appropriate prior to initiating construction of the Proposed Action.~~

Page 54, the first two paragraphs under Alternative 2 – Proposed Action are revised as follows:

Erosion counter measures will not include substantial ground ~~disturbance~~ excavation, ~~including bank excavation and~~ the project is primarily riprap placement~~, and use of staging areas~~. Earthmoving activities could result in damage to or destruction of unknown or subsurface historic-period sites, prehistoric- period archaeological sites, and Native American identified Tribal Cultural Resources. Earthmoving is not included in this project, therefore this impact would be avoided.

The only recorded Historic Property within the APE is P-34-002143, the Sacramento River East Levee Unit 115. The proposed action will have No Adverse Effect to Sacramento River East Levee Unit 115 as it will not affect the integrity of the resource, including aspects of setting, feeling, and association. ~~In accordance with the ARCF PA, confirmation of NRHP eligibility and findings of effect and appropriate mitigation would be made through consultation between USACE, SHPO, and other ARCF PA Parties as appropriate prior to initiating construction of the~~

~~Proposed Action. Compliance with the terms of the ARCF PA reduces effects to less than significant under NEPA~~. A draft report detailing these findings was distributed to consulting Native American Tribes in April 2020, with no comments received. SHPO concurred with the finding of No Adverse Effect in a letter dated September 2, 2020.

Page 55, Mitigation Measure CR-2 is revised as follows:

In accordance with the procedures described in Sections 9.2 and 9.3.9 of the ARCF HPMP, an archaeological monitoring and discovery plan ~~shall be developed for the Proposed Action~~ was included in the Identification and Evaluation Report, and distributed to consulting Native American Tribes in April 2020. No comments were received. SHPO had no comment on the monitoring and discovery plan. This plan identifies the locations of known Historic Properties as well as sensitive areas designated for archaeological monitoring and includes methods and procedures for monitoring and the procedures to be followed in the event of a discovery of archaeological materials or human remains. Consultation with Native American Tribes concerning Tribal Monitoring is ongoing.

Page 59, the last sentence of the first paragraph under Alternative 2 – Proposed Action is revised as follows:

Although the Proposed Action will result in temporary closures to a portion of the levee, this will not eliminate or substantially restrict the availability of the recreational value of the levee, because this portion of the levee is not available for use by the general public because of gates across the levee that prevent public access.

Page 59, the follow sentence is inserted into the second paragraph under Alternative 2 – Proposed Action:

The impacts will be less-than-significant with implementation of the mitigation measures below.

Page 63, a sentence in the first paragraph under Avoidance and Minimization Measures is revised as follows:

Consistent with the ARCF GRR EIS/EIR, the long-term effects to visual resources from the Proposed Action will be reduced to less than significant with avoidance, minimization, and inclusion of the on-site riparian planting bench (Mitigation Measures VEG-1, VEG-2, and SRA-1).

Page 68, the first paragraph under Alternative 2 – Proposed Action is revised as follows:

Implementing Mitigation Measures VEG-1 and VEG-2 will reduce the long-term impact on vegetation and wildlife, including nesting birds, to less than significant by avoiding and minimizing impacts and compensating for habitat removal in coordination with USFWS and NMFS. […] Therefore, the impacts due to short-term habitat loss will remain significant and unavoidable.

Page 69, the second paragraph under Alternative 2 – Proposed Action is revised as follows:

As stated in mitigation measure VEG-2~~1~~, the riparian habitat slated to be removed for the Proposed Action will be compensated for according to the appropriate ratio. 1.258 acres of canopy will be removed for the placement of bank protection revetment, planting bench, and IWM. In the event more canopy is needed to be removed by trimming or removal of full trees, an additional 10% of canopy may be removed such that no more than 1.38 acres of canopy will be removed. The planting bench will compensate for 0.22 acres, the remaining compensation will be at an off-site location within a radius of 50 miles (55 river miles) on or adjacent to the main stem of the Sacramento River. USACE, CVFPB, and SAFCA are seeking to implement mitigation to address impacts associated with the ARCF 2016 Project by 2025. However, the specific timing of implementing the mitigation is uncertain due to potential challenges with acquiring the necessary real estate on a scale that can provide mitigation for impacts anticipated from multiple contracts being constructed as part of the ARCF 2016 Project. Mitigation sites that are closer to project site are preferred but, is dependent on site availability. Off-site mitigation options are currently being analyzed for riparian compensation and will be investigated in additional NEPA and CEQA documentation. If additional canopy removal is required, it would be compensated for in accordance with VEG-2~~1~~.

Page 69, the fifth paragraph contains the following revision:

A 404(b)(1) evaluation has been completed and is included in Appendix C. ~~and~~ A 401 permit will be completed prior to the start of work below the OHWM that is subject to Section 401[…]

Page 69, the last paragraph of Alternative 2 – Proposed Action is revised as follows:

The ARCF GRR EIS/EIR concluded that mitigation measures will reduce potential long-term impacts on vegetation and wildlife resources to a less-than-significant level because once vegetation has fully developed, the on-site and off-site mitigation areas will provide ~~the habitat quality of the Project Area would be~~ similar or better habitat value compared to ~~than under~~ existing conditions. The ARCF GRR EIS/EIR also concluded that short-term impacts on vegetation and wildlife resources associated with construction along the Sacramento River will be significant and unavoidable because of the many years for riparian habitat to become fully mature and provide the same value as the existing riparian habitat. Construction of the Proposed Action will not result in short-term impacts on vegetation and wildlife resources that are new or more severe than those addressed in the ARCF GRR EIS/EIR and, therefore, those construction-related short-term impacts on vegetation and wildlife are adequately addressed in the ARCF GRR EIS/EIR.

Page 70, Mitigations Measures are revised as follows:

Mitigation Measure VEG-1: ~~Compensate~~ Retain, Protect, and Plant Trees On-Site ~~for Riparian Habitat Removal~~.

Project designs will be refined to reduce impacts on vegetation and wildlife to the extent practicable. Refinements implemented to reduce the loss of riparian habitat will include reducing the impact footprint, constructing bank protection rather than launchable rock trench whenever feasible, and designing planting benches.

Where practicable, trees will be retained in locations where the bank protection and planting bench is constructed. Trees will be protected in place along the natural channel during the placement of rock. Additional plantings will be installed on the newly constructed bench to provide habitat for fish and avian species. The planting bench will be used where practicable to minimize impacts on fish and wildlife species. The on-site habitat will be created in accordance with the ARCF GRR HMMAMP, which includes conceptual mitigation proposals, performance standards, and adaptive management tasks.

Mitigation Measure VEG-2: Compensate for Riparian Habitat Removal.

USACE will implement the following measures to compensate for riparian habitat degradation:

To compensate for the removal of riparian habitat (1.258 acres), replacement habitat will be created at a ratio of 2:1 to account for the temporal loss of habitat while newly created habitat is growing. Species selected to compensate for the riparian corridor removal will be consistent with the approved list of trees, shrubs, and herbaceous plants native to the Great Valley Mixed Riparian Forest. The replacement habitat will be created in accordance with the ARCF GRR HMMAMP, which includes conceptual mitigation proposals, performance standards, and adaptive management tasks.

After construction has been completed, 0.22 acres of riparian vegetation will be planted in the planting bench. The remaining compensation for the temporal loss of riparian vegetation and habitat will be off-site and would occur at locations that will be protected in perpetuity. These sites will be selected and designed in coordination with NMFS and USFWS as part of the consultation under the Endangered Species Act.

Page 72, a sentence in the first paragraph under Alternative 2 – Proposed Action is revised as follows:

Under the Clean Water Act, a 401 permit and 404(b)(1) evaluation ~~(Appendix C)~~ will be required before work below the OHWM begins. The 404(b)(1) evaluation has been completed and is included in Appendix C.

Page 73, two sentences in Mitigation Measure WATERS-1 includes the following revision:

Water quality certification pursuant to Section 401 of the Clean Water Act (CWA) will be obtained from the Central Valley RWQCB before starting project activities subject to Section 401.

If compensation is provided through permittee-responsible mitigation with additional NEPA documentation, a mitigation plan would be developed to detail appropriate compensation measures determined through consultation with USACE and Central Valley RWQCB.

Page 75, the following sentence is inserted to the beginning of the first paragraph under Alternative 2 – Proposed Action

<u>The Proposed Action would not expose people or structures to substantial effects involving earthquakes, landslides, and expansive soils. Additionally, the Proposed Action would not be located on unstable geographic units.</u>