Appendix J
Endangered Species Act Section 7 Consultation

Appendix J.1

Biological Assessment for the West Sacramento General Reevaluation Study and the Southport Sacramento River Early Implementation Project

Biological Assessment

West Sacramento, California
General Reevaluation Study and
Section 408 Permission

November 2014

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Acronyms and Abbreviations

BA	biological assessment
BMPs	best management practices
BSSCP	bentonite slurry spill contingency plan
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CHP	California Highway Patrol
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Corps	U.S. Army Corps of Engineers
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
dbh	diameter at breast height
DPS	distinct population segment
DSM	deep soil mixing
DWR	California Department of Water Resources
DWSC	Sacramento Deep Water Ship Channel
EFH	essential fish habitat
EIP	Early Implementation Project
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
EPA	U.S. Environmental Protection Agency
ESA	Federal Endangered Species Act
ESU	evolutionary significant unit
ETL	Engineer Technical Letter
FRM	flood risk management
GRR	general reevaluation report
IWM	instream woody material
lf	linear feet
LPP	locally preferred plan
MBTA	Migratory Bird Treaty Act
MMP	Mitigation and Monitoring Plan
MSA	Magnuson-Stevens Fishery Conservation and Management Act of 1997
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
O&M	operations and maintenance
OHWM	ordinary high water mark

PL	public law
psi	pounds per square inch
RD	reclamation district
RM	river mile
RWQCB	Regional Water Quality Control Board
SAM	Standard Assessment Methodology
SCS	U.S. Soil Conservation Service
SPCCP	spill prevention, control, and counter-measure plan
SRA	shaded riverine aquatic
SRBPP	Sacramento River Bank Protection Project
SRFCP	Sacramento River Flood Control Project
SWPPP	stormwater pollution protection plan
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VELB	valley elderberry longhorn beetle
VVR	vegetation variance request
WRDA	Water Resources Development Act
WRI	weighted species response index
WSAFCA	West Sacramento Area Flood Control Agency

1.0 Introduction

The U.S. Army Corps of Engineers (Corps) is requesting consultation with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Federal Endangered Species Act (ESA) on potential effects on listed threatened or endangered species and on designated critical habitat from implementation of flood risk management (FRM) improvements proposed under the West Sacramento General Reevaluation Study (West Sacramento Project). The West Sacramento Project's proposed action also includes FRM improvements proposed by the West Sacramento Area Flood Control Agency's (WSAFCA) Southport Sacramento River Early Implementation Project (EIP). WSAFCA is requesting permission from the Corps pursuant to Section 14 of the River and Harbors Act of 1899 (Title 33 of the United States Code [USC], Section 408, [33 USC 408]), for the alteration of the Federal flood management project.

The purpose of this Biological Assessment (BA) is to analyze the potential effects from the proposed project on listed threatened or endangered species and on designated critical habitat, within the project's area of effect (action area). The outcome of this BA and consultation with the USFWS and NMFS will determine the need for formal consultation or whether a determination of "not likely to adversely affect" is appropriate for listed species that may be affected. In addition, this BA intends to fulfill consultation requirements for the Magnuson-Stevens Fishery Conservation and Management Act of 1997 (NMFS 1997). This BA was prepared in accordance with the Corps' Engineering Regulation 1105-2-100 (Corps 2000a).

Section 7 of the ESA requires Federal agencies to conserve listed species and their critical habitat, and to consult with USFWS and NMFS (the Services) to ensure that actions they fund, authorize, or perform do not jeopardize the existence of any listed species or result in the destruction or adverse modification of their designated critical habitat. The actions covered in this BA are associated with future levee modifications proposed under the West Sacramento Project.

The Magnuson-Stevens Fishery Conservation and Management Act of 1997 (MSA) governs the conservation and management of commercially harvested ocean fisheries. The purpose of the Act is to take immediate action to conserve, protect, and manage U.S. coastal fishery resources, anadromous species, and Essential Fish Habitat (EFH). EFH is the aquatic habitat (water and substrate) that is necessary for fish to spawn, breed, feed, or mature, and that allows production levels needed to: (1) support a long-term, sustainable commercial fishery, and (2) contribute to a healthy ecosystem (NMFS 1997). Most, if not all, of the West Sacramento General Reevaluation Report (GRR) study area is designated as EFH habitat for Pacific salmon under Section 305(b)(2) of the MSA. Species to be addressed in this BA include:

- Fish species with designated EFH under the MSA
- Listed species under the Federal Endangered Species Act
- Species with designated critical habitat under the ESA

1.1 Action Area

The action area refers to the area directly or indirectly affected by the proposed action (50 CFR 402.02 and 402.14[b][2]). This includes the project footprint and surrounding areas where covered species could be affected by project-related impacts. The action area for the West Sacramento project is shown in Figure 1 and includes the Sacramento River from the Sacramento Bypass down to the South Cross levee, the Sacramento Deep Water Ship Channel (DWSC) and Port of West Sacramento, and the Sacramento and Yolo Bypasses.

The Action Area includes perennial waters of the Sacramento River extending 200 feet perpendicular from the average summer-fall shoreline and 1,000 feet downstream from proposed in-water construction areas. This represents the potential area of turbidity and sedimentation effects based on the reported limits of visible turbidity plumes in the Sacramento River during similar construction activities (NMFS 2008).

Erosion repairs are proposed as part of the proposed action. These repairs are likely to somewhat reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, from a system sediment perspective, the bank material we are protecting in the project reaches is not a major source of sediment compared to the upstream reaches of the Sacramento, Feather and especially the Yuba River systems. For velocity, the site specific designs will be constrained from allowing any velocity increases outside the erosion repair site.

In addition, the proposed Southport levee setback action would have hydraulic effects which would include slight changes in water surface elevations that extend for several miles upstream and downstream of the project area during flood events. However, hydraulic analyses indicate that potential effects on hydraulic, geomorphic, and sediment transport conditions in the Sacramento River will be insignificant and unlikely to adversely affect listed species and designated critical habitat (ICF International 2013). Therefore the action area for the project would be directly related to the study area and not extend significantly outside where construction activities would occur. The action area is described in greater detail below and includes the following study areas.

1.1.1 West Sacramento Project Study Area

The West Sacramento project study area refers to the area that would be protected by the proposed levee improvements, including the city of West Sacramento itself and the lands within WSAFCA's boundaries, which encompass portions of the Sacramento River, the Yolo Bypass, and the Sacramento DWSC. The flood protection system associated with these waterways consists of over 50 miles of levees in Reclamation District (RD) 900, RD 537, the California Department of Water Resources'

(DWR's) Maintenance Area 4, and the DWSC. These levees completely surround the city, with the exception of intersecting waterways (the barge canal and DWSC). The city of West Sacramento is located in eastern Yolo County at the confluence of the American and Sacramento Rivers. The city lies within the natural floodplain of the Sacramento River, which bounds the city along the north and east. It is made up of a small amount of high ground north of Highway 50 along the Sacramento River, and reclaimed land protected from floods by levees and the Yolo Bypass system. The Yolo Bypass diverts flood flows around the city to the west. In addition to the area within the city limits (in Yolo County), the study area partially extends into Solano County on the extreme southwestern edge along the DWSC.

The DWSC provides a navigable passageway for commercial shipping to reach the Port of West Sacramento (formerly Port of Sacramento) from the Pacific Ocean via the San Francisco Bay, Delta, and connecting waterways. The DWSC water surface elevation is directly influenced by changes in water levels in the Delta at the south end of the Yolo Bypass and is relatively insensitive to stage in the Sacramento River. The study area is within the bounds of the Legal Delta as defined by the State of California under the Delta Protection Act (Section 12220 of the Water Code). The Legal Delta is further subdivided into a primary zone and secondary zone for land use planning and resource protection purposes. Most of West Sacramento is in the secondary zone, while the extreme northern part of the city is outside of any of these Delta planning areas. The study reach along the DWSC west levee is the only portion of the study area within the primary zone.

The DWSC and barge canal bisect the city into two subbasins, separating the developing Southport area from the more established neighborhoods of Broderick and Bryte to the north (City of West Sacramento 2000). The two subbasins are broken up into nine levee reaches based on location and fixes. The North Basin, which encompasses 6,100 acres, contains:

- Sacramento River north levee – 5.5 miles from the Sacramento Bypass south to the stone lock structure on the DWSC.
- Port north levee – 4.9 miles from the stone lock structure west to the Yolo Bypass levee.
- Yolo Bypass levee – 3.7 miles from the Port north levee north to the Sacramento Bypass.
- Sacramento Bypass Training levee – 0.5 miles west into the Yolo Bypass from the Sacramento Bypass levee.

The South Basin, which encompasses 6,900 acres, contains:

- Sacramento River south levee – 5.9 miles south along the Sacramento River from the DWSC stone lock structure to the South Cross levee (just north of the waste water treatment plant).
- South Cross levee – 1.2 miles across the South Basin from the Sacramento River to the DWSC.
- DWSC east levee – 2.8 miles from the South Cross levee north to the point where it bends east.
- Port south levee – 4.0 miles east from the bend in the DWSC east levee to the stone lock structure.
- DWSC west levee – 21.4 miles from the intersection of the Port north levee and the Yolo Bypass levee south to Miners Slough.

The West Sacramento Project study area and the problems identified for improvement are shown on Figure 1.

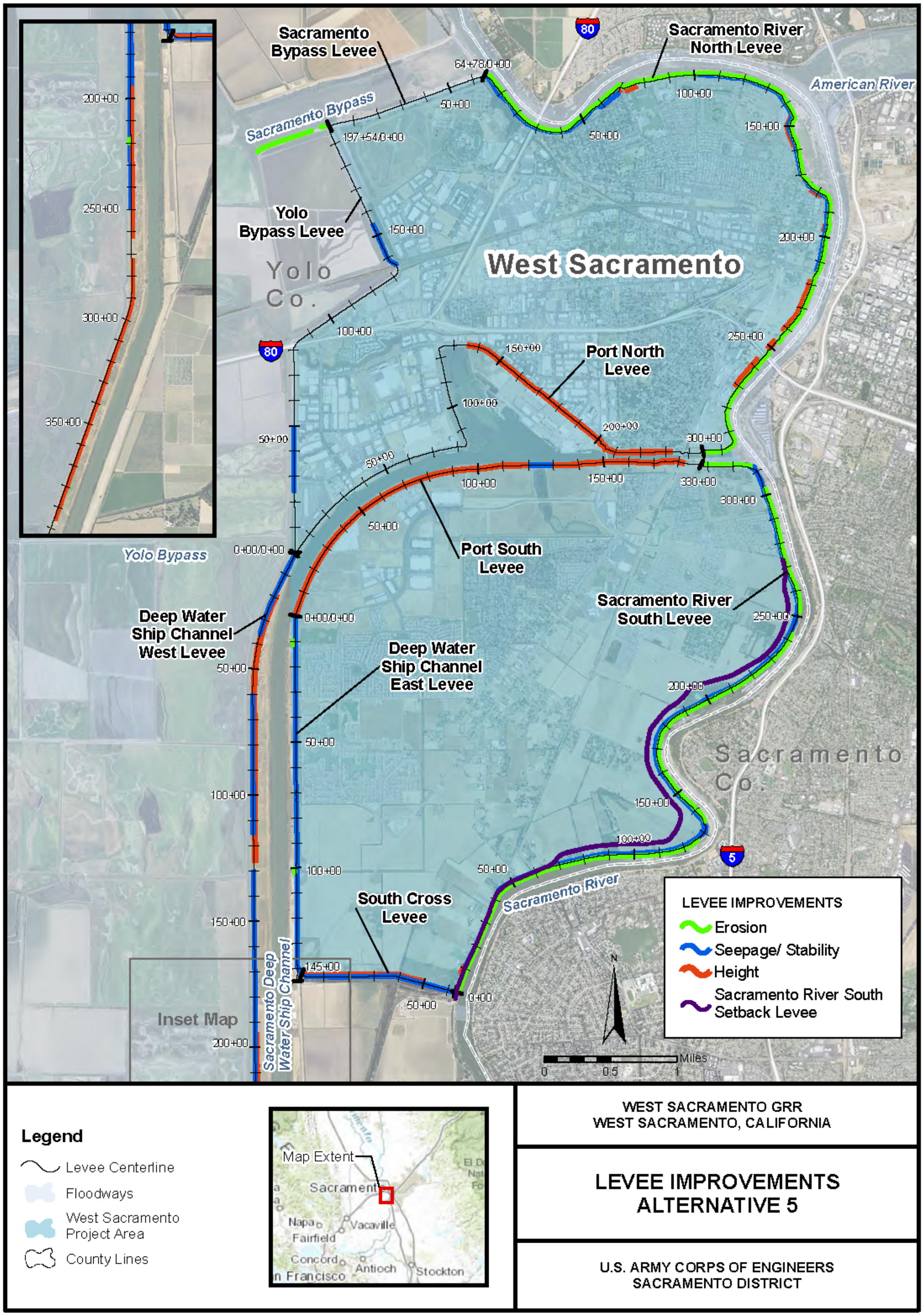

Figure 1. West Sacramento GRR Study Area with Individual Reach Identification.

1.1.2 Southport EIP Study Area

The Southport EIP study area is encompassed within the West Sacramento Project study area. Because the Southport EIP is further along in design, its action area is described in greater detail below. The construction footprint for the Southport EIP component of the West Sacramento Project extends approximately 5.6 miles along the Sacramento River South Levee from the southern end of the Corps Sacramento River Bank Protection Project (SRBPP) at River Mile (RM) 57.2 south to the South Cross levee at RM 51.6. It is comprised of a 3.6-square mile project area, which encompasses 5.8 miles of the existing levee structure along the Sacramento River corridor, the construction footprint in which flood risk–reduction measures would be constructed, the footprint of the Village Parkway extension and associated residential access roads, and potential soil borrow sites located throughout the Southport area of West Sacramento (Figure 2). Potential borrow sites make up large portions of the construction footprint, as soil may be extracted from these areas prior to or during construction of the flood risk–reduction measures. The project area covers all or portions of Sections 10, 15, 21, 22, 28, 29, and 32, Township 8 North, and Range 4 East, Mount Diablo Meridian, Yolo County, California.

South River Road runs along the top of the levee for the majority of this reach of the river. The road diverts off of the levee top and merges with Gregory Avenue and runs along the landside toe for a short distance to the southern end of the construction area. The landside of the levee is bordered mainly by private agricultural lands containing rural residences. Two small bodies of water referred to as Bees Lakes are located adjacent to the levee landside toe near the middle of the construction area, and two marinas and multiple boat docks are located on the waterside of the levee near Bees Lakes.

The Southport project area also includes several adjacent and nearby locations at which suitable borrow material may be available for use in constructing the project. As shown on Figure 2, potential borrow sites are located both close to the levee footprint, to the east and west of southern Jefferson Boulevard, and along the DWSC.

The project construction area was defined as the area in which flood risk–reduction measures—such as setback levees, seepage berms, and slurry cutoff walls—are likely to be constructed, the area in which Village Parkway and ancillary roadways would be constructed, as well as areas in which soil borrow activities may occur. All direct and indirect effects would occur within this area and the 200-foot buffer around this area.

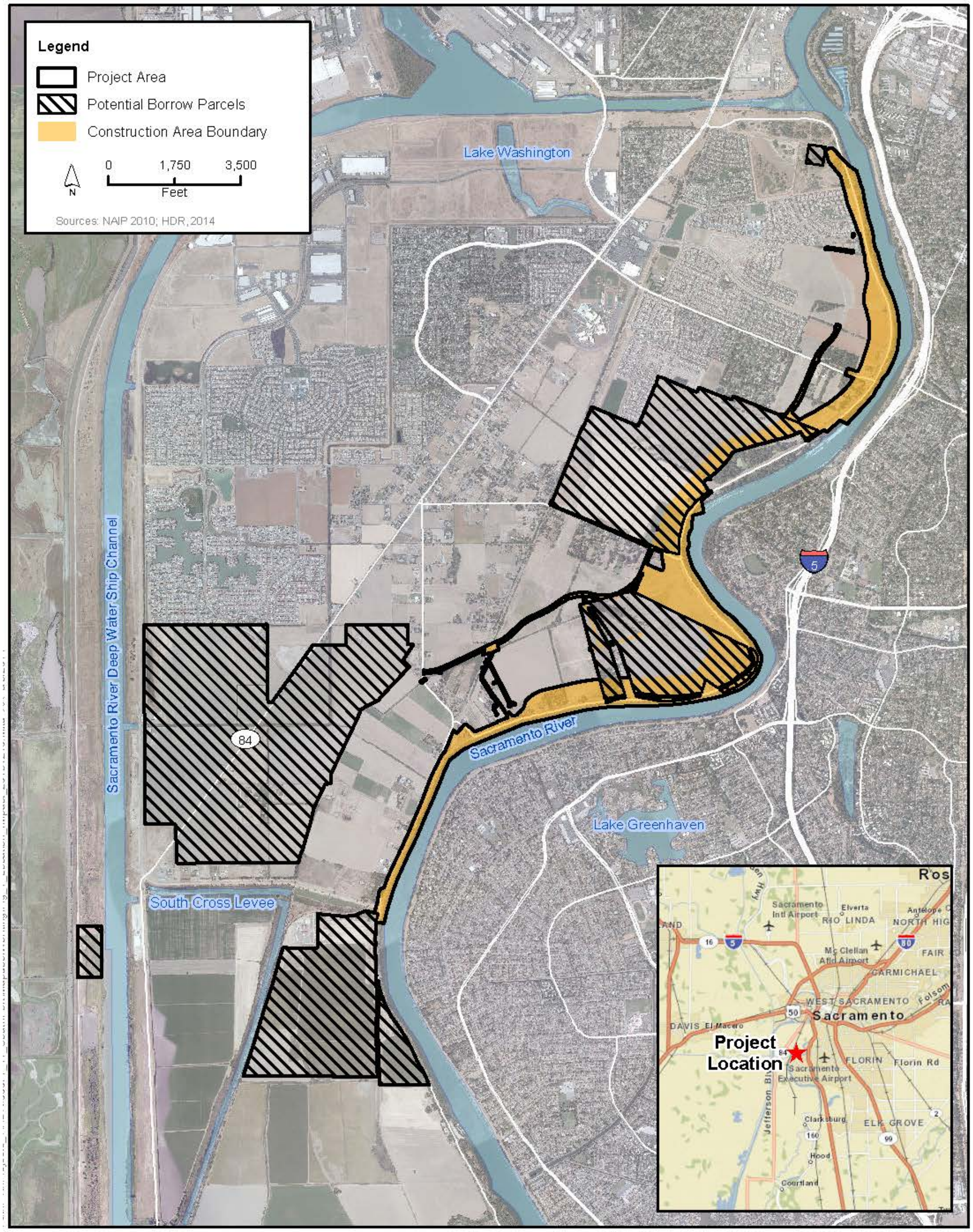

Figure 2. Southport EIP Project Area.

The Southport EIP Action Area includes the 3.6-square mile project area and a 200-foot buffer around this area. The project construction area was defined as the area in which flood risk reduction measures—such as seepage berms, relief wells, slurry cutoff walls, and potential soil borrow sites—are likely to be constructed, the area in which Village Parkway and ancillary roadways would be constructed, as well as areas in which soil borrow activities may occur. All direct and indirect effects would occur within this area and the 200-foot buffer around this area. To address potential construction-related impacts on Delta smelt and critical habitat resulting from in-water construction, the Southport EIP Action Area includes perennial waters of the Sacramento River extending 200 feet perpendicular from the average summer-fall shoreline and 1,000 feet downstream from the proposed in-water construction areas. This represents the potential area of turbidity and sedimentation effects based on the reported limits of visible turbidity plumes in the Sacramento River during similar construction activities (NMFS 2008). Long-term effects of the Southport EIP's Proposed Action include slight changes in water surface elevations that extend for several miles upstream and downstream of the project area during flood events. However, hydraulic analyses indicate that potential effects on hydraulic, geomorphic, and sediment transport conditions in the Sacramento River will be insignificant and unlikely to adversely affect listed species and designated critical habitat (ICF International 2013).

1.2 Project Background and Authority

The current levees do not adequately protect the city of West Sacramento during a 100-year event (an event that has a 1 percent chance of occurring in any given year). Structural modifications to the levee are proposed to address seepage, slope stability, erosion, and height concerns along the existing West Sacramento levees and provide flood risk reduction.

The history of the Sacramento River Flood Control Project (SRFCP) dates back to the mid 1800s with the initial construction of levees along the Sacramento, American, Feather, and Yuba Rivers. The early history of the system was characterized by trial and error, with initial construction followed by a levee failure, followed by improvement (strengthening and/or raising), followed by another levee failure, etc. This continued until the California Legislature authorized a comprehensive plan for controlling the floodwaters of the Sacramento River and its tributaries in the Flood Control Act of 1911. Federal participation in the SRFCP began shortly after authorization in 1917 and continued for approximately 40 years.

Historically, from the mid 1800s onward, most hydraulic engineers at the Federal, State, and local level thought that the most effective way to control flood flows in the river system was to construct levees close to the main channel. The record floods of 1907 and 1909 forced a reevaluation of this historic approach. It was clear from the size of these flood events in relation to existing channel capacities that major bypass systems were needed to control excess flood flows. These bypasses were designed to divert flood flows away from urban centers. Throughout the SRFCP, the frequency that flow starts to divert from the Sacramento River to the bypass system varies between a 3-year to 5-year flood event.

The series of storms that struck California in February of 1986 resulted in the flood of record for many areas in northern and central California. The estimated peak flows associated with the 1986 flood were nearly equal or exceeded the design flows of the Sacramento River, Sacramento Bypass, and the Yolo Bypass in the vicinity of West Sacramento. As a result of the problems experienced during the 1986 flood, the Corps initiated a study of the levees comprising the SRFCP that were impacted by the flood. Due to the large scale of the study, the review was split into five phases. The first phase of this study included West Sacramento and was documented through an Initial Appraisal Report titled, Sacramento Urban Area Levee Reconstruction Project, California dated May 1988. This phase included the review of approximately 110 miles of levee and recommended the repair of 34 miles.

The 1986 flood also exposed structural problems and identified the inability of the existing levees to provide critical flood protection to the Sacramento metropolitan area. As a result, the Corps, in cooperation with the State of California, initiated the study titled, Sacramento Metropolitan Area, California, Feasibility Report. This report was published in February 1992 and indicated the existing flood control system in the study area provided significantly less than a 100-year level of protection. The study went on to recommend a program of improvements. The repairs recommended by the Sacramento Metropolitan Area, California, Feasibility Report were authorized in the Water Resources Development Act (WRDA) of 1992 (Public Law [PL] 102-580).

The Corps was preparing construction plans and specifications for the levee repairs authorized in the WRDA of 1992, when the 1997 New Year's Day Flood occurred. It was one of the largest experienced in northern California since the beginning of the measured record in 1906. In the wake of the 1997 flood, the Corps identified underseepage as an area of greater concern in the design and repair of levees. This resulted in a number of design revisions to the levee repairs recommended in the West Sacramento Project Design Memorandum. These design revisions and the associated increase to the total estimated project cost were captured in a supplemental authorization through the Energy and Water Development Appropriation Act of 1999 (PL 105-245).

The initial study authority for the West Sacramento area was provided through Section 209 of the Flood Control Act of 1962, PL 87-874. The West Sacramento Project was authorized in WRDA 1992, PL 102-580 Sec. 101 (4), as amended by the Energy and Water Development of 1999, PL 105-245. It was reauthorized on October 28, 2009 with a total project cost of $53,040,000 under WRDA 2010, PL 111-85.

1.3 Species Considered and Species Requiring Consultation

An official list of species with the potential to occur in the vicinity of the West Sacramento project area and Federally listed as threatened, endangered, and proposed threatened or endangered was obtained from the Sacramento USFWS website for Yolo County (USFWS 2014) (Appendix A). The following Federally endangered and threatened species were included on the USFWS species list and were considered for inclusion in this BA.

- Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (VELB)—threatened.
- Conservancy fairy shrimp (*Branchinecta conservatio*)—endangered.
- Vernal pool fairy shrimp (*Branchinecta lynchi*)—threatened.
- Vernal pool tadpole shrimp (*Lepidurus packardi*)—endangered.
- Delta green ground beetle (*Elaphrus viridis*)—threatened.
- California freshwater shrimp (*Syncaris pacifica*)—endangered.
- Delta smelt (*Hypomesus transpacificus*)—threatened.
- California red-legged frog (*Rana draytonii*)—threatened.
- California tiger salamander (*Ambystoma californiense*)—threatened.
- Yosemite toad (*Anaxyrus canorus*)—threatened.
- Giant garter snake (*Thamnophis gigas*)—threatened.
- Western snowy plover (*Charadrius alexandrinus nivosus*)—threatened.
- Western yellow-billed cuckoo (*Coccyzus americanus)* —threatened.
- Northern spotted owl (*Strix occidentalis caurina*)—threatened.
- Least Bell's vireo (*Vireo bellii pusillus*)—endangered.
- Palmate-bracted bird's-beak (*Cordylanthus palmatus*)—endangered.
- Colusa grass (*Neostapfia colusana*)—threatened.
- Keck's checker-mallow (*Sidalcea keckii*)—endangered.
- Solano grass (*Tuctoria mucronata*)—endangered.
- Sacramento River winter-run Chinook salmon evolutionary significant unit (ESU) (*Oncorhynchus tshawytscha*)—endangered.
- Central Valley spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)—threatened.
- California Central Valley steelhead DPS (*Oncorhynchus mykiss*)—threatened.
- Southern DPS of North American green sturgeon (*Acipenser medirostris*)—threatened.

On-going coordination with the Services will occur as the project progresses to the preliminary engineering design phase to ensure compliance with Section 7. The Corps would coordinate potential design refinements with the Services to avoid, minimize, and compensate for affects to listed species and reinitiate consultation if necessary. The action area includes the protected species and critical habitat listed in Table 1, as well as fall-/late fall–run Chinook salmon, which has EFH within the study area.

Of the 23 Federally listed species considered for inclusion in this BA, the 7 species (and their critical habitats) listed in Table 1 have the potential to occur in the Action Area and may be affected by the Proposed Action; accordingly, these species are the subject of this BA.

Table 1. Federally Protected Species and Critical Habitat Addressed in this Biological Assessment.

Common Name	Scientific Name	Federal Status
Threatened and Endangered Species		
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	T
Sacramento River winter-run Chinook Salmon ESU	*Oncorhynchus tshawytscha*	E/MSA
Central Valley spring-run Chinook Salmon ESU	*Oncorhynchus tshawytscha*	T/MSA
Central Valley steelhead DPS	*Oncorhynchus mykiss*	T
Delta Smelt	*Hypomesus transpacificus*	T
Green Sturgeon southern DPS	*Acipenser medirostris*	T
Giant garter snake	*Thamnophis gigas*	T
Critical Habitat		
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	
Sacramento River winter-run Chinook Salmon ESU	*Oncorhynchus tshawytscha*	
Central Valley spring-run Chinook Salmon ESU	*Oncorhynchus tshawytscha*	
Central Valley steelhead DPS	*Oncorhynchus mykiss*	
Delta Smelt	*Hypomesus transpacificus*	
Green Sturgeon southern DPS	*Acipenser medirostris*	

Note: ESU = Evolutionarily Significant Unit, DPS = Distinct Population Segment, T = Threatened, E = Endangered, MSA = Magnuson-Stevens Fishery Conservation and Management Act.

1.3.1 Other Species Considered but Eliminated from Further Evaluation

The West Sacramento Project's Action Area does not contain suitable habitat (i.e., vernal or seasonal pools or swales) for conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, or Delta green ground beetle and is outside the geographic range of the California freshwater shrimp and the Yosemite toad. Therefore, it has been determined that the Proposed Action would have no effect on any of these species, and no further evaluation or consultation on these species is needed (50 Code of Federal Regulations [CFR] 402.12).

Seasonal and perennial wetlands in the West Sacramento Project's Action Area are connected to the Sacramento River and the Sacramento DWSC (which contains predatory fish) and/or are surrounded by cultivated or developed areas; therefore, they do not provide suitable aquatic or upland habitat for California tiger salamander. California red-legged frog is considered extirpated from the floor of the Central Valley (USFWS 2002) and would not occur in the Action Area. Therefore, it has been determined that the Proposed Action would have no effect on California tiger salamander and California red-legged frog; no further evaluation or consultation on these species is needed (50 CFR 402.12).

There is no suitable nesting habitat for the western snowy plover which requires barren to sparsely vegetated ground at alkaline or saline lakes, reservoirs, ponds, riverine sand bars, and sewage, salt-evaporation, and agricultural wastewater ponds. The least Bell's vireo historically nested in the Sacramento Valley, but no nesting has been documented north of Santa Barbara County since prior to 1970s. Two recent male sightings have been reported from Putah Creek in Yolo County in 2010 and 2011 but no confirmed nesting (CDFW 2013). The western yellow-billed cuckoo, which was recently listed as threatened, historically wintered in this region, but there is no suitable habitat in the West Sacramento Action Area and there have been no recent sightings south of Colusa on the Sacramento River. The West Sacramento Project Action Area is outside the geographic range of the northern spotted owl. Therefore, it has been determined that the Proposed Action would have no effect on any of these species, and no further evaluation or consultation on these species is needed (50 CFR 402.12).

There are four Federally listed plants that could potentially occur in the region, including Palmate-bracted bird's-beak, Colusa grass, Keck's checker-mallow, and Solano grass. Palmate-bracted bird's-beak is not expected to occur because grasslands in the West Sacramento Project Action Area lack typical associates (iodine bush [*Allenrolfea occidentalis*]) and there is no suitable microhabitat (alkaline soils) present. Similarly, Colusa grass is not expected to occur in the Action Area because there are no vernal pools. In addition, habitat conditions are of poor quality for two species; Solano grass, which could occur in mesic annual grassland, and Keck's checker mallow, which could occur in annual grassland or valley oak woodland. Therefore none of these plants are expected to occur in the Action Area. Therefore, it has been determined that the Proposed Action would have no effect on any of these species and no further evaluation or consultation on these species is needed (50 CFR 402.12).

1.4 Consultation to Date

Coordination with the USFWS and NMFS has occurred independently on the West Sacramento Project and the Southport EIP. On April 21, 2014 an interagency meeting was held to discuss the Biological Assessments for both actions. As a result of that meeting, Biological Assessments were combined because the two projects were determined to be too related to be considered in two separate consultations, and that both actions should be addressed together. A history of the consultation process is provided to document the process that led up to this decision.

1.4.1 Southport EIP Consultation History

The Corps and WSAFCA, pursuant to the ESA, must consult with USFWS and NMFS with regard to any proposed actions that may affect the continued existence of a Federally listed species. Following is a summary of communications with USFWS and NMFS for the Southport EIP Proposed Action.

- January 2014—an updated species list for Yolo County was obtained from the USFWS website.
- December 18, 2013 – USFWS and NMFS staff participated in an environmental stakeholder group meeting on project design development
- December 11 and 18, 2013—USFWS and NMFS staff participated in public meetings on the Southport EIP Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR)
- September 30, 2013 – NMFS staff correspondence requested additional information from the Corps to support consultation
- August 27, 2013 – NMFS staff met with WSAFCA and Corps staff to discuss project design and BA comments
- June 4, 2013—Corps requested initiation of consultation with USFWS and NMFS
- March 28, 2013—USFWS and NMFS staff participated in National Environmental Policy Act/California Environmental Quality Act (NEPA/CEQA) scoping meeting
- January 3, 2013—a species list for Yolo County was obtained from the USFWS website.
- November 14, 2011—USFWS and NMFS staff participated in an environmental stakeholder group meeting on project alternatives development
- August 15, 2011—USFWS and NMFS staff participated in an informal meeting of the Southport EIP environmental stakeholder group and attended a field visit led by WSAFCA.
- May 26, 2011—USFWS and NMFS staff participated in the kick-off of an environmental stakeholder group for the Southport EIP
- 2008 through 2010—USFWS and NMFS staff participated in numerous site visits and meetings associated with WSAFCA's overall levee improvements program, leading to completed consultations for the I Street Bridge, The Rivers, and California Highway Patrol (CHP) Academy projects.

1.5 West Sacramento Project Future Consultation Approach

The West Sacramento Project is at a feasibility level of design and therefore an earlier stage of development than the Southport EIP. Due to the uncertainty of when and how the West Sacramento Project will be implemented, this BA analyzes the maximum affects to listed species using the largest foreseeable footprint. The Corps will consult on Alternative 5 which is the locally preferred plan (LPP). As the project moves into further design, design refinements will likely reduce the footprint and reduce the effects to listed species. This approach will allow the USFWS and NMFS to conduct the jeopardy analysis and to determine the level of take in an Incidental Take Statement. Coordination with the resource agencies will continue into the design phase to obtain input which can help to avoid, minimize, or compensate for affects to listed species. This future coordination would attempt to reduce any mitigation required for the project and also would determine if additional consultation is needed for the project.

2.0 Proposed Action and Project Evaluation Approach

2.1 Introduction

The Corps has identified a number of problems associated with the flood risk management system protecting the city of West Sacramento and surrounding areas. There is a high probability that flows in the American and Sacramento Rivers will stress the network of levees protecting West Sacramento to the point that levees could fail. The consequences of such a levee failure would be catastrophic, since the area inundated by flood waters is highly urbanized and the flooding could be up to 20 feet deep.

The majority of the Sacramento River north and south levee reaches within the West Sacramento study area require seepage, slope stability, height, and erosion improvements in order to meet Corps criteria. This BA analyzes the effects of repairing the levees in the West Sacramento GRR North and South basins. A summary of the remediation measures proposed under this study are included in Table 2 below.

Table 2. Proposed Measures for the West Sacramento Project.

Waterway/Location	Extent of Action	Proposed Measure
North Basin		
Sacramento River North Levee *	5.5 miles from the Sacramento Bypass south to the stone lock structure on the DWSC.	• Construct bank protection • Install cutoff walls • Construct levee raise
West Sacramento Port North Levee **	4.9 miles from the stone lock structure west to the Yolo Bypass levee.	• Construct floodwalls
Yolo Bypass **	3.7 miles from the Port North levee north to the Sacramento Bypass.	• Install cutoff walls
Sacramento Bypass Training Levee **	1.1 miles from the Yolo Bypass levee to the Sacramento River.	• Construct bank protection

Waterway/Location	Extent of Action	Proposed Measure
South Basin		
Sacramento River South Levee *	5.9 miles south along the Sacramento River from the DWSC stone lock structure to the South Cross levee.	• Construct bank protection • Install cutoff walls • Construct levee raise • Construct seepage berm • Construct setback levee
South Cross Levee **	1.2 miles across the South Basin from the Sacramento River to the DWSC.	• Install cutoff walls • Construct seepage berms • Levee Raise
Deep Water Ship Channel East Levee **	2.8 miles from the South Cross levee north to the point where it bends east.	• Construct floodwalls • Levee raise • Construct bank protection
West Sacramento Port South Levee **	4.0 miles east from the bend in the DWSC east levee to the stone lock structure.	• Install cutoff walls • Construct levee raise
Deep Water Ship Channel West Levee **	21.4 miles from the intersection of the Port North levee and the Yolo Bypass levee south to Miners Slough.	• Install cutoff walls • Construct seepage berms • Levee raise • Construct bank protection • Construct closure structure
South Cross Levee **	1.2 miles across the South Basin from the Sacramento River to the DWSC.	• Install cutoff walls • Construct seepage berms • Levee Raise

* Would establish compliance with Corps vegetation requirements for upper 2/3 slopes of the levee, with a variance allowing the lower 1/3rd waterside vegetation to stay.
** Would establish compliance with Corps vegetation requirements. Engineering Technical Letter 1110-2-571.

The West Sacramento project is being completed in accordance with the principles that have been outlined in the Corps' SMART Planning Guide (Corps 2013). SMART Planning requires that all feasibility studies should be completed within a target of 18 months (to no more than three years at the greatest), at a cost of no more than $3 million, utilizing 3 levels of vertical team coordination, and of a "reasonable" report size. The SMART Planning methodology and framework were developed to facilitate more efficient, effective, and consistent delivery of Planning Decision Documents. All designs associated with this project use the largest footprint to evaluate affects to listed species. The larger footprint will look at the maximum extent the project could affect species in the project area. As design refinements occur, consideration will be given to designs that reduce affects to listed species where practicable.

2.2 West Sacramento Project Proposed Action

2.2.1 Measures Proposed for Alternatives

Levees in the West Sacramento project area require improvements to address seepage, slope stability, overtopping, and erosion concerns. The measures proposed to improve the levees are described below and consist of: (1) seepage cutoff walls, (2) seepage berms, (3) stability berms, (4) levee raises, (5) flood walls, (6) relief wells, (7) sheet pile walls, (8) jet grouting, and (9) bank protection. The above measures would be implemented by fixing levees in place, constructing adjacent levees, or constructing a setback levee. It is possible that sheet pile walls, jet grouting, and relief wells would be used at various locations so they are also described below. Figure 1 identifies the reaches where each measure would be required. Once a levee is modified, regardless of the measure implemented for the alternative, the levee would be brought into compliance with Corps levee design criteria. This would include slope flattening and/or crown widening, where required. The levee crown would be widened to 20 feet, and 3:1 landside and waterside slopes would be established where possible. If necessary, the existing levee centerline would be shifted landward in order to meet the Corps' standard levee footprint requirements.

<u>**Seepage and Slope Stability Measures**</u>

Cutoff Walls

To address seepage concerns, a cutoff wall would be constructed through the levee crown. The cutoff wall would be installed by one of two methods: (1) conventional open trench cutoff walls, or (2) deep soil mixing (DSM) cutoff walls. The method of cutoff wall selected for each reach would 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 approximately 85 feet. For cutoff walls of greater depth, the DSM method would be utilized.

Prior to construction of either method of cutoff wall, the construction site and any staging areas would be cleared, grubbed, and stripped. The levee crown would be degraded to approximately half the levee height to create a large enough working platform (approximately 30 feet) and to reduce the risk of hydraulically fracturing the levee embankment from the insertion of slurry fluids (Figure 3). Excavated and borrow material (from nearby borrow sites) would be stockpiled at staging areas. Haul trucks, front end loaders, and scrapers would bring borrow materials to the site, which would then be spread evenly and compacted according to levee design plans. The levee would be hydroseeded once construction was completed.

Conventional Open Trench Cutoff Wall

A trench approximately 3 feet wide would 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 would be filled with low density temporary bentonite water slurry to prevent cave in. The soil from the excavated trench would be mixed nearby with hydrated bentonite, and in some applications cement. The soil bentonite mixture would be backfilled into the trench, displacing the temporary slurry. Once the slurry has hardened, it would be capped and the levee embankment would be reconstructed with impervious or semi-impervious soil.

Deep Soil Mixing Cutoff Wall

The DSM method would require large quantities of cement bentonite grout. This would necessitate the use of a contractor-provided, on-site batch plant and deliveries of concrete aggregate, concrete sand, bentonite, and cement. The batch plant would be powered by generators or electricity from overhead power lines and would be located within the project area or in an adjacent staging area. The batch plant area would consist of an aggregate storage system, aggregate rescreen system (if needed), rewashing facility (if needed), the batching system, cement storage, ice manufacturing, and the grout mixing and loading system. All aggregate used within the batch plant operations would be obtained from existing local commercial off-site sources and delivered to the site.

From the batch plant, the grout mixture would be transported through high-pressure hoses (8,000 pounds per square inch [psi]) to the location of construction. At the construction site, a crane supported set of two to four mixing augers would used to drill through the levee crown and subsurface to a maximum depth of approximately 140 feet. As the augers are inserted and withdrawn, the cement bentonite grout would be injected through the augers and mixed with the native soils. An overlapping series of mixed columns would be drilled to create a continuous seepage cutoff barrier. Once the slurry has hardened it would be capped and the levee embankment would be reconstructed with impervious or semi-impervious soil.

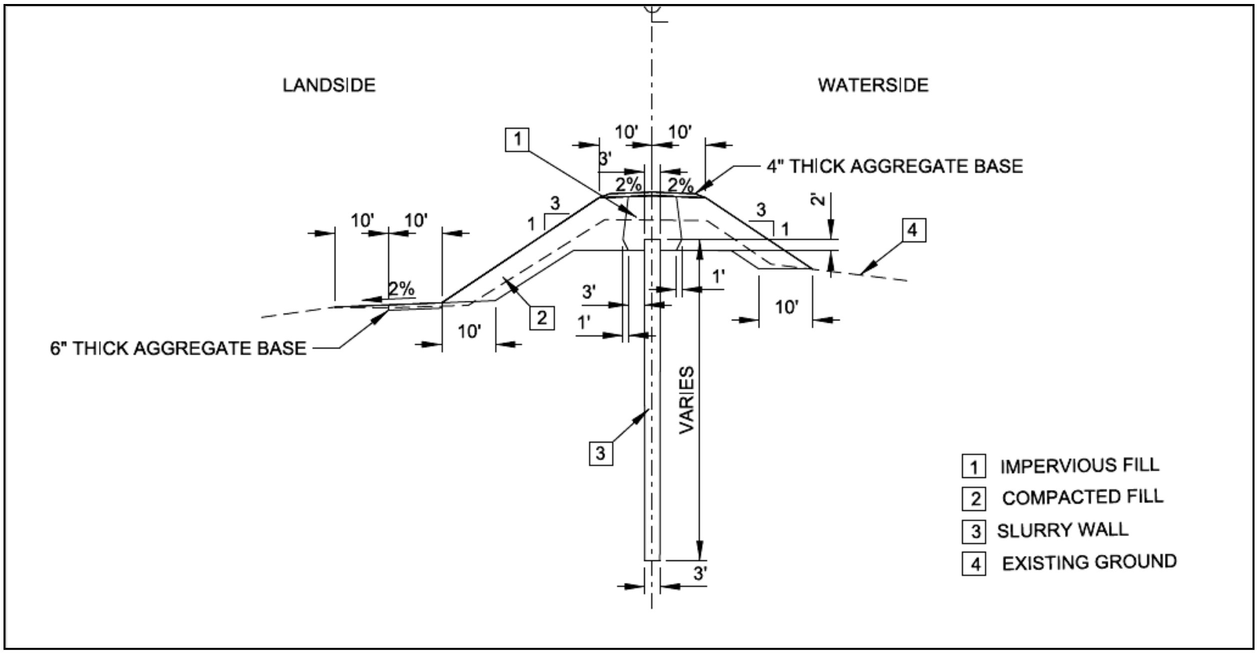

Figure 3. Levee Improvement with Slurry Wall.

Seepage Berm

Seepage berms are wide embankment structures made up of low-permeable to semi-pervious materials that resist accumulated water pressure and safely release seeping water. A seepage berm would be constructed in areas where it has been determined by geotechnical investigations that a seepage berm is more appropriate to address seepage than a cutoff wall. The seepage berm would extend out from the landside levee toe and would vary in width from 70 to 100 feet, tapering down from a five foot thickness, at the levee toe, to a three foot thickness, at the berm toe (Figure 4). The length of the seepage berm would depend on the seepage conditions along the levee reach.

Construction would consist of clearing, grubbing, and stripping the ground surface. Depending on the action alternative, soil used to construct a berm would be stockpiled from levee degradation, excavated from nearby borrow pits, or trucked on site from off-site locations (if on-site material is not adequately available). During the degrading, soil would be stockpiled at the proposed berm site. If constructing the alternative does not require levee degradation, all soil material used to construct a berm would come from nearby borrow sites. At the borrow sites, bulldozers would excavate and stockpile borrow material. Front-end loaders would load haul trucks, and the haul trucks would transport the borrow material to the site. The haul trucks would then dump the material, and motor graders would spread it evenly, placing approximately 3 to 5 feet of embankment fill material. Material used for berm construction would have greater permeability than the native blanket material. However, depending on material availability, a lower permeability material may be used. Adjustments to berm width would be made in such cases, as appropriate. During the embankment placement, material would be placed in a maximum of 1- to 2-foot loose lifts, thereby allowing the compactors to achieve the specified compaction requirements. Sheepsfoot rollers would compact the material, and water trucks would distribute water over the material to ensure proper moisture for compaction and reduction of fugitive dust emissions. The new seepage berm would be hydroseeded following construction.

Seepage berms may have an optional feature of a drainage relief trench under the toe of the berm. Drained seepage berms would include the installation of a drainage layer (gravel or clean sand) beneath the seepage berm backfill and above the native material at the levee landside toe. A drained seepage berm would likely decrease the overall footprint of the berm.

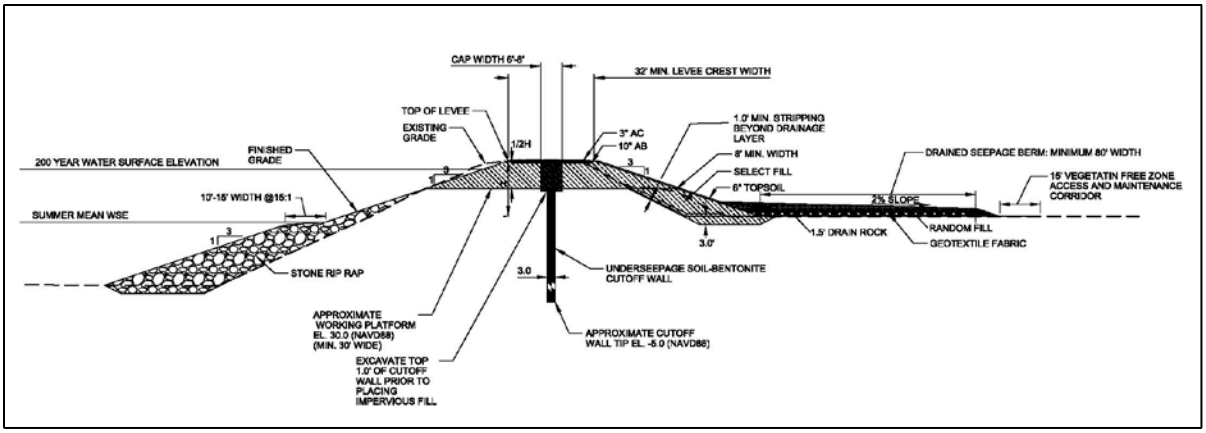

Figure 4. Fix in Place Levee Improvement with Seepage Berm.

Stability Berm

A stability berm would be constructed against the landside slope of the existing levee with the purpose of supplying support as a buttress. A stability berm is proposed along the South Cross levee as shown in Figure 5. The height of the stability berm would generally be 2/3 of the levee height, and would extend for a distance determined by the structural needs of the levee along that reach. Embankment fill material necessary to construct the berm is excavated by a bulldozer from a nearby borrow site. Front-end loaders would load haul trucks with the borrow material and the haul trucks would transport the material to the stability berm site. Motor graders would spread the material evenly according to design specifications, and a sheepsfoot roller would compact the material. Water trucks would distribute water over the material to ensure proper moisture for compaction. The new seepage berm would be hydroseeded after construction.

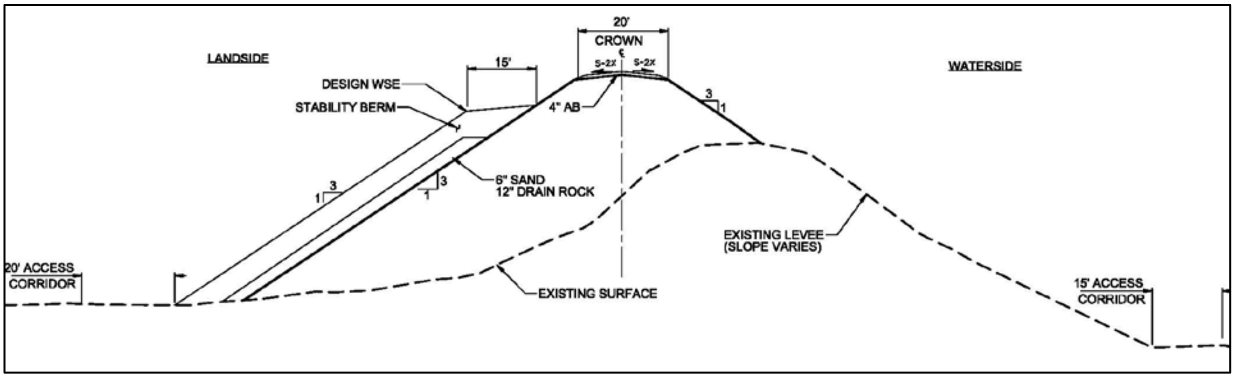

Figure 5. Levee Improvement with Stability Berm.

Adjacent Levee

An adjacent levee is proposed along some sections of the Sacramento River south levee. The adjacent levee essentially adds material to increase the cross section of the levee, thereby allowing the prescribed 3:1 landside slopes and 20-foot-wide crown to be established (Figure 6). The adjacent levee would be constructed on the landward side of the levee and would make it possible to leave all waterside vegetation in place.

The first construction phase would include clearing, grubbing, and stripping the work site and any construction staging areas, if necessary. A trapezoidal trench would be cut at the toe of the slope and the levee embankment may be cut in a stair-step fashion to allow the new material to key into the existing material. Bulldozers would then excavate and stockpile borrow material from a nearby borrow site. Front-end loaders would load haul trucks with the borrow material, and the haul trucks would subsequently transport it to the adjacent levee site. The haul trucks would dump the material, and dozers would spread it evenly. Sheepsfoot rollers would then compact the material, and water trucks would distribute water over the material to ensure proper moisture for compaction. The landside levee would be graded at a 3:1 slope, and the levee crown would be at least 20 feet wide. The slope may be track-walked with a dozer. The levee crown would be finished with an aggregate base or paved road, depending on the type and level of access desired. Either condition would require importation of material with dump trucks, placement with a loader and motor grader, and compaction. A paver would be required for asphalt placement.

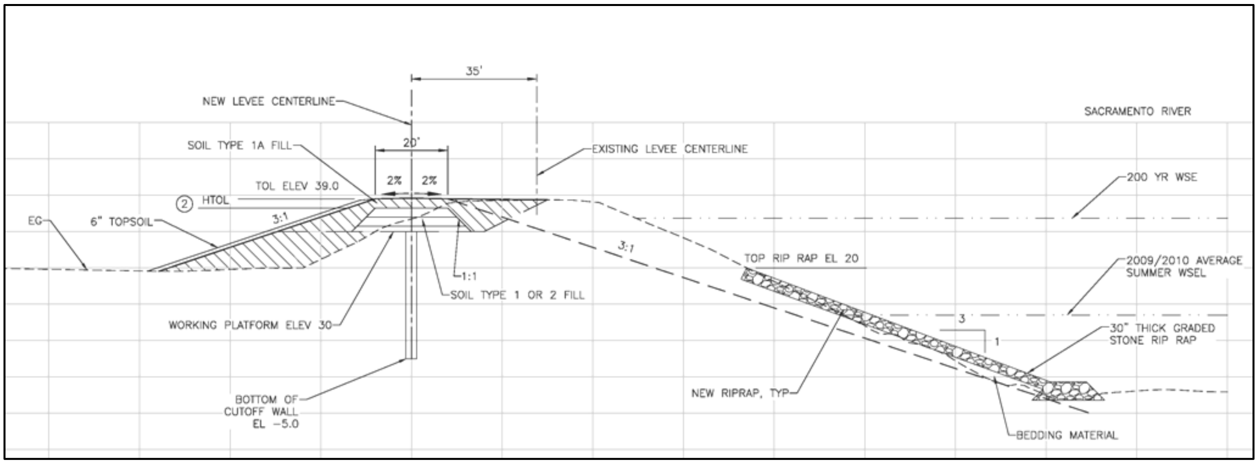

Figure 6. Adjacent Levee Improvement.

Sheet Pile Wall

A sheet pile wall is proposed at the Stone Locks to tie together the levees on either side of the Barge Canal (Figure 7). A trench would be excavated along the sheet pile alignment to allow the pile to be driven to the proposed depth (below the existing levee grade). A driving template fabricated from structural steel would be placed to control the alignment as the sheet pile is installed. A hydraulic or pneumatically operated pile driving head attached to a crane would drive the sheet pile into the levee crown to the desired depth (up to 135 feet). An additional crane or excavator would be used to facilitate staging of the materials. The conditions of the site, driving pressure, hydrostatic loads, and corrosion considerations would determine the thickness and configuration of the sheet piles. If conditions indicate that corrosion is an issue, the sheet piles could be coated, oversized to provide additional thickness as a corrosion allowance, and/or provided with a cathodic protection system.

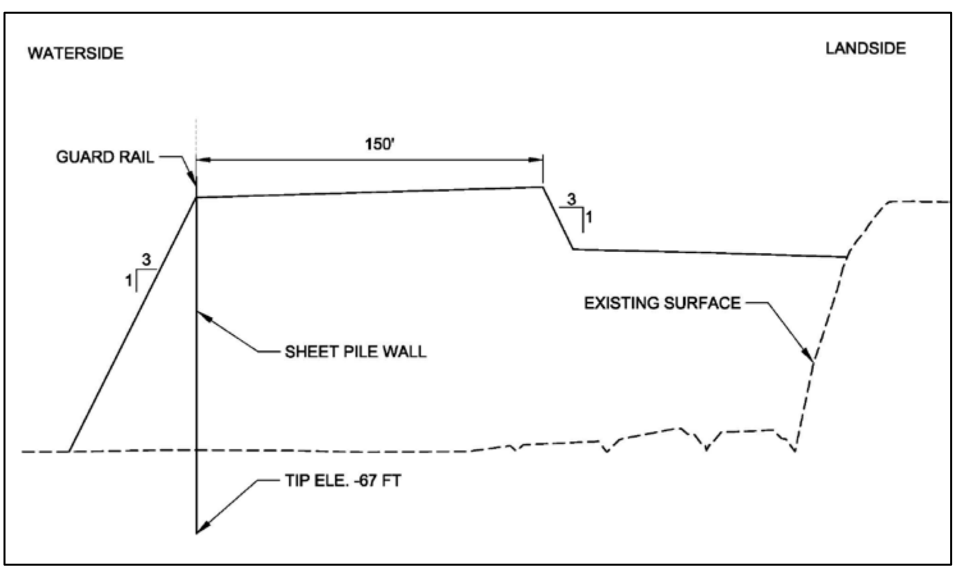

Figure 7. Sheet Pile Wall with Embankment Fill.

Jet Grouting

Jet grouting typically is used in constructing a slurry cutoff wall to access areas other methods cannot. In this regard, it is typically a spot application rather than a treatment to be applied on a large scale. Jet grouting would be used around existing utilities not proposed for removal, and at bridges along the West Sacramento levees. It involves injecting fluids or binders into the soil at very high pressure. The injected fluid can be grout; grout and air; or grout, air, and water. Jet grouting breaks up soil and, with the aid of a binder, forms a homogenous mass that solidifies over time to create a mass of low permeability.

Equipment required for jet grouting consists of a drill rig fitted with a special drill string; a high pressure, high flow pump; and an efficient batch plant with sufficient capacity for the required amount of grout and water, supporting generators and air compressors, holding tanks, and water tanks, with bulk silos of grout typically used to feed large mixers. The high-pressure pump conveys the grout, air, and/or water through pipelines that run the length of the site through the drill string to a set of nozzles located just above the drill bit. Smaller equipment can be used in combination with the single phase–fluid system and can be permanently trailer-mounted to permit efficient mobilization and easy movement at the job site. Jet-grouted columns range from 1 to 16 feet in diameter and typically are interconnected to form cutoff barriers or structural sections. One construction crew, consisting of a site supervisor, pump operator, batch plant operator, chuck tender, and driller under ideal conditions, can construct two 6-foot-diameter, 50-foot columns per day consisting of approximately 100 cubic yards of grout injected per 8-hour shift. Ideal conditions would be characterized by no technical issues, such as loss of fluid pressure, breakdown of equipment, or subsurface obstructions to drilling operations occurring at either the batch plant or the drilling site.

To provide a wide enough working platform on the levee crown, the upper portion of some segments of the levee may require degradation with a paddle wheel scrapper. Material would be scraped and stockpiled at a nearby stockpile area. Hauling at the work area would involve scraper runs along the levee to the staging area, and grout, bentonite, and water deliveries to the batch plant. To initiate jet grouting, a borehole would be drilled through the levee crown and foundation to the required depth (to a maximum depth of approximately 130 feet) by rotary or rotary-percussive methods using water, compressed air, bentonite, or a binder as the flushing medium. When the required depth is reached, the grout would be injected at a very high pressure as the drill string is rotated and slowly withdrawn. Use of the double, triple, and superjet systems create eroded spoil materials that would be expelled out of the top of the borehole. The spoil material would contain significant grout content and could be used as a construction fill.

Relief Wells

Relief wells would be used to address underseepage and would be applied only on a limited basis for site-specific conditions rather than a segment-wide application. They would be located along adjacent and setback levee toes in the South Basin and only in segments where geotechnical analyses have identified continuous sand and gravel layers and the presence of an adequate impermeable layer (Figure 8). Relief wells are passive systems that are constructed near the levee landside toe to provide a low-resistance pathway for underseepage to exit to the ground surface in a controlled and observable manner. A low-resistance pathway releases water pressure under the upper impermeable layer, allowing underseepage to exit without creating sand boils or piping levee foundation materials.

Relief wells are constructed using soil-boring equipment to drill a hole vertically through the upper fine-grained layer (usually clays or silty clays), through the coarse-grained aquifer layer of sand or gravel, and into the lower fine-grained clay layer beneath. Pipe casings and gravel/sand filters are installed to allow water to flow freely while preventing transportation and removal of material from the levee foundation, which can undermine the levee foundation. The water then is collected and discharged into a drainage system using a series of ditches or an underground piping system.

Relief wells generally are spaced at 50- to 150-foot intervals, dependent on the amount of underseepage, and extend to depths of up to 150 feet. Areas for relief well construction are cleared, grubbed, and stripped. During relief well construction, a typical well-drilling rig would be used to drill to the required depth and construct the well (including well casing, gravel pack material, and well seal) beneath the ground surface. The drill rig likely would be an all-terrain, track-mounted rig that could access the well locations from the levee toe.

Areas along the levee toe may be used to store equipment and supplies during construction of each well. Construction of each well and the lateral drainage system typically takes 10 to 20 days. Additional time may be required for site restoration.

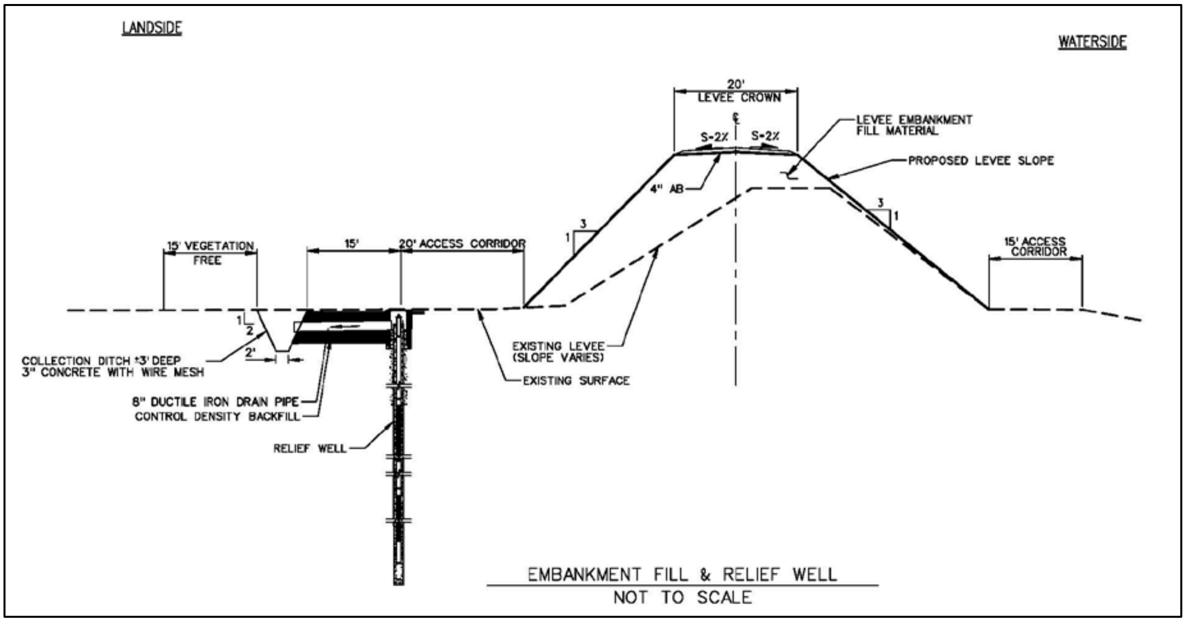

Figure 8. Fix in Place Levee Improvement with Relief Well.

Overtopping Remediation

Levee Height Raise

To address the height deficiencies, additional borrow material would be added after cutoff walls and levee reshaping improvements are completed (Figure 9). The additional material would be brought from nearby borrow sites, stockpiled in staging areas then hauled to the site with trucks and front end loaders. Material would be spread evenly and compacted according to levee design plans. The levee would be hydroseeded once construction was completed.

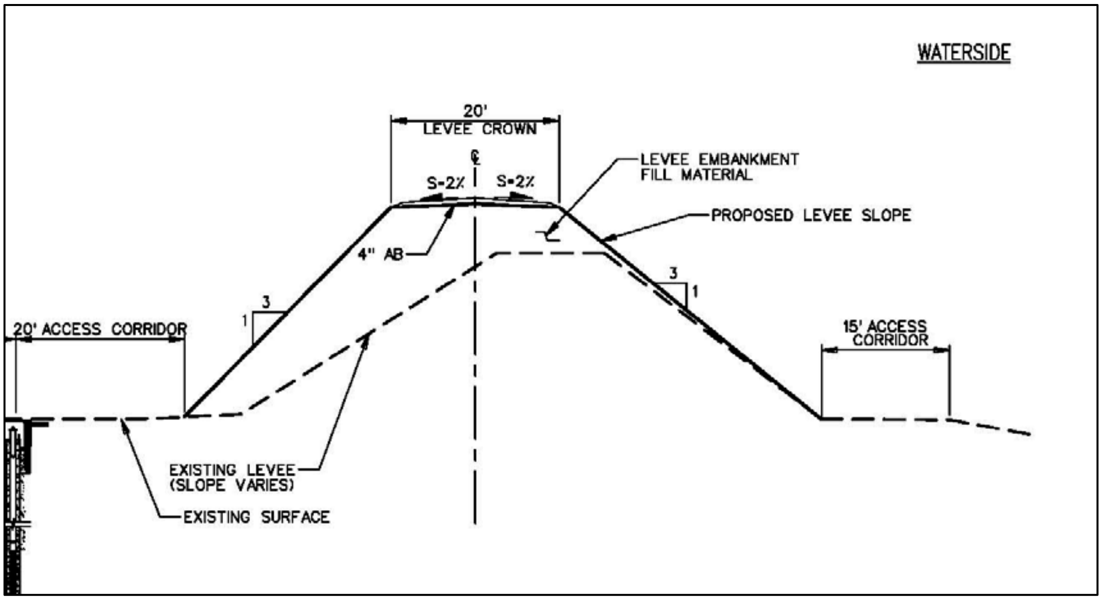

Figure 9. Levee Height Raise.

Floodwalls

Floodwalls are proposed along the waterside hinge point of the Port north levee and along the selected levee alignment around the Port of West Sacramento. Floodwalls are an efficient, space-conserving method for containing unusually high water surface elevations. They are often used in highly developed areas, where space is limited. To begin the floodwall construction, the area would be cleared, grubbed, stripped, and excavation would occur to provide space to construct the footing for the floodwall. The floodwall would primarily be constructed from pre-fabricated materials, although it may be cast or constructed in place, and would be constructed almost completely upright. Floodwalls mostly consist of relatively short elements, making their connections very important to their stability. The floodwalls would be designed to disturb a minimal amount of waterside slope and levee crown for construction (Figure 10). The height of the floodwalls varies from 1 to 4 feet, as required by water surface elevations. The waterside slope would be re-established to its existing slope and the levee crown would grade away from the wall and be surfaced with aggregate base

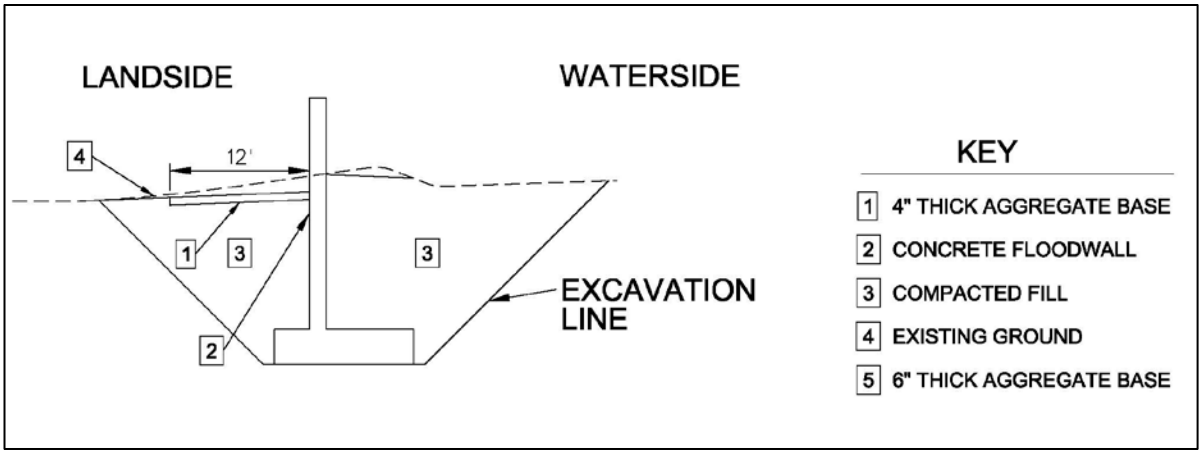

Figure 10. Floodwall Typical Design.

Erosion Protection Measures

Levee Bank Protection

The primary erosion protection measure consists of waterside armoring of the levees to prevent erosion and subsequent damage to the levee. This measure consists of placing rock revetment on the river's bank, and in some locations on the levee slope, to prevent erosion (Figure 11). The extent of the revetment would be based on site-specific analysis. Along the Sacramento Bypass Training levee, revetment would be placed on both sides of the levee slopes as shown in Figure 12. This would protect the levee in place when the Sacramento and Yolo Bypasses have water in them. When necessary, the eroded portion of the bank would be filled and compacted prior to the rock placement.

The Corps conducts ongoing erosion repairs to sites on the Sacramento River levees under the SRBPP. As part of the SRBPP NMFS Biological Opinions, the Corps is required to conduct post-construction monitoring in order to evaluate the relative success of on-site habitat features that are incorporated into the repairs. Under the SRBPP, bank protection designs have been constantly evolving, as the results of the monitoring help inform engineers to adapt the designs to optimize for site-specific conditions in meeting the objective of the habitat features. The Corps will use the best available information and SRBPP design templates as a basis for designing site-specific bank protection repairs for this project. As a result, the bank protection measure described below is a basic example of a typically designed bank protection site.

The sites would be prepared by clearing and stripping the site prior to construction. Small vegetation and deleterious materials would be removed. Bank protection would be placed around existing trees on the lower portion of the slope. Trees on the upper portion of the slope would be removed during degrading of levees for slurry cutoff walls and bank protection would be placed following reconstruction of the levee. Temporary access ramps would be constructed, if needed, using imported borrow material that would be trucked on site.

Revetment would be imported from an offsite location via haul trucks or barges. Revetment transported by haul trucks would be temporarily stored at a staging area located in the immediate vicinity of the construction site. A loader would be used to move revetment from the staging area to an excavator that would place the material on site. Rock required on the upper portions of the slopes would be placed by an excavator located on top of the levee. Rock placement from atop the levee would require one excavator and one loader for each potential placement site.

Revetment transported by barges would not be staged, but placed directly on site by an excavator. Rock required within the channel, both below and slightly above the water line at the time of placement, would be placed by an excavator located on a barge. The excavator would construct a large rock berm in the water up to an elevation slightly above the mean summer water surface. A planting trench would be established on this rock surface for revegetation purposes. Construction would require two barges: one barge would carry the excavator, while the other barge would hold the stockpile of rock to be placed on the channel slopes.

The bank protection would be placed via the methods discussed above on the existing bank at a slope varying from 2V:1H to 3V:1H depending on site specific conditions. After rock placement has been completed, a small planting berm would be constructed in the rock, when feasible, to allow for some revegetation of the site outside of the vegetation free zone as required by Engineer Technical Letter (ETL) 1110-2-571.

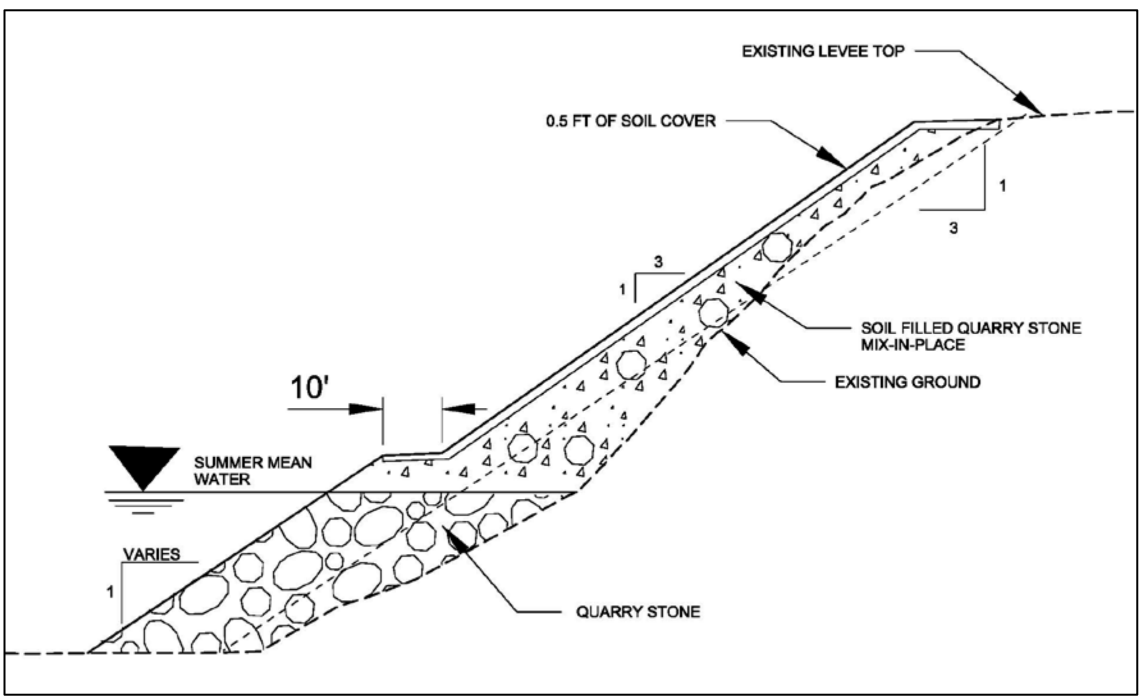

Figure 11. Bank Protection Typical Design.

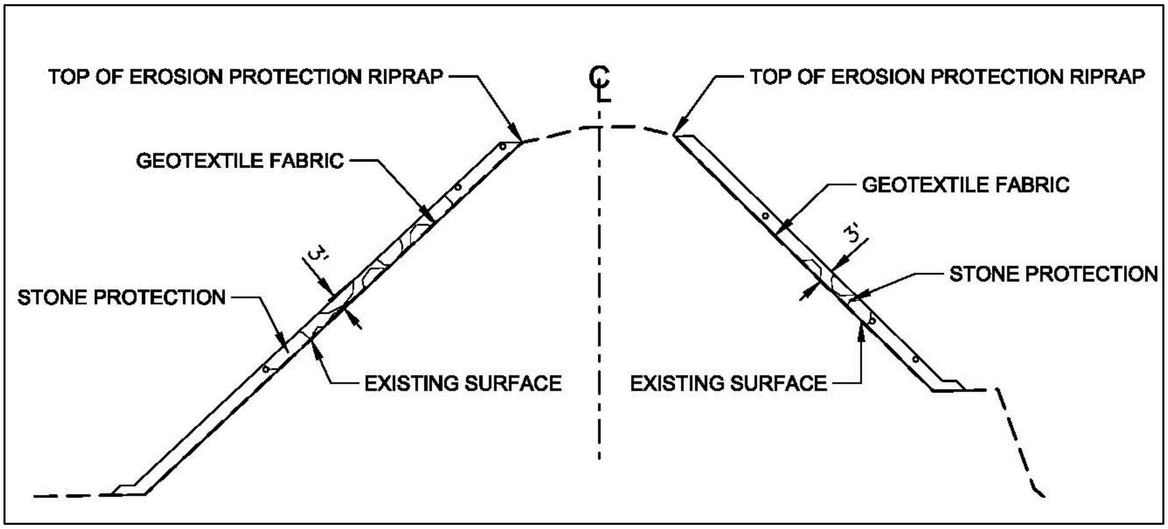

Figure 12. Bank Protection along Sacramento Bypass Training Levee.

Levee Biotechnical Measures

In addition to the bank protection measure, biotechnical measures have been proposed for several reaches. This remediation measure would be implemented for any of the proposed alternatives discussed in this document. This measure is being considered for lower velocity reaches to preserve existing vegetation. Under this measure, the Corps would use plant material and minimal amounts of rock to stabilize the eroded slope and prevent further loss of material.

Operation and Maintenance

Operation and maintenance (O&M) of the levees in the West Sacramento area are the responsibility of the local maintaining agencies, including RD 900, RD 537, DWR's Maintenance Area 4, and the Corps. The applicable O&M Manual the West Sacramento levees is the Standard Operation and Maintenance Manual for the Sacramento River Flood Control Project. Typical levee O&M in the West 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 would be monitored using the piezometers.

For sites with a vegetation variance, the O&M manual for these Sacramento River reaches would be adjusted to reflect the variance. Under the adjusted O&M manual, large trees that were protected in place under the variance would be allowed to remain on the waterside slopes, but smaller shrubs would be removed and grasses would be regularly mowed to allow for inspection and access.

Additional Construction Measures

In addition to the proposed levee improvements measures described above, the following measures and policies would apply to all of the alternatives, and would be addressed during construction:

- The Corps' standard levee footprint would be established during construction of structural improvements on all levees that are out of compliance. The standard levee footprint consists of a 20 foot crown width and 3:1 waterside and landside slopes. If the 3:1 landside slope is not possible based on site specific conditions then a minimum 2:1 landside slope would be established with supporting engineering analysis.
- A 20 foot landside and waterside maintenance access would be established. In areas where 20 feet cannot be obtained, 10 feet is allowable.
- Utility encroachments such as structures, certain vegetation, power poles, pump stations, and levee penetrations (e.g., pipes, conduits, cables) would be brought into compliance with applicable Corps policy or removed depending on type and location. This measure would include the demolition of such features and relocation or reconstruction as appropriate on a case-by-case basis (or retrofit to comply with standards). Utilities replacements would occur via one of two methods: (1) a surface line over the levee prism, or (2) a through-levee line equipped with positive closure devices.
- Private encroachments shall be removed by the non-federal sponsor prior or property owner prior to construction.

Vegetation Removal/Vegetation Variance Request

Construction of the levee improvement measures would require compliance with Corps Engineering Technical Letter (ETL) 1110-2-571 Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures. The vegetation requirements include a vegetation-free zone on the levee slopes and crown, 15 feet from both landside and waterside levee toes, and 8 feet vertically. When the Corps is modifying an existing levee, it must comply with Corps levee safety policy in its designs and construction. The levees within the study area require seepage, slope stability, height, and erosion improvements in order to meet Corps levee safety criteria.

Where feasible, a vegetation variance would be sought during the preconstruction engineering and design phase before construction to allow vegetation to remain on the lower 2/3 of the waterside slope and out 15 feet from the waterside toe. If granted, the variance would allow for vegetation to remain in these areas. No vegetation would be permitted on the landside slope or within 15 feet of the landside toe. To show that the safety, structural integrity, and functionality of the levee would be retained with a variance, an evaluation of underseepage and waterside embankment slope stability was completed by Corps geotechnical engineers.

The preliminary analysis for the vegetation variance was conducted by analyzing two index points. Index Point 1 is located on the Sacramento River north levee. Index Point 6 is located on the Sacramento River south levee. The index points for the project are shown on Figure 13. These two index points were chosen for the vegetation variance analyses because they were considered to be representative of the most critical channel and levee geometry, underseepage, slope stability conditions, and vegetation conditions of the respective basins. The analysis incorporated tree fall and scour on the cross-section geometry of the index points by using a maximum depth of scour for cottonwoods as approximately 11.0 feet; the associated soil removed was projected at a 2:1 slope from the base of the scour toward both the landside, and waterside slopes. The base scour width was equal to the maximum potential diameter at breast height (dbh) of cottonwoods (12.0 feet) projected horizontally at a depth of 11.0 feet below the existing ground profile. The results show that the tree fall and scour did not significantly affect levee performance and that the levee would meet Corps seepage and slope stability criteria when the seepage and slope stability improvement measures are in place ("with project" conditions). Therefore, it is a reasonable conclusion that allowing vegetation to remain on the lower waterside levee slope would not affect the safety, structural integrity, and functionality of the Sacramento River levee.

As a result of the geotechnical analysis, a vegetation variance would be requested to provide compliance for the Sacramento River portion of the project. In many cases along the Sacramento River levees, the levee is far enough back from the water's edge to allow vegetation providing shaded riverine aquatic cover to remain on the bank with no vegetation variance necessary. However, in the Sacramento River north reach, vegetation along the bank would be thinned in order to place rock on the bank for erosion protection. No woody vegetation would be permitted on the landside slope or within 15 feet of the landside toe for purposes of providing access for levee inspections and flood repair response.

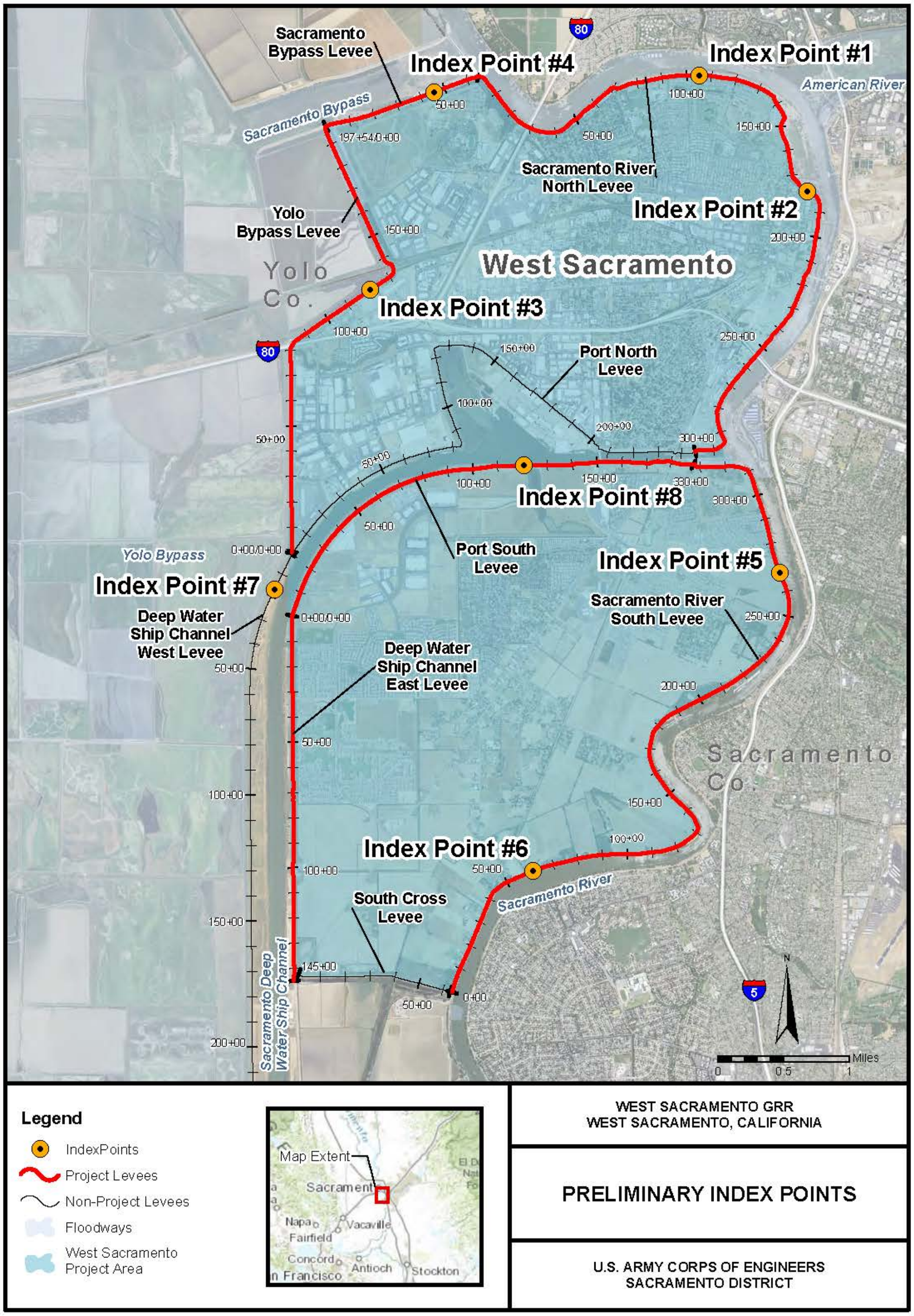

Figure 13. Index Points for the West Sacramento GRR.

Table 3 below summarizes the West Sacramento project reaches and whether or not a variance would be requested. Any reach without a vegetation variance would be subject to vegetation removal as detailed in ETL 1110-2-571.

Table 3. West Sacramento GRR Project Summary of Variance Requests.

Levee Reach	Vegetation Variance	Vegetation Removal
West Sacramento North Basin		
Sacramento River North	X	
Port North		X
Yolo Bypass *		X
Sacramento Bypass Training Levee		X
West Sacramento South Basin		
Sacramento River South	X	
South Cross		X
Deep Water Ship Channel East *		X
Deep Water Ship Channel West*		X
Port South		X

*Vegetation is sparse in these reaches. Individual trees would be considered an adverse affect, however, overall the vegetation removal does not significantly impact the system as a whole.

Out of the seven reaches in which vegetation would be fully removed under ETL 1110-2-571, there would be minimal effects on the Yolo Bypass, South Cross, and DWSC reaches. This is because there are very few trees on these levees, and, in some cases, the levees are inland and any vegetation on the levees is unlikely to contribute to fish habitat. Since the Yolo Bypass toe drain is considered critical habitat for salmonids, there is the potential that any areas with significant vegetation along the toe drain could be considered a significant effect, however, there is potential that in the preconstruction engineering and design phase of the project, site-specific designs could be adjusted to avoid these impacts.

Approximately 65 acres of primarily landside riparian vegetation would be removed, both to provide for the construction footprint, and to comply with ETL 1110-2-571. In addition, approximately 5,000 lf of shoreline habitat would be removed from the Port north and south levees along the Barge Canal due to ETL compliance. Vegetation removed as a part of ETL 1110-2-571 compliance would be mitigated on site, outside of the vegetation-free zone, to the extent feasible. When on-site mitigation is not feasible, mitigation would occur at a local mitigation bank with available credits. If credits are not available locally, then mitigation would occur within the West Sacramento city limits.

Compliance with ETL 1110-2-571 is not expected to have a significant impact on instream woody material (IWM) recruitment in the Sacramento River system. The reach of the river included in this study is constrained by the levee banks and is not currently a significant source of IWM in the system. Most if not all IWM recruitment in the Sacramento River system comes from areas with more natural banks allowing for meandering and overbank erosion, such as upstream sections of the Sacramento River and the Feather River.

Standard O&M activities are discussed above. For sites with a vegetation variance, the O&M manual for these Sacramento River reaches would be adjusted to reflect the variance. Under the adjusted O&M manual, large trees that were protected in place under the variance would be allowed to remain on the waterside slopes, but smaller shrubs would be removed and grasses would be regularly mowed to allow for inspection and access.

Staging Areas

As depicted on Figure 14, ten preliminary staging areas have been identified for use in the West Sacramento project area. These staging areas are located on the landside of the levees or within the project footprint and would occupy approximately 160 acres in total. Preliminary staging area locations were selected by identifying areas with the least environmental impacts on vegetation and endangered species. If it is determined that critical habitat occurs at proposed staging area, they would not be used for staging without further consultation. These areas would be used for staging construction activities and to provide space to house construction equipment and materials before and during construction activities.

Borrow Sites

It is estimated that a maximum of 9 million cubic yards of borrow material could be needed to construct the West Sacramento Project. Because the West Sacramento Project is in the preliminary stages of design, detailed studies of each alternative borrow needs have not been completed. For the purposes of NEPA/CEQA a worst case scenario is being evaluated for the volume of borrow material needed. Actual volumes exported from any single borrow site would 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. The criteria used to determine potential locations were based on current land use patterns, soil types from U.S. Soil Conservation Service (SCS), and Corps' criteria for material specifications. These potential borrow locations are shown on the Borrow Site Map (Figure 15). Evaluation of potential borrow sites would begin with those nearest to the project area, to reduce impacts. Potential borrow sites with endangered species habitat would not be used for borrow material without further consultation. Borrow sites would be lands that are the least environmentally damaging and would be obtained from willing sellers. The data from land use maps and SCS has not been field verified, therefore, to ensure that sufficient borrow material would be available for construction the Corps looked at all locations within the 20 miles radius for 20 times the needed material. This would allow for sites that do not meet specifications or are not available for extraction of material.

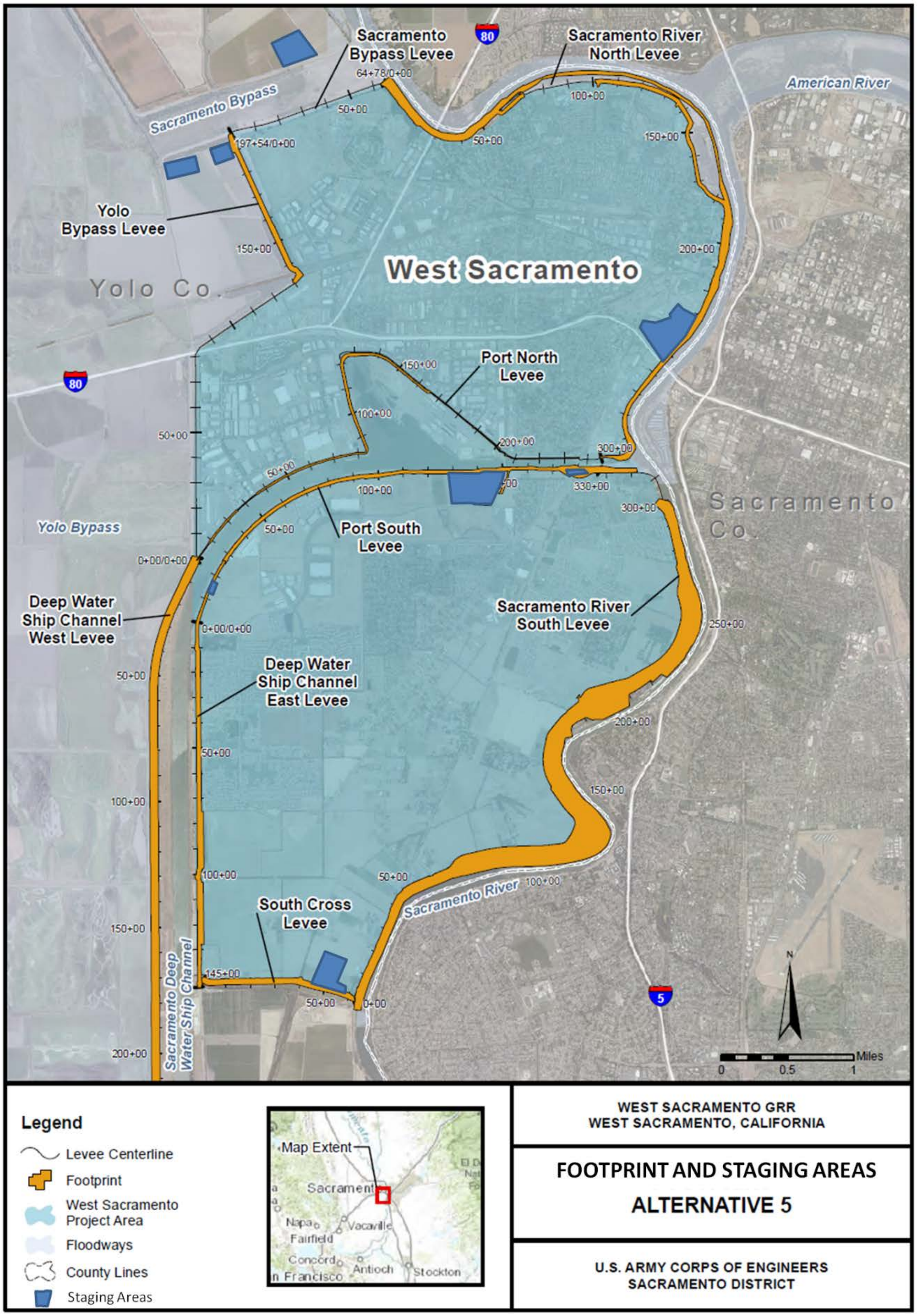

Figure 14. Potential Locations for Staging Areas for the West Sacramento GRR.

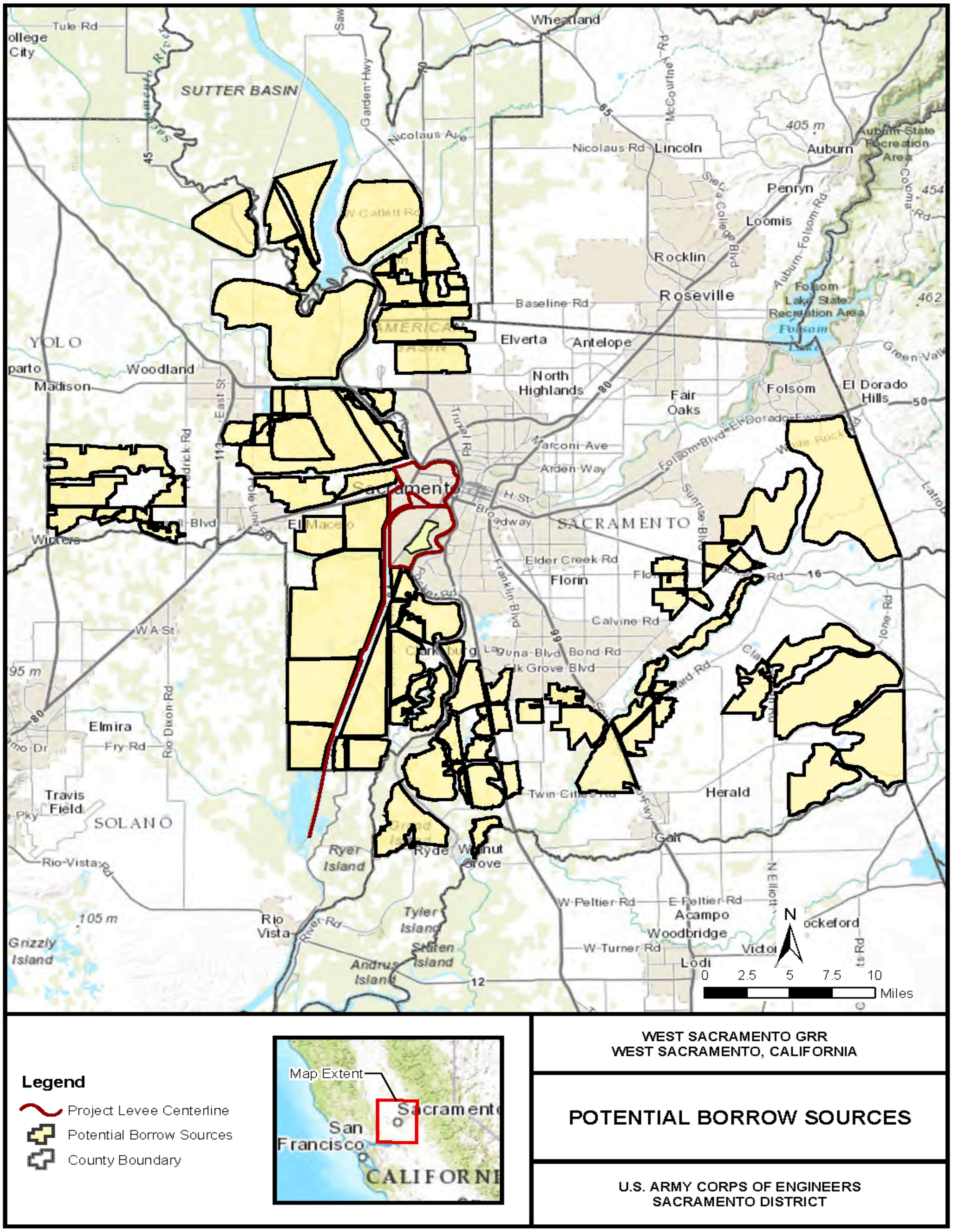

Figure 15. Potential Locations for Borrow Material for a 20-mile Radius Surrounding the West Sacramento Study Area.

The excavation limits on the borrow sites would provide a minimum buffer of 50 feet from the edge of the borrow site boundary. From this setback, the slope from existing grade down to the bottom of the excavation would be no steeper than 3H:1V. Excavation depths from the borrow sites would be determined based on available suitable material and local groundwater conditions. The borrow sites would be stripped of top material and excavated to appropriate depths. Once material is extracted, borrow sites would be returned to their existing use whenever possible, or these lands could be used to mitigate for West Sacramento Project impacts, if appropriate.

2.2.2 West Sacramento Project Tentatively Selected Plan – Alternative 5 – Improve Levees with Setback Levee along Sacramento River South

The tentatively selected plan for the West Sacramento Project is Alternative 5 – Improve Levees with Setback Levee along Sacramento River South. Alternative 5 would include the construction of levee improvements to address: (1) seepage, (2) slope stability, (3) overtopping, and (4) erosion concerns identified for the Sacramento River, South Cross, DWSC, Port, Yolo Bypass, and Sacramento Bypass training levees. Figure 16 below identifies the reaches where each measure would be required under Alternative 5. Levees would be improved through a combination of fix in place and setback levee construction. A description of the measures identified and construction methods can be found above in Section 2.2.1. Once a levee is modified, regardless of the measure implemented for the alternative, the levee would be brought into compliance with Corps levee design criteria. To provide for levee construction, inspection, maintenance, monitoring, and flood-fighting access, some properties may need to be acquired. The levee remediation measures proposed under Alternative 5 are summarized in Table 4 below.

Due to environmental, real estate, and hydraulic constraints within the West Sacramento North Basin, Alternative 5 proposes fix in place remediation. For the South Basin, a combination of fix in place, adjacent levee, and a set back levee are being proposed. In addition, a seepage berm is proposed for the South Basin where there are not as many real estate constraints or the cutoff wall does not completely remove the through- and underseepage concerns. The fix in place is most suitable where real estate is constrained, the existing levee meets or exceeds minimum levee standards, and/or vegetation and erosion are not considerations. Table 4 summarizes the levee remediation measure for each reach in each basin.

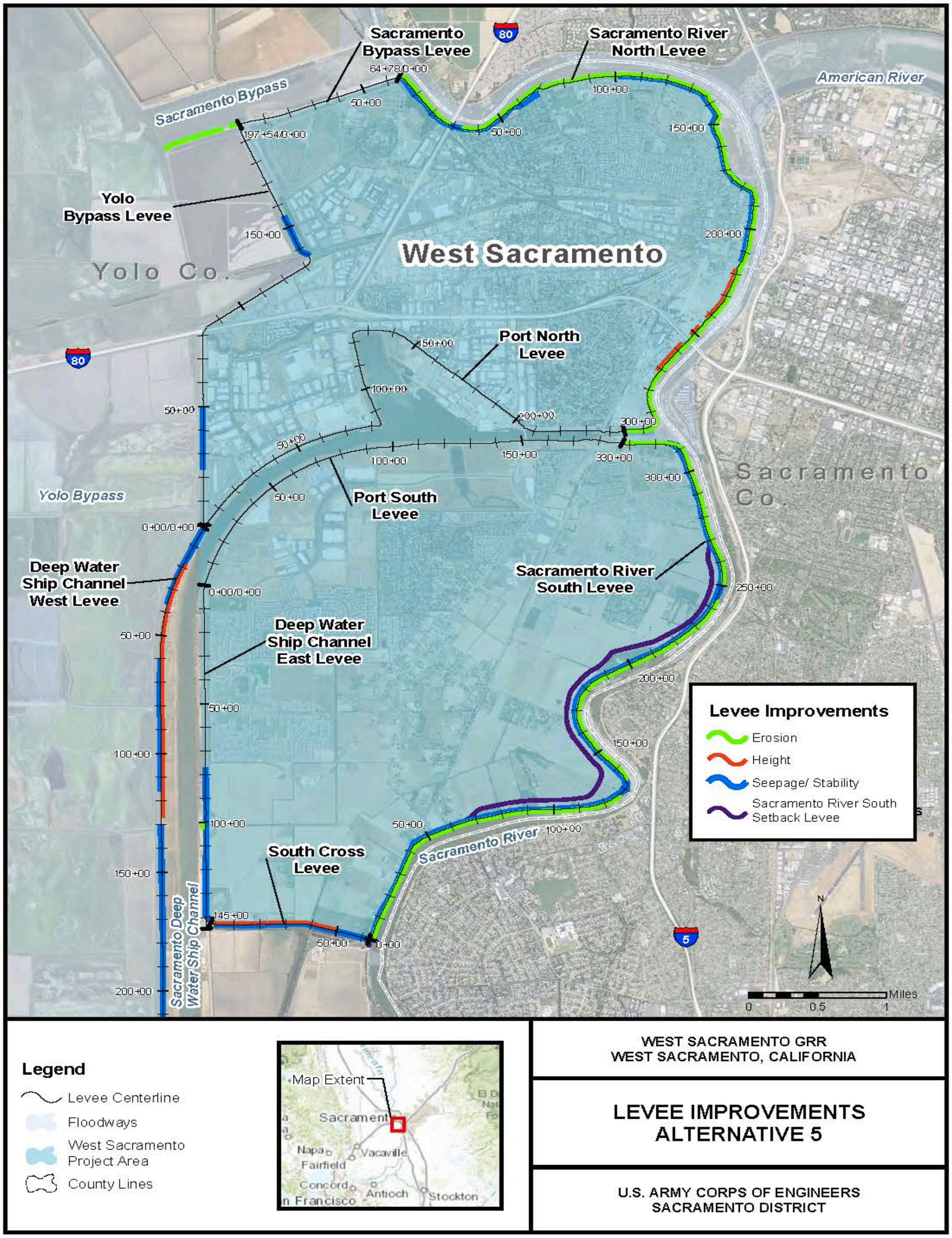

Figure 16. Map of Levee Improvements for West Sacramento Project Alternative 5.

Table 4. West Sacramento Project Alternative 5 – Proposed Remediation Measures by Levee Reach.

Levee Reach	Seepage Measures	Stability Measures	Overtopping Measures	Erosion Protection Measures
North Basin				
Sacramento River North	Cutoff Wall	Cutoff Wall	Levee raise	Bank Protection
Port North *	---	---	Floodwall	---
Yolo Bypass *	Cutoff Wall	Cutoff Wall	---	---
Sacramento Bypass Training Levee	---	---	---	Bank Protection
South Basin				
Sacramento River South	Setback Levee, Cutoff Wall, Seepage Berm,	Setback Levee, Cutoff Wall, Seepage Berm	---	Setback Levee, Bank Protection
South Cross	Stability Berm, Relief Wells	---	Levee Raise	---
Deep Water Ship Channel East *	Cutoff Wall	Cutoff Wall	Levee Raise	Bank Protection
Deep Water Ship Channel West*	Cutoff Wall	Cutoff Wall	Levee Raise	---
Port South*	Cutoff Wall	Cutoff Wall	Levee Raise	---

* The entire levee reach does not need remediation, only specific sections.

It is estimated that 9 million cy of borrow material would be needed to construct Alternative 5. This includes 4 million cy of material for the setback levee. For the purposes of NEPA/CEQA, a worst case scenario is being evaluated for the volume of borrow material needed. Actual volumes exported from any single borrow sites would be adjusted to match demands for fill. Borrow sites for Alternative 5 would be the same as those identified in Section 2.2.1 above.

Construction of Alternative 5 is proposed to take approximately 19 years if each reach is constructed sequentially. The construction reaches have been prioritized based on a variety of factors, including the condition of the levee, the potential damages that would occur due to levee failure, and construction feasibility considerations, such as the availability of equipment at any given time. The tentative schedule of construction is shown in Table 5. The durations are for construction activities only, and do not include the time needed for design, right-of-way, utility relocation, etc.

Table 5. West Sacramento ProjectAlternative 5 – Construction Sequence and Duration.

Construction Sequence	Construction Duration
Sacramento River South Levee	4 years
Sacramento Bypass Training Levee	1 years
Sacramento River North Levee	2 years
Yolo Bypass	1 years
Deep Water Ship Channel West	3 years
Port South	1 years
Deep Water Ship Channel East	3 years
South Cross	2 years
Port North	2 years

Once a levee is modified, regardless of the measure implemented for the alternative, the levee would be brought into compliance with Corps levee design criteria. To provide for levee construction, inspection, maintenance, monitoring, and flood-fighting access, some properties may need to be acquired. The measures proposed for this alternative are described below.

West Sacramento North Basin

The primary issues in the North Basin, as identified on Figure 15, are seepage, slope stability, and erosion, with minimal levee height concerns. The measures that would be implemented under West Sacramento Project Alternative 5 for the levees in the North Basin would be: (1) installation of cutoff walls to address seepage and slope stability concerns; (2) levee raises to address height concerns; and (3) erosion protection to address erosion concerns. These measures are described above in Section 2.2.1. Table 6 shows the lengths of levee reaches, the measures for those reaches, and the approximate length of improvements for the North Basin.

Table 6. West Sacramento Project Alternative 5 – Construction Lengths and Measures for the North Basin

Levee Reach	Length of Reach (feet)	Length of Measure (feet)	Improvement	Measure
Sacramento River North Levee	30,700	30,000	Erosion Protection	Bank Protection
		11,000	Seepage	30 Foot Deep Slurry Wall
		1,500	Seepage	80 Foot Deep Slurry Wall
		500	Seepage	45 Foot Deep Slurry Wall
		5,500	Seepage	110 Foot Deep Slurry Wall
		4,600	Height	Embankment Fill
Stone Locks	570	550		Embankment Fill, Sheet Pile Wall
Port North	23,225	8,500	Height	4 to 10 Foot High Floodwall
		14,000	Height	Embankment Fill
Yolo Bypass	19,749	2,500	Seepage	40 Foot Deep Slurry Wall
		2,000	Seepage	100 Foot Deep Slurry Wall
Sacramento Bypass Training Levee	3,000	3,000	Erosion Protection	Bank Protection

Sacramento Bypass Training Levee

The training levee that extends into the Yolo Bypass from the Sacramento Bypass levee was not repaired by the sponsors, and still has erosion concerns as shown on Figure 15. Under Alternative 5 of the West Sacramento Project, bank protection is proposed to address erosion. Bank protection would be implemented as described in Section 2.2.1.

Sacramento River Levee

The Sacramento River north levee does not meet design requirements, and has seepage and stability concerns along most of the reach with erosion and height issues identified at various locations which are shown on Figure 15. The measures that would be implemented under West Sacramento Project Alternative 5 for the Sacramento River levee would be: (1) installation of cutoff walls to address seepage and slope stability concerns; (2) levee raises to address inadequate levee height; and (3) bank protection to address erosion concerns.

The Sacramento River north levee consists of 20-foot wide levee crown with 3:1 side slopes. The cutoff wall would be constructed through the levee crown to address seepage concerns. The cutoff wall would be installed by one of two methods discussed in Section 2.2.1, depending on the depth of the cutoff wall needed to address the seepage and stability issues. The conventional open trench method would be used to install a cutoff wall to a depth of approximately 85 feet. The DSM method would be utilized for cutoff walls that are installed to a depth greater than 85 feet.

Levee embankment grading, height improvements, and bank protection would be constructed in the same manner discussed in Section 2.2.1. Following construction, the levee would be reconstructed to current Corps standards as described above in Section 2.2.1.

In addition, a new levee with a sheet pile wall would also be constructed on the Sacramento River side of the Stone Locks to close the connection between the Sacramento River and the barge canal. The new levee would also connect the levee along the Sacramento River between the North Basin and South Basin. To construct the new levee, a coffer dam would be constructed on the river side of the construction footprint and that the new levee would be constructed in the dry area. Initially a sheet pile wall would be placed on the east side of the construction area as described in Section 2.2.1. The levee would be constructed west of the sheet pile wall as described under the setback levee heading in Section 2.2.1. Construction of the levee and sheet pile wall would require the removal of 1.7 acres of riparian habitat along the outlet of the Barge Canal. It would also require the relocation of three power poles and two storm drains, and the removal of concrete infrastructure.

Port North Levee

The primary issue in the Port north area is overtopping concerns as shown on Figure 15. Under Alternative 5 of the West Sacramento Project, remediation measures were proposed to address the height concerns along the Port north reach. The measure implemented under Alternative 5 would be: (1) installation of flood walls to address height concerns. The flood wall description can be found above in Section 2.2.1.

Yolo Bypass Levee

Along the Yolo Bypass levee, seepage and slope stability problems were identified at various locations shown on Figure 15. The measures that would be implemented under Alternative 5 of the West Sacramento Project would be: (1) installation of a cutoff wall to address seepage and slope stability concerns. A conventional open trench cutoff wall would be constructed at these locations as described above in Section 2.2.1.

<u>West Sacramento South Basin</u>

The primary issues in the South Basin, as identified on Figure 15, are seepage, slope stability, and erosion with minimal levee height concerns. The measures that would be implemented under West Sacramento Project Alternative 5 for the levees in the South Basin would be: (1) installation of cutoff walls, stability berms, seepage berms, relief wells, or setback levees to address seepage and slope stability concerns; (2) levee raises to address height concerns; (3) erosion protection to address erosion concerns. These measures are described above in Section 2.2.1. Table 7 shows the lengths of levee reaches, the measures for those reaches, and the approximate length of improvements for the South Basin.

Table 7. West Sacramento Project Alternative 5 – Construction Lengths and Measures by South Basin Levee Reach.

Reach	Length of Reach (feet)	Length of Measure (feet)	Improvement	Measure
Sacramento River South Levee	31,000	31,000	Seepage/Erosion	80 Foot Deep Slurry Wall 70 Foot Berm Bank Protection
South Cross Levee	6,273	1,100	Stability/Height	Stability Berm and Embankment Fill
		5,000	Seepage/Height	Relief Wells and Embankment Fill
DWSC East Levee	17,171	1,500	Seepage	120 Foot Deep Slurry Wall
		7,100	Seepage	130 Foot Deep Slurry Wall
		6,000	Seepage	50 Foot Deep Slurry Wall
		2,600	Height	Embankment Fill
Port South	16,262	15,600	Height	Embankment Fill
		1,000	Seepage	70 Foot Deep Slurry Wall
DWSC West Levee	100,260	9,000	Height/Seepage	85 Foot Deep Slurry Wall
		7,000	Height/Seepage	50 Foot Deep Slurry Wall
		9,000	Height/Seepage	75 Foot Deep Slurry Wall
		75,300	Height	Embankment Fill
		100,000	Erosion Protection	Bank Protection

Sacramento River South Levee

Under Alternative 5, Sacramento River levee remediation measures were proposed to address seepage, slope stability, and erosion. A setback levee would be constructed under the tentatively selected plan at the location shown on Figure 15. The measures that would be implemented for the Sacramento River south levee would be: (1) construction of a setback levee, adjacent levee, seepage berm, and fix in place to address seepage, slope stability, and erosion concerns; (2) installation of cutoff walls, sheet pile walls, jet grouting, and relief wells to address seepage and slope stability concerns; and (3) bank protection measures to address erosion concerns. The description of these measures can be found in Section 2.2.1 above.

The West Sacramento Project setback levee would be constructed between RM 57.00 and RM 52.75, separated by Bees Lake. The existing levee at Bees Lake would not be degraded, and flow through Bees Lake would be prohibited by road embankments on each end. The natural hydraulic connection through the existing levee would remain intact, maintaining the tidal connection with the Sacramento River. The north offset area setback levee is just over a mile in length, extending from about RM 56.8 to RM 55.7. The south offset area setback levee is a little more than two miles in length, extending from about RM 55.1 to RM 52.8. The typical offset distance of the setback levee from the existing levee is approximately 400 feet. Most of the existing levee would be degraded to an elevation of 30 feet (NAVD 88). Where necessary, bank protection would be added to the existing levee to protect the bank in place. In the north offset area, there are two locations where the existing levee would be completely degraded to original ground for a length of 800 to 1,000 feet. In the south offset area, there are three locations where the existing levee would be completely degraded to original ground for a length of about 800 feet. Both offset areas are degraded about 10 feet, in general. The complete degrades would require bank protection upstream and downstream to prevent erosion during high flows.

South Cross Levee

The primary issues along the South Cross levee are overtopping and seepage, as shown on Figure 15. The measures that would be implemented under West Sacramento Project Alternative 5 for the South Cross levee would be: (1) a stability berm to address seepage and slope stability concerns; (2) relief wells to address seepage concerns; and (3) a levee raise to address height concerns. These measures would be constructed as described above in Section 2.2.1.

Deep Water Ship Channel East Levee

Along the DWSC east levee there are issues with seepage, slope stability, and height at various locations shown on Figure 15. The measures that would be implemented under Alternative 5 of the West Sacramento Project for the DWSC east levee would be: (1) installation of cutoff walls to address seepage and slope stability concerns and (2) a levee raise to address height concerns. Both cutoff wall methods would be constructed along this reach as described above in Section 2.2.1 to address the seepage and slope stability problems. Since the DWSC levees are set back from the channel with a large berm in between, and because no erosion protection is proposed for this reach, there would be no impacts to the DWSC waterway.

Levee raising would be implemented where required and would be constructed as described above in Section 2.2.1. The irrigation ditch at the toe of the levee would be relocated outside the levee footprint below the housing development and would be covered over with soil and replaced with two 48 inch diameter pipes that would be placed along the levee toe adjacent to the housing development. The construction methods described above in Section 2.2.1 would be used for the cutoff wall and raises and the levee would be brought into compliance with Corps standards.

Deep Water Ship Channel West Levee

The DWSC west levee has seepage, slope stability, height, and erosion problems at various locations shown on Figure 15. The measures that would be implemented under West Sacramento Project Alternative 5 for the DWSC west levee would be: (1) installation of cutoff walls and seepage berms to address seepage concerns; (2) a levee raise to address height concerns; and (3) bank protection to address erosion concerns. The conventional open trench cutoff wall would be constructed at locations shown on Figure 14 to address the seepage and slope stability concerns in that reach. At various locations from the South Cross levee south to Prospect Island in the Delta, a distance of roughly

19 miles, a cutoff wall and bank protection would be constructed. The bank protection would address erosion and would be placed along the Yolo Bypass side of the levee at identified locations, as described above in Section 2.2.1. The cutoff wall would also be constructed as described above in Section 2.2.1. Levee raises would be implemented where required, as identified on Figure 15, and would be constructed as described above in Section 2.2.1.

Port South Levee

The primary issues in the Port south area are overtopping, seepage, and slope stability at a few locations shown on Figure 15. The measures that would be implemented under West Sacramento Project Alternative 5 for the Port South levee would be: (1) installation of cutoff walls to address seepage and slope stability concerns and (2) a levee raise to address inadequate levee height. The cutoff wall would only be constructed along a small section adjacent to Lake Washington. The construction methods described above in Section 2.2.1 for cutoff walls and height improvements would be used to address these issues.

2.3 Southport EIP Element of West Sacramento Project Proposed Action

The Southport EIP element of the Proposed Action is a blend of flood risk reduction measures selected based on their effectiveness in addressing deficiencies, compatibility with land uses, minimization of real estate acquisition, avoidance of adverse effects, and cost. The Proposed Action includes a combination of setback levees, cutoff walls, and seepage berms (along with other measures) (Table 8). WSAFCA is proposing the Southport project to implement flood risk reduction measures along the Sacramento River South Levee in order to provide 200-year level of performance consistent with the state goal for urbanized areas, as well as to provide opportunities for ecosystem restoration and public recreation. The overall project involves the following elements.

- Construction of flood risk reduction measures, including seepage berms, slurry cutoff walls, setback levees, rock and biotechnical slope protection, and encroachment removal.
- Partial degrade of the existing levee, forming a “remnant levee.”
- Construction of offset areas using setback levees.
- Construction of breaches in the remnant levee to open up the offset areas to Sacramento River flows.
- Offset area restoration.
- Road construction.
- Drainage system modifications.
- Utility line relocations.

2.3.1 Southport EIP Flood Risk Reduction Measures

In order to address levee deficiencies, several flood risk reduction measures would be constructed in the Southport EIP project area. These measures consist of setback levees, seepage berms, slurry cutoff walls, rock and biotechnical slope protection, and encroachment removal. The approximate linear length of each flood risk reduction and erosion control measure proposed for each segment is provided in Table 8, below, and is displayed in Figure 17.

The levee flood risk reduction measure footprint includes the following elements: a waterside O&M easement (where available), the levee from toe to toe, a seepage berm (where specified), and the landside O&M easement. The waterside and landside O&M easements are assumed to be 20 feet wide and unpaved. The landside O&M easement follows the toe of the levee or the landside toe of seepage berms, where present. The utility corridor is included largely within the Village Parkway right-of-way. In Southport EIP Segment G, where existing residences are close to the existing levee, the landside O&M easement is assumed to vary from approximately a few feet to 100 feet between the proposed flood risk reduction measure toe and the existing residential lot lines. In Southport EIP Segment A the landside O&M easement is coincident with South River Road. For segments where a suitable impermeable tie-in layer was not identified from the geotechnical explorations, a seepage berm would be constructed. Where a tie-in layer was located, a cutoff wall at the associated depth would be constructed. For levee reaches where a seepage berm would be constructed to address underseepage, a shallow cutoff wall would also be installed in lieu of an inspection trench.

Table 8. Southport EIP Flood Risk Reduction and Erosion Control Measures.

Segment	Approximate Length (linear feet)	Measures
A	4,830	Slurry cutoff wall
B	115	Slurry cutoff wall
	1,955	Slurry cutoff wall and landside seepage berm
	3,490	Setback levee, slurry cutoff wall, landside seepage berm, and bank stabilization at breach S3
C	4,490	Setback levee, slurry cutoff wall, landside seepage berm, toe rock and bank stabilization at breaches S1 and S2.
	940	Setback levee, slurry cutoff wall, bank stabilization at Erosion Sites C1 and C2, and toe rock upstream and downstream of Erosion Sites C1 and C2.
D	1,985	Setback levee, slurry cutoff wall, and toe rock upstream of Erosion Sites C1 and C2
E	995	Setback levee and slurry cutoff wall
	2,297	Setback levee, slurry cutoff wall, and landside seepage berm
F	5,583	Setback levee, slurry cutoff wall, landside seepage berm, bank stabilization and toe rock at breach N1, and toe rock and bank stabilization at breach N2
G	2,795	Slurry cutoff wall and bank stabilization at Erosion Site G3

Each of the proposed flood risk–reduction and erosion control measures is described below. Post-construction, the levee slopes, areas used for construction staging, and any other disturbed areas would be hydroseeded with a native seed mix.

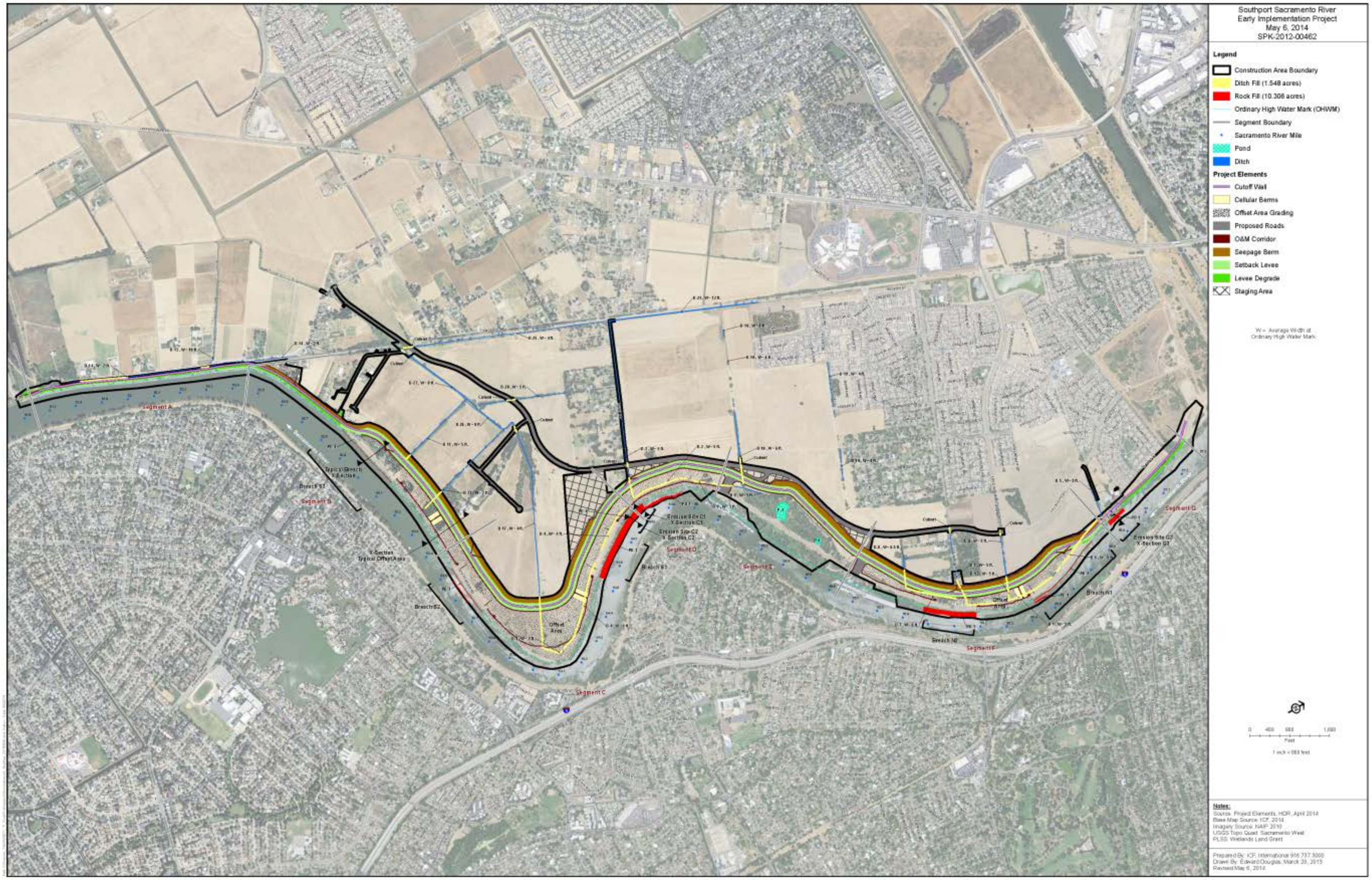

Figure 17. Southport EIP Project Plan.

Slurry Cutoff Wall

A slurry cutoff wall would be constructed throughout the alignment of the proposed Federal project levee. A slurry cutoff wall consists of impermeable material that is placed parallel to the levee, typically through the center of the levee crown. While slurry cutoff walls may be constructed using a variety of methods, this document considers two possible methods of construction: (1) conventional slot trench and (2) clamshell trench.

Shallow cutoff walls are those that extend through the levee embankment and a portion of the levee foundation. They do not finish into a low permeability aquitard but serve to "tie together" surface layers, causing them to function more as a blanket layer, and increasing the seepage path. Shallow cutoff walls also serve to cut off localized seepage pathways, such as high permeability crevasse splay deposits, root pathways, or other subsurface structures. As such, they replace the need for installing an inspection trench beneath or adjacent to new levees. The feasibility and design of these features is evaluated based on local conditions.

Fully penetrating conventional cutoff walls (open trench installation with track-hoe) extend through the levee embankment and levee foundation and finish into a low permeability aquitard. Fully penetrating conventional cutoff walls generally are preferred, if feasible to construct, because they are the least costly compared to cutoff walls installed using the DSM, trench cutting re-mixing, or clamshell technology, while still providing the advantage that all cutoff walls provide of minimizing construction disturbance outside the levee footprint. Where the low permeability aquitard is too deep for conventional cutoff wall, completion of the wall with a clamshell trench is proposed. By this method, the open trench is excavated by trackhoe to the limit of the excavator and is finished by a dragline with a clam shell.

If a fully penetrating wall is not feasible because of the foundation conditions (the lower impervious layer is nonexistent or at a depth impossible to reach with the existing equipment), shallow cutoff walls supplemented with seepage berms are proposed.

Conventional Slot Trench Method

To begin construction, the construction site and any necessary construction staging or slurry mixing areas would be cleared, grubbed, and stripped.

In the conventional slot trench method using a soil-bentonite wall, the levee would be degraded by one-third its height and a trench excavated through the levee center from the top of the levee and into subsurface materials. The size of the trench would be based on the depth of the low permeability aquitard, but is typically 3 feet wide and up to 85 feet deep. As the trench is excavated, it would be filled temporarily with soil, bentonite, and water slurry to prevent collapse of the trench. The soil from the excavated trench would be hauled to a nearby location and mixed with hydrated bentonite. The soil-bentonite mixture would then be returned to the levee and backfilled into the trench. This mixture hardens and creates the impermeable barrier wall in the levee.

Degradation of the levee crown would be required to prevent hydro-fracturing of the levee, or, in the case of a soil-bentonite wall, to prevent slope failures through the slurry wall caused by extremely low trench strength. Degradation would also provide a temporary work platform, typically a minimum of 40 feet wide, to accommodate seepage berm construction activities and allow equipment to reach lower impervious layers. The temporary work platform also provides access for haul trucks used to haul excavated degrade material to a nearby stockpile area for later use in reconstructing the levee crown, or in constructing seepage berms. The material may need to be hauled offsite and borrow material imported if the in-situ levee material is found to be unsuitable for current levee standards.

Following completion of the slurry cutoff wall, either borrow material or previously degraded levee material would be hauled and placed on the temporary working platform to reconstruct the levee with a 2:1 landside slope and a waterside slope that matches the existing slope. Front-end loaders or excavators would load haul trucks with the borrow material, and the haul trucks would transport it to the degraded levee site. The haul trucks would dump the material, and dozers spread it evenly. Sheepsfoot rollers would compact the material, and water trucks would distribute water over the material to ensure proper moisture for compaction. Topsoil would then be placed on the levee slopes.

One construction crew typically is able to construct 200 to 250 linear feet of slurry wall (approximately 70 to 80 feet deep) in an 8-hour shift. Equipment needed for the crew includes a long-reach track hoe, three or four dump trucks (15 cubic-yard capacity each), bulldozers, excavators, loaders, a rough terrain forklift, compactors, maintainers, and a water truck. Vertical clearance of about 40 feet would be needed for the excavator boom. Horizontal clearance of about 30 feet beyond the levee crest may be required for excavator swing when loading dump trucks.

A mixing area would be located at the construction staging area. The mixing area would be used to prepare the soil-bentonite mixture and supply bentonite-water slurry. The mixing area would be contained to avoid inadvertent dispersal of the mixing materials. Dump trucks would haul material between the excavator and the mixing area along the levee.

The construction equipment and materials necessary to construct a slurry cutoff wall by this method are listed in Table 9. Floodlights and generators would also be used for nighttime slurry wall construction. Post-construction, areas used for construction staging, mixing, the levee crown, slopes, and any other disturbed areas would be hydroseeded with a native seed mix.

Table 9. Southport EIP Conventional Slot Trench Slurry Wall – Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Site preparation (clearing, grubbing, and stripping)	Scraper	
Work platform and trench excavation	Excavator or track hoe Haul truck	Bentonite
Mixing/placement of soil-bentonite mix	Long-reach track hoe Haul trucks Bulldozer Rough terrain fork lift	Bentonite Water
Replacement of levee material	Excavator or track hoe Bulldozer Loader Scraper Haul truck Motor grader Sheepsfoot roller Water truck	Embankment fill material Water
Finish grading	Bulldozer Motor grader	
Site restoration and demobilization	Front end loader Haul trucks Motor grader Sheepsfoot roller Water truck	Miscellaneous construction support materials Embankment fill material Topsoil Hydroseed
Piezometer installation	Drill truck	Water Sand Cement Well Casing

Operations and Maintenance

Post-construction, the only permanent facilities would be the slurry cutoff wall and an aggregate base, levee-top patrol road for the purpose of levee inspection and emergency vehicle access, and the levee O&M corridors. Typical levee O&M in the Southport project 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 would be monitored using the piezometers.

Clamshell Method

The clamshell method is an alternative to the DSM method of constructing a slurry cutoff wall, and uses a dragline crane with a clamshell bucket. The initial trench would be excavated and backfilled as described above for the conventional slot trench method. When the trench exceeds the limit of the excavator's reach, a dragline with clamshell would be used to complete the excavation. As with the conventional slot trench method, soil-bentonite grout would be mixed with the native soil and placed in the trench as the clamshell is withdrawn. Cement may also be added to the mixture to increase strength and reduce curing time when needed. Levee degradation, trench placement, material stockpiling, and levee-top reconstruction would be completed as described for the conventional slot trench method. The equipment and materials necessary to construct a clamshell slurry wall are listed in Table 10. Post-construction, areas used for construction staging, the levee slopes, and any other disturbed areas would be hydroseeded with a native seed mix.

Operation and Maintenance

Operation and maintenance for a clamshell slurry cutoff wall would be the same as described above for the conventional slot trench method.

Table 10. Southport EIP Clamshell Method Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Site preparation (clearing, grubbing, and stripping)	Scraper	
Work platform and trench excavation	Excavator or track hoe Haul truck	
Mixing/placement of soil-bentonite mix	Long-reach track hoe Haul trucks Bulldozer Rough terrain fork lift	Bentonite Cement Water
Replacement of levee material	Excavator or track hoe Bulldozer Loader Scraper Haul truck Motor grader Sheepsfoot roller Water truck	Embankment fill material Water
Finish grading	Bulldozer Motor grader Compactor	
Site restoration and demobilization	Front end loader Haul truck Motor grader Sheepsfoot roller Water truck	Miscellaneous construction support materials Embankment fill material Topsoil Hydroseed
Piezometer installation	Drill truck	Water Sand Cement Well Casing

Setback Levee

A setback levee is an entirely new section of levee constructed at some distance behind the landside of the existing levee. The existing levee would remain in place or be removed or breached, depending on conditions. The new section of levee would be tied into the existing levee and then become the Federal project levee.

The Southport EIP's new levee section would be constructed to meet current design standards, including height and slope requirements. To begin construction activities, the area required to construct the new levee would be cleared, grubbed, and stripped, and encroachments into the new levee footprint would be removed. To construct the new section of levee, bulldozers would excavate and stockpile borrow material from a nearby permitted borrow site. Front-end loaders or excavators would load haul trucks with the borrow material. The haul trucks would transport the material to the new levee site, where motor graders would spread it evenly. Sheepsfoot rollers would compact the material, and water trucks distribute water over the material to ensure proper moisture for compaction. Once the foundation of the new setback is built up to a suitable elevation, a slurry cutoff wall would be constructed using either the conventional slot trench method or clamshell method, as described in Slurry Cutoff Wall. Following completion of the slurry cutoff wall, the top portion of the levee would be built up to an elevation of approximately +40 feet NAVD 88 for the entire length of the setback levee. Levee slopes would be graded to a 3:1 slope, and a crown at least 20 feet wide created. Topsoil would then be placed on the levee slopes and hydroseeded. For the purpose of levee inspection and emergency vehicle access, an aggregate base, all-weather levee-top patrol road would be constructed.

Equipment and materials necessary to construct a setback levee are listed in Table 11. Post-construction, construction staging areas, levee slopes, and any other disturbed areas would be hydroseeded with a native seed mix.

Table 11. Southport EIP Setback Levee Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Site preparation (clearing, grubbing, and stripping)	Scraper Bulldozer	
Embankment fill material placement	Excavator or tack hoe Dozer Loader Scraper Haul Truck Motor grader Sheepsfoot roller Water truck	Embankment fill Water
Finish grading	Bulldozer Motor grader Compactor	Aggregate base rock
Site Restoration and demobilization	Front-end loader Haul truck Motor grader Sheepsfoot roller Water truck	Topsoil Hydroseed

Operations and Maintenance

Post-construction, the only permanent facility would be the improved levee. O&M would be the same as for a typical levee, described under Slurry Cutoff Wall.

Seepage Berm

Seepage berms are wide embankment structures made up of low-permeability to semi-pervious materials that resist accumulated water pressure and safely release seeping water. Seepage berms proposed for the Southport project would extend outward from the landside levee toe and laterally along the levee as needed relative to the seepage conditions. A seepage berm addresses the levee deficiency of underseepage.

Seepage berms for the Southport EIP would vary from 50 to 100 feet in width. Berms typically would be a minimum of 5 feet in height at the levee landside toe, tapering to approximately 3 feet at the landside hinge with a 1.5–2% minimum grade to promote drainage, and then slope down to the berm toe at a 3:1 slope. Lateral length would depend on seepage conditions along the area of identified levee deficiency.

To begin construction, the construction site would be cleared, grubbed, and stripped. Soil used to construct a berm would be stockpiled from levee degradation, excavated from nearby borrow pits, or trucked onsite from offsite locations (if adequate onsite material is not available). During the degrading of the existing levee, soil would be stockpiled at the proposed berm sites or used to construct the berms. At the borrow sites, bulldozers would excavate and stockpile borrow material. Front-end loaders would load haul trucks that would transport the borrow material to the site. The haul trucks would dump the material and motor graders would spread it evenly, placing approximately 3 to 5 feet of embankment fill material. Material used for berm construction would have greater permeability than the native blanket material. However, depending on material availability, a lower permeability material may be used. Adjustments to berm width would be made in such cases, as appropriate. During the embankment placement, material would be placed in a maximum of 1- to 2-foot loose lifts, sheepsfoot rollers would compact the material, and water trucks would distribute water over the material to ensure proper moisture for compaction and to reduce fugitive dust emissions. Topsoil would then be placed on the berm and hydroseeded. No new drainage system would be associated with the seepage berms.

Equipment and materials necessary to construct a seepage berm are listed in Table 12. Areas used for construction staging, levee slopes, the berm, and any other disturbed areas would be hydroseeded with a native seed mix.

Table 12. Southport EIP Seepage Berm Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Site preparation (clearing, grubbing, and stripping)	Scraper Bulldozer	
Embankment fill material placement	Excavator or tack hoe Bulldozer Loader Scraper Haul Truck Motor grader Sheepsfoot roller Water truck	Embankment fill Water
Finish grading	Bulldozer Motor grader	
Site Restoration and demobilization	Front-end loader Haul truck Motor grader Sheepsfoot roller Water truck	Topsoil Hydroseed

Operation and Maintenance

The only post-construction permanent facility would be the berm. Maintenance of the berm would be similar to the typical O&M practices presently in place for maintenance of levee surfaces.

- 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.
- Visual inspection at least monthly by driving on the patrol road on the levee crown and O&M corridor at the toe of the seepage berm.

Bank Erosion Sites

Three bank erosion sites requiring repairs were identified in the Southport EIP project reaches along the Sacramento River; two sites are in Segment C and the third site is in Segment G (Figure 16). The Segment C sites would not be subject to the Corps vegetation policy, as they would be on the remnant levee; however, the Segment G site would be located on the Federal project levee and would comply with the vegetation policy. Therefore, the design of the Segment C sites differs from that of the Segment G site, as described below. The repairs at all three sites are designed to protect against erosional forces that threaten levee stability, such as wind, waves, boat wake, and fluvial forces.

Remnant Levee Sites

The two erosion sites on the remnant levee are Sites C1 and C2, which are adjacent to each other. Once the setback levees for the Southport EIP are complete, the existing levee in Segment C would no longer be part of the Federal project levee. Site C1 has a top length of 160 linear feet and tapers near the bottom of the slope. The proposed repairs at Site C1 would address a scour hole that has formed on the slope between elevations of -33 feet NAVD 88 and +11 feet NAVD 88, as well as slumping that has occurred at the base of the slope. Site C2 would include repairs along 547 linear feet of Segment C. Repairs at Site C2 would address general erosion problems that have been created by wave erosion.

Design and Construction

Erosion site repairs on the remnant levee would be designed both to control erosion and to maintain existing vegetation and instream woody material (IWM). This would be accomplished by incorporating rock benches that serve as buffers against erosion while providing space for planting riparian vegetation and creating a platform to support aquatic habitat features (Appendix B, Figures 3a and 3b). Rock would be placed onto the levee slope from the waterside by means of barges; one barge would hold the stockpile of rock to be placed, and a second barge would hold the crane that would place the rock on the channel slopes. A backhoe would be used from the bank to shape the rock. Clean rock fill would be placed over existing riprap between elevations of -33 feet NAVD 88 and +5 feet NAVD 88, and type C graded stone would be placed over the clean rock fill in a 2.5-foot thick layer with a 2:1 slope from the toe of the slope to an elevation of +7 feet NAVD 88. The clean rock fill and graded stone at the top of the erosion site would be placed to form a planting bench at an elevation of +7 feet NAVD 88 in order to match the average annual low-water surface elevation, and the bench would have an average width of approximately 10 feet. At Site C1, stone would be placed at the upstream and downstream ends of the site in thickened sections in order to address problems created by a scour hole along the site. These sections would extend up and down the bank and would be approximately 5 feet thick and 12.5 feet wide, and would transition laterally to 2.5-foot thickness at a 1:1 slope.

Once the rock has been placed along the slope of the erosion sites, a 1-foot thick layer of 0.75-inch crushed clean rock would be placed at the upslope end of the stone bench to create a filter between the topsoil and the stone bench. Topsoil would then be placed above the newly constructed bench at a 3:1 slope to meet the existing bank, and coir fabric would be placed over the soil to keep it in place. Topsoil would be placed from a barge, similar to the process for placing the rock. Pole plantings would then be hand-placed in the planting bench between elevations of +7 feet NAVD 88 and +11.5 feet NAVD 88. Beaver fencing would be installed at the upslope and downslope extents of the topsoil installation. IWM would be anchored along the remnant levee erosion sites to achieve at least 40% shoreline coverage, and would be placed between 1 and 3 feet below the elevation of the average annual low water surface. IWM would likely come from trees removed in other portions of the project area, and would be selected based on suitability for the site. Existing vegetation and riprap at the erosion site would be retained.

The two erosion sites on the remnant levee are located on the outer bank of a bend in the river and are therefore subject to greater erosive forces. Given the location of these two erosion sites, rock would be placed along the toe of the bank (toe rock) at both sites, as well as upstream and downstream of the erosion sites to further protect the bank of the remnant levee. The toe rock would begin approximately 850 feet upstream of Site C1, would extend through both erosion sites, and would terminate approximately 300 feet downstream of Site C2. Portions of this area are currently riprapped, and the additional toe rock to be placed would be limited to areas where there is currently no rock below an elevation of +7 feet NAVD 88.

Equipment and materials necessary for bank erosion site repairs along the remnant levee are listed in Table 13.

Table 13. Southport EIP Bank Erosion Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Rock placement	Crane Barges Backhoe	Rock
Biotechnical element installation	Crane Barge Hand tools	Topsoil Coir fabric Pole cuttings Beaver fencing

Active Levee Erosion Site

Site G3 is located in Segment G and would be part of the Federal project levee. Site G3 would include 410 linear feet of repairs to the top of the erosion scarp and the creation of a planting bench and vegetated slope to protect against boat wake and fluvial erosion.

The design and construction equipment, methods, and materials for Site G3 would be similar to those described for Sites C1 and C2. However, Site G3 would require additional rock armoring and soil fill (up to elevation +25 feet NAVD 88) to repair the erosion scarp and meet Federal levee protection standards. The proposed design includes riprap toe protection, earth and rock fill to restore the levee prism between elevation -10 feet NAVD 88 and +25 feet NAVD 88, a soil-covered 10-foot-wide planting bench (10:1 slope) and bank (3:1 slope) planted with pole cuttings and large container plantings, and IWM anchored between 1 and 3 feet below the elevation of the average annual low water surface. The planting bench would be 15 feet outside the minimum levee template, per the Urban Levee Design Criteria.

Operations and Maintenance

Post-construction, only the rock slope protection, native vegetation, and other biotechnical features would be permanent. Anticipated O&M actions include regular visual inspections of the site, vegetation maintenance and irrigation for up to 3 years, and periodic repairs, as needed, to prevent or repair localized scour along the bank and rock toe of the site.

Encroachment Removal

Levee standards for vegetation and encroachments may require removing encroachments, such as structures, levee penetrations (e.g., pipes, conduits, cables), power poles, pump stations, and similar features, from the levee footprint. This measure would include the demolition of such features and relocation or reconstruction as appropriate on a case-by-case basis (or retrofit to comply with standards). Existing piling within the river at Oak Knoll Bend would also be removed.

Encroachment removal techniques would be implemented based on the needs of the specific encroaching feature. Smaller encroachments would be removed, relocated, or retrofitted by manual labor of small crews (approximately two to 10 workers) using hand tools. Larger encroachments would require machinery such as an excavator, skid-steer, and bulldozer. Piling removal would require a barge with a crane for removal or cutting off at or below the mud line. Dump trucks would be used for hauling and disposal of removed material at an offsite permitted commercial source. Encroachments that substantially penetrate the levee (like footings or large woody vegetation) would require levee reconstruction, discussed as a separate measure.

Equipment and materials necessary for encroachment removal are listed in Table 14. Relocations would require similar equipment. Post-construction, areas disturbed by the equipment would be hydroseeded.

Table 14. Southport EIP Encroachment Removal Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Encroachment removal and/or relocation	Excavator Skid-steer Bulldozer Loader Dump truck	Debris
Piling removal	Barge Crane Pump Torch	
Site restoration and demobilization	Haul truck Water truck	Hydroseed Water

Vegetation Policy Compliance

Vegetation removal under the Southport project would be limited to only vegetation removed from the project's flood risk–reduction measures footprint to address other deficiencies. New levees (such as setback levees) would be designed to be compliant with Corps levee vegetation policy. Consistent with the Central Valley Flood Protection Plan (CVFPP) guidance, vegetation would be removed to meet specific project objectives. Any vegetation removed as part of direct construction activities would not be replaced at that location, but may require offsite, in-kind mitigation, to be determined in consultation with the appropriate resource agencies.

In accordance with Corps guidance, WSAFCA would submit a detailed removal plan to the local Corps District Levee Safety Officer for review and comment prior to removal of vegetation. Methods for removing vegetation are identified below.

- By excavation, remove the trunk (or stem), stump, rootball, and all roots greater than 0.5 inch in diameter; all such roots in, or within 15 feet of, the flood risk–reduction structure will be completely removed.
- Ensure that the resulting void is free of organic debris.
- Cut poles to salvage propagation materials for replanting, such as willows and cottonwoods.
- Conduct hand clearing using chainsaws and trimmers.
- Conduct mass clearing using bulldozers.

Operations and Maintenance

O&M would be the same as for a typical levee. Any remaining or replaced encroachments would be maintained as they were pre-project.

Additional Construction Elements

Remnant Levee Degrade

With the construction of the Southport EIP setback levee, the existing levee in Segments B through F would no longer be part of the Federal project levee. Most of the existing levee in these areas would be degraded in order to provide additional borrow material for constructing seepage berms or for reclamation of other borrow areas. The remnant levee in Segment E would remain as-is in order to maintain access to Sherwood Harbor Marina and Sacramento Yacht Club. Also, in the portion of Segment F south of breach N2, the roadway would be removed up to the Sacramento Yacht Club access road but would not be degraded in order to help protect the marinas during high flow events (Figure 15).

Prior to excavation, the area to be degraded would be cleared, grubbed, and stripped. The remnant levee would be degraded to an elevation of +30 feet NAVD 88, with a crown width of 20 feet and a landside slope of 3:1. Front-end loaders would load haul trucks with the excavated material. Haul trucks would then transport the material to stockpile areas in the staging areas for later use for berms or to borrow areas for use in site restoration. Material used for borrow area restoration would be spread evenly using motor graders and compactors. The waterside slope would not be excavated, with the exception of the area above elevation +30 feet NAVD 88. Disturbed areas would then be planted as part of the offset area restoration plantings, and an unpaved O&M corridor would be established at the landside toe of the remnant levee.

Equipment and materials necessary to construct a setback levee are listed in Table 15.

Table 15. Southport EIP Remnant Levee Excavation Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Site preparation (clearing, grubbing, and stripping)	Scraper Bulldozer	
Embankment excavation	Bulldozer Loader Haul truck Motor grader Scraper	
Site restoration and demobilization	Haul truck Motor grader Sheepsfoot roller Water truck	Hydroseed Water

<u>Operations and Maintenance</u>

Post-construction, there would be no continued maintenance of the remnant levee. However, the remnant levee would be monitored periodically to ensure that future erosion does not jeopardize the flood risk–reduction measures. The landside toe O&M corridor would provide access for inspection and erosion repair, if needed.

Levee Breaches

Portions of the remnant levee would be breached to allow Sacramento River flows into two separate offset areas during high flow events (Figure 15). The northern offset area breaches, from north to south, are N1 and N2 (both in Segment F), and the southern offset area breaches, from north to south, are S1 (Segment C), S2 (Segment C), and S3 (Segment B). Construction of the breaches would occur during the summer–fall period to take advantage of low flows in the Sacramento River and to comply with Central Valley Flood Protection Board (CVFPB) regulations.

The proposed breaches would be constructed in phases, with breaches S3 and N1 being constructed first, and the remaining breaches likely being constructed 2 years later in order to allow offset area restoration areas to establish before being exposed to flows. To construct the breaches, the existing levee would be degraded down to an elevation of +10 feet NAVD 88 using excavators. Existing revetment found to be in good condition would be retained up to an elevation of +10 NAVD 88. Until breaches S1, S2 and N2 are constructed, culverts would be installed at their proposed locations in order to drain the offset area between the new Federal levee and the degraded remnant levee. These culverts would be used to equilibrate hydraulic pressure on both sides of the degraded levee (i.e., between the offset area and Sacramento River channel), as well as to provide drainage for the associated offset segment in order to minimize fish stranding and extended inundation of restored habitats. Each culvert would be 54 inches in diameter and approximately 140 feet long (Figure 4). The culverts would be placed at approximately +7 NAVD in order to fully drain the offset area behind them. Each culvert would utilize existing riprap located at the mouth of each structure on the Sacramento River.

Excavation to facilitate construction of culverts in the offset area would be to an elevation of +7 feet. In-water construction activities would be scheduled for between July 1 and October 31, when water elevations in the Sacramento River along the project area are typically at the average annual low water elevation of +6.7 feet to +7.1 feet. Installation of temporary cofferdams may be necessary prior to culvert installation in order to prevent river flows from entering the construction area. At a minimum, sandbags would be used to construct the cofferdam and water would be pumped out of the inundated construction area. Depending on water elevations in the river at the time of construction, the cofferdams may be constructed using sheet pile walls or other methods. In order to accommodate the use of construction equipment in constructing the culverts, the cofferdams would typically extend up- and downstream of the end of the culverts in order to provide a temporary work area.

The breach shoulders would be armored with rock from the top extent of the existing riprap at +10 NAVD 88 on the waterside, up and over the degraded remnant levee crown, and down the landside slope (Appendix B, Figure 5a). Along the alignment of the remnant levee, rock would be placed from the base of the inlet shoulder in the breach to the top of the degraded remnant levee, and would extend an additional 100 feet from the top edge of the shoulder on each side of the breach. A 25-foot riprap apron would then extend out from the landside toe of the breach shoulder at an elevation of roughly +10 NAVD 88, as well as from the toe of the shoulder in the breach. All rock for the shoulder and apron armoring would be placed in a layer approximately 2.5 feet thick.

The upstream shoulder of breach N1 and the downstream shoulder of breach S3 would have slightly different erosion control measures than the other breach shoulders, as both of these breaches would have transitions from the newly constructed setback levee to the existing levee (Appendix B, Figures 5b and 5c). Rock armoring would be placed on the slope of the waterside berm of the setback levee. Rock placement on these transition shoulders would be contiguous with the apron zone and riverbank zone protection measures.

On the waterside of the breaches, new riprap would be placed from the toe of the bank slope up to an elevation of +7 feet NAVD 88 in areas where the existing riprap is lacking. Breaches N1, N2, S1, and S2 would also have toe rock placed along portions of the base of the bank to further protect it from erosive forces. Coir fabric would be placed between elevations of +7 feet NAVD 88 and +10 feet NAVD 88, and this “riverbank zone” would be planted with species suitable for coppicing in order to create a vegetated bench. Coppicing is a method of woodland management in which young tree stems are repeatedly cut down to a predetermined height, which takes advantage of the fact that many trees make new growth from the remaining stumps. The vegetation in this area would be coppiced in order to maintain a region of nearly uniform hydraulic resistance and prevent erosion due to concentration of flows between clumps of trees. Coir fabric would also be placed in the “apron zone” between the edge of the +10 feet NAVD 88 elevation and the centerline of the breach, with jute netting continuing landward of the termination of the coir fabric for 100 feet. This area would be planted with cuttings, rootstock, or container plants. The final design of the breaches would be included in the draft Mitigation and Monitoring Plan (MMP), presently under preparation.

Rock would be placed onto the levee slope from atop the degraded levee, from the breach sill, from the waterside by means of barges, or by a combination of the three methods. Rock required within the channel, both below and slightly above the surface of the water at the time of placement, would be placed by a crane located on a barge and then spread by an excavator located on top of the levee or in the breach sill. Construction would require two barges—one barge to carry the crane and another to hold the stockpile of rock to be placed on the channel slopes—and one excavator located in the breach. Rock required on the upper portions of the slopes would be placed by an excavator located on top of the levee. Rock placement from atop the levee would require one excavator for each potential placement site. The loader would bring the rock from a permitted source within 25 miles of the project area and dump it within 100 feet of the levee breach. The excavator would move the rock from the stockpile to the waterside of the levee. Equipment and materials necessary for constructing the breaches are listed below in Table 16.

Table 16. Southport EIP Levee Breach Construction Phases, Equipment, and Materials.

Phases of Construction	Equipment	Materials
Breach excavation	Excavator	
Rock placement	Crane Barges Excavator	Rock
Biotechnical element installation	Hand tools	Jute netting Coir fabric Pole cuttings Container stock

Operations and Maintenance

O&M access to the breaches would be provided by O&M corridor roads that cross the cellular berms described in Offset Floodplain Area Restoration, below, and by the O&M corridor located along the landside toe of the remnant levee in the offset areas. Access to the N1 and S3 breaches would also be from where the setback levee transitions to the existing levee.

Offset Floodplain Area Restoration

The offset floodplain area refers to the two expanded floodways located between the proposed Southport setback levee and the remnant levee that would be created when portions of the existing levee are breached to allow Sacramento River water to flow into the offset area (Figure 16). Project activities in this area would include floodplain and habitat restoration and borrow excavation. The offset areas would be planted to provide mitigation for vegetation removed as part of construction.

If appropriate for reuse, the excavated material would be used in construction of the setback levee and seepage berms. Following excavation, the offset area would be finished and graded to allow creation and restoration of riverine floodplain and riparian habitats. Excavation in the offset areas may require groundwater management, which would potentially be done by pumping water out of excavated areas. The offset areas and existing levee would be degraded, and the existing levee would be breached initially in two locations at such time as permitted to ensure completion of the setback levee before the flood season. The breaches would be constructed to allow for inlet and outlet of floodplain-inundating flows. The remaining three breaches would be constructed at a later time, as described in Levee Breaches, above.

The period between when the first two breaches are constructed and when the remaining three breaches are constructed is referred to as the “interim condition.” The interim condition would allow restoration plantings to establish in the offset areas during the fall, winter, and spring following construction Year 3 without exposure to through-flows from the Sacramento River, increasing the likelihood of long-term planting success. Following breaching of the existing levee in Segments B and F in Year 3, the offset areas would fill as the level of the Sacramento River rises and would drain through the single breach in each offset area, as well as through the culverts installed where breaches N2, S1, and S3 would eventually be constructed, as river stage decreases. Swales would be constructed in both offset areas, and the surrounding areas would be graded to encourage drainage to the swales as river stages decrease. Temporary and permanent erosion control measures such as jute netting, coconut fiber with net, live brush mattresses, and native turf would be selected as appropriate to protect graded areas.

Once breaches N2, S1, and S3 are constructed, permanent “cellular” berms would be built between the setback levee and the remnant levee downstream of breaches N1, S1, and S2 to reduce erosive conditions during flood events in the offset area. The cellular berms would create separate “cells” that would have independent drainage once water levels drop below the crest of the cellular berms. Material excavated from the breaches would be used to construct the cellular berms and construct terrain features. Berms would have a top elevation of +20 feet, top width of 20 feet, and side slopes no steeper than 10:1; they would overtop once water levels reach +20.0 feet NAVD 88. Offset areas upstream and downstream of the berms would be graded with positive drainage away from the berms and to the closest existing levee breach location.

The target habitats in the offset floodplain area are riparian forest, shaded riverine aquatic habitat, seasonal wetlands, and upland grasslands. Elevations in the offset floodplain area would vary from approximately +7.0 feet NAVD 88 to +20.0 feet NAVD 88 in order to provide broad habitat variability for a range of environmental and hydrodynamic conditions.

The target plant communities in the offset floodplain area would include emergent marsh, riparian willow scrub, riparian cottonwood forest, mixed riparian woodland, elderberry shrubs and associated plants for valley elderberry longhorn beetle habitat, and grassland. Botanical and tree surveys conducted within the project area provided guidance on plant material selection for the mitigation area. A vegetation stratification survey on the Southport levee conducted by ICF in March of 2012 helped further inform and refine the restoration target plant communities. In the survey, different species of plants were observed to favor different elevation ranges based on species preferences and adaptations. The restoration design intends to mimic this stratification of vegetation. Plants selected for establishment of each of the target plant communities were based on how the plants associate in nature, and the elevations at which these plants were observed growing along the Southport levee. Elevations showing the conceptual planting plan and plant palette for the mitigation area will be shown in the draft MMP.

Native riparian plant species could be installed as container plants and pole cuttings spaced at regular intervals throughout the offset floodplain area. Both overstory and understory species would be installed to mimic the natural structure of riparian forests along the Sacramento River. Supplemental irrigation would be provided for several years during the plant establishment period and then discontinued; irrigation water could possibly be pumped from the river or from an adjacent water supply by agreement with the owner. To avoid trampling or disturbing the plantings during the establishment period, signs would be posted at appropriate intervals providing notice that access to the restoration areas is not allowed. The CVFPB would likely not allow exclusionary fencing for these purposes.

Planting of the offset areas would take place in the fall following finish-grading operations and construction of the neighboring flood control features. Areas of the offset that are not finished in any given year would be kept free of vegetation in order to keep future construction areas clear.

A network of seasonal wetland swales would be excavated in the offset floodplain area and inundate during high-water events on the Sacramento River to provide habitat for special-status native fish species, including Chinook salmon, Sacramento splittail and steelhead. Excavation of the swales would also be phased to coincide with the construction of offset areas. To mimic some natural floodplain conditions that species like splittail depend on for spawning and rearing, the swales would be constructed at an elevation that provides shallow, low-velocity, off-channel habitat in the spring during smaller flood events. Swale margins would be gently sloping to maximize edge habitat during flood events. IWM structures could be installed in some of the swales to provide cover from predators. In larger flood events during the winter and spring, the upper riparian terraces would be inundated and provide additional areas of habitat for fish as well as contribute to the productivity of the ecological foodweb.

The created swales would have several connections to the main river channel at the breach locations in order to maximize connectivity and minimize potential stranding as floodwaters recede. The swales would, on average, fully dewater by the early summer in any given year in order to discourage use by nonnative fish.

Areas of upland grassland in the offset floodplain area would serve as potential floodplain rearing habitat for native fish during periods of high flows, as well as foraging habitat for raptors during periods of low water.

O&M access to the offset areas would be provided by O&M corridors at the waterside toe of the setback levee and by unpaved O&M roads that cross the cellular berms. At a minimum, turnaround areas would be located at the breach shoulders.

Southport EIP Offset Area and Remnant Levee Revegetation

Revegetation of the offset areas and remnant levee is proposed as a means to mitigate for construction impacts. The riparian willow scrub target plant community would be established where there is proper soil hydrology, between approximately the 8 foot and 10 foot elevation. In the offset area, the riparian willow scrub will be established just upslope from the constructed swales in a band width varying from approximately 10 to 150 feet following both sides of the swales near the middle of the offset floodplain area. On the remnant levee, the riparian willow scrub will be established in a narrow band varying from approximately 5 to 20 feet in width outside of the canopy of the existing trees to remain. The plants selected for the riparian willow scrub planting are intended to establish a self-sustaining mix of riparian scrub dominated by four species of willows. The plant material installed could be container grown plants, cuttings, or a mixture of both. The areas within the offset area will be seeded, and the areas on the remnant levee with established herbaceous cover will not be seeded.

Road Construction, Marina Access, and Bees Lakes

Village Parkway would be extended southward from its current intersection with Lake Washington Boulevard to Gregory Avenue near the Southport EIP project area's southern extent, moving South River Road traffic to the landside of the Sacramento River South Levee and to the future Village Parkway alignment. The existing alignment of South River Road in Segment A would be retained, as would the railroad abutments at the southern end of Segment A. However, a detour or permanent realignment of South River Road would be constructed at the south end of Segment A to maintain access on South River Road south of the project area during and after construction. Access roads would be built in Segment B to connect residences to the new Village Parkway alignment. Year 1 would include the construction of this section of the future Village Parkway and the associated residential and marina access roads (Figure 16). “No parking” signs would be installed at the new residential roads in Segment B. At the project’s northern extent, South River Road would be demolished. Where practicable, culverts would be constructed in ditches that are crossed by proposed roadways. Drainage ditches would be constructed along both sides of the new Village Parkway alignment, with an average width of 5 feet.

In order to maintain access between Sherwood Harbor Marina and Sacramento Yacht Club, South River Road would continue in its current alignment on the existing levee at Segment E and a portion of Segment F. However, the existing levee structure would no longer serve a flood risk–reduction function. In order to maintain access to the marinas, two new roads would be constructed that would be routed over the levee crown, with embankment crests of +40 feet NAVD 88 and 3:1 side slopes. The first road would be constructed just north of the Bees Lake area, and the second would be constructed on the southern side of the Bees Lake area. The road embankments would link the setback levee and the existing levee. While these embankments would not be part of the flood risk–reduction features, they would prevent hydraulic surface connectivity between Bees Lakes and the Sacramento River. Linden and Davis Roads would be connected to the new Village Parkway alignment to restore traffic circulation, and a cul-de-sac would be added at the end of Linden Road, past the intersection with Village Parkway.

Dual access ramps would be constructed along the levee alignment to provide O&M and emergency access to the levee-top patrol road. There would be one ramp in Segment B where South River Road currently descends from the existing levee to meet Gregory Avenue; one ramp in Segment C; one ramp in Segment D at the terminus of Davis Road; one ramp In Segment F at the terminus of Linden Road; and one ramp in Segment G near the northern end of the project alignment. Access to the levee-top patrol road would also be provided where the Sherwood Harbor Marina and Sacramento Yacht Club access road embankments cross the proposed setback levee crown. Access ramps would be gated and would have “no parking” signs.

<u>**Southport EIP Construction Details**</u>

Construction Schedule

If WSAFCA is granted Section 408 permission to alter the Federal levee and construct the Southport EIP in advance of the West Sacramento GRR, then the following schedule would apply to the Southport action. Construction of the project would occur in more than one annual construction season, with construction of flood risk–reduction measures beginning in April of 2015, and likely finishing in 2017. Construction and restoration of the offset area would likely continue after 2017, with final remnant levee breaches constructed in 2020. A small portion of Village Parkway construction and utility relocations would possibly begin in fall of 2014, but most of the work for those portions of the project would be done in 2015. A description of construction activities by construction year is provided below.

Year 1

- Village Parkway construction and utility relocation would be completed.
- The entire length of the setback levee would be started in Year 1, beginning with the foundation and working platform. Construction of the cutoff wall would follow if weather allows.

Year 2

- The setback levee cutoff wall and remaining buildup of the setback levee would be constructed to a finished elevation of +40 feet NAVD 88.
- South River Road detour at south end of Segment A.
- Seepage berms would be constructed following completion of the setback levees.
- Segment A and the southern portion of Segment B would be degraded to an elevation of +32 feet NAVD 88, and in Segment G the levee would be degraded to an elevation of +34.5 feet NAVD 88. Cutoff walls would then be constructed in these segments, tying into the setback levee cutoff walls in Segments B and F. The levee crown in Segment A and the southern portion of Segment B would then be built back up to a finished elevation of +39 feet NAVD 88, and the levee in Segment G would be built back up to a finished elevation of +40 feet NAVD 88. The slurry cutoff wall toe would be at an elevation of -5 feet NAVD 88 through Segments A, B, C, and D; at 0 feet NAVD 88 for Segments E, F, and the southern portion of G; and would be at -67 feet NAVD 88 for the remainder of Segment G.
- The remnant levee in Segments B, C, D, and F would be degraded to an elevation of +30 feet NAVD 88, and would have a 20-foot-wide crown. Remnant levee degrading would be concurrent with setback levee and seepage berm construction.
- Offset area grading would begin.
- Erosion site repairs at C1, C2, and G3 would be constructed.

Year 3

- Offset area grading would be completed. Culverts would be installed through the remnant levee at breaches N2, S1, and S2 to allow water to flow into, and drain out of, the offset areas during the interim condition.
- Breaches N1 and S3 would be constructed.
- Offset area planting would begin and would continue through Year 6.

Year 4

- Offset area planting would continue.

Year 5

- The three remaining breaches and the offset area cellular berms would be constructed, and the southern offset area would be contoured.

Year 6

- Offset area planting would be completed.

Flood risk reduction measure construction activities would primarily occur during the typical construction season, April 15 to October 31, although extension of the CVFPB encroachment permit may be sought if weather conditions permit. All construction activities, including, but not limited to, structure and vegetation removal, roadway removal and replacement, revegetation, and utility removal and replacement, that may occur outside the primary construction season would be subject to the conditions of environmental and encroachment permits and authorizations to be issued by the California Department of Fish and Wildlife (CDFW), Central Valley Regional Water Quality Control Board (RWQCB), CVFPB, the Corps, USFWS, NMFS, Yolo County, City of West Sacramento, and others.

At the end of each primary construction season, the levee system would be restored, at a minimum, to the level of flood risk–reduction performance existing at the Southport EIP project outset. During construction Years 1 and 2, "tie-ins" would be built connecting the existing levee up- and downstream to the segments constructed that season, as needed. These tie-ins would be achieved by benching the existing levee and installing compacted lifts to completely bond the new and existing levee materials. During the flood season, maintenance of the flood risk–reduction structures would be undertaken by the maintaining agency, RD 900.

Sources of Borrow Material

To meet borrow material demands for constructing the flood risk–reduction measures, multiple sources are being considered, including the following.

- Embankment fill material excavated from the existing levee structure as part of construction.
- Material excavated from the offset areas.
- Material excavated from borrow sites located on open land within the city, or close to the city limits.
- Dredged material previously removed from the DWSC (presently stockpiled on high-terrace, upland benches adjacent to the west of the channel).
- Material purchased from permitted commercial borrow locations within 20 miles of the project site.

Embankment fill material excavated as part of construction would be evaluated for reuse, and that deemed suitable would be used as part of construction of the new levees and berms. Embankment fill material available for construction of the Southport EIP would include materials salvaged as a result of the proposed partial degrading of the existing levee and grading of the offset areas.

Ongoing borrow analysis has also identified potential borrow sites near the Southport EIP project site from which suitable borrow may be excavated (Figure 2). These potential borrow sites range in location from immediately adjacent to the levee construction to approximately a 7-mile round-trip haul distance from the area of construction. If local borrow sites are used, existing topsoil would be scraped and set aside, and borrow material excavated from the site. Excavation depths would vary, depending on landowner agreement; however, wherever feasible, depths of excavation would not encroach upon the water table. Following material extraction, Southport-area borrow sites would be graded to a depth of no greater than 3 feet. To maximize the use of local borrow sites, high plasticity clay may be used as deeply buried setback levee core fill material. Where feasible, excess embankment fill material deemed unsuitable for reuse could be placed in the borrow site pits and compacted, and the topsoil replaced. The borrow sites then would be reseeded and returned to vegetated conditions.

Also under evaluation for suitability as borrow is material previously dredged from the DWSC as part of routine maintenance, which is presently stockpiled along the western bank of the DWSC and located on the city’s western border with unincorporated Yolo County. This possible borrow source, referred to as “dredge material,” is located on a high-terrace, upland bench adjacent to the channel, placed during previous dredge events unrelated to this project. If suitable, dredge material would be loaded onto trucks and transported to the project site, an approximately 24-mile round trip. Use of dredge material would not require any postextraction borrow site activity.

Lastly, borrow also could be purchased and hauled onsite from a permitted commercial borrow location within 20 miles of the project site.

Management of Woody Vegetation

For woody vegetation remaining after construction, and until an alternative long-term compliance strategy is agreed upon (which ultimately may include a variance but not as part of this project), the levees would be maintained per the approved O&M manual applicable to this reach (subject to revision).

Structure and Road Demolition and Utility Relocation

Structure and road demolition activities would consist of removing standing structures within the flood risk–reduction measure footprints and removing sections of two-lane asphalt rural road in the project area. Construction activities would consist of removing and demolishing the facilities with the use of a bulldozer and excavator with a percussion hammer attachment for breaking up concrete foundations as needed. The contractor would load the rubble into waste containers using a front-end loader and then haul the waste to a permitted disposal site within 10 miles of the Southport EIP project area.

Vegetation Removal

Vegetation clearing activities would consist of removing larger woody vegetation, such as trees and shrubs. Grubbing activities would consist of removing roots, and stripping activities would consist of excavating approximately 6 inches of organic material from the levee surface. The vegetation on the existing Sacramento River levee would be retained where feasible, with the exception of the five breach locations, because the existing levee would no longer provide flood risk–reduction functions or be subject to the Corps vegetation guidelines. Some vegetation would be removed as part of construction of the new setback levee, seepage berms, and the landside utility O&M corridor.

Staging Areas and Equipment Access

As depicted on Figure 15, five staging areas would be used in the Southport EIP project area. These staging areas are located on the landside of the levee at Segments C, D, and E, and would occupy approximately 25.2 acres in total. These areas would be used for staging construction activities and to provide space to house construction equipment and materials before and during construction activities. Areas where seepage berms are proposed would also be used for staging until construction begins on the seepage berms.

To facilitate project construction, temporary earthen ramps would be constructed to permit equipment access between the levee crown and the staging area(s). The earthen ramps would not affect any delineated water bodies and would be removed when construction is complete.

2.4 Proposed Conservation and Mitigation Measures for the West Sacramento Project

2.4.1 Compensation Timing

Compensation timing refers to the time between the initiation of construction at a particular site and the attainment of the habitat benefits to protected species from designated compensation sites. In general, compensation time is the time required for on-site plantings to provide significant amounts of shade or structural complexity from instream woody material recruitment. Significant long-term benefits have often been considered as appropriate to offset small short-term losses in habitat for listed species in the past, as long as the overall action contributes to recovery of the listed species. The authority to compensate prior to or concurrent with project construction is given under WRDA 1986 (33 USC §§ 2201–2330); however, long-term compensation to offset short-term losses is generally not an option for the loss of critical habitats under the ESA (USFWS 1998).

Depending on the species of interest (e.g., delta smelt), the severity of the short-term habitat losses due to bank erosion repair actions may not be compensated by long-term gains, whereas longer lived species (e.g., steelhead, Chinook) have longer periods for compensation to be provided. The following compensation time periods (based loosely on life expectancy) should be considered as guidelines for compensation:

- Green sturgeon, 15 years;
- Chinook salmon, 5 years;
- Central Valley steelhead, 4 years; and
- Delta smelt, 2 years (Corps, 2012).

2.4.2 Valley Elderberry Longhorn Beetle (VELB) Conservation Measures

The following is a summary of measures based on the *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (USFWS 1999a). These measures will be implemented to minimize any potential effects on VELB or their habitat, including restoration and maintenance activities, long-term, protection, and compensation if shrubs cannot be avoided. Approximately 120 elderberry shrubs have the potential to be adversely affected due to construction of the West Sacramento project, including the Southport EIP project. The 120 shrubs were estimated based on the number of shrubs surveyed in the Southport EIP action area. An estimated number of stems was calculated based on taking the average number of stems in each stem diameter range for the shrubs that were surveyed in the Southport EIP action area and adding the stem counts from shrubs surveyed in the Southport EIP action area. In addition, to cover a worst case scenario, an assumption was made that all shrubs not surveyed were in riparian areas and that there were exit holes in all the shrubs in the West Sacramento project area not included in the Southport EIP action area survey. Table 17 shows the estimated stem counts for elderberry shrubs adversely affected in the entire action area. The stem averages used to calculate stems in Table 17 are are as follows.

- Number of stems ≥1 inch and ≤3 inches = 16.
- Number of stems >3 inches and <5 inches = 4.
- Number of stems ≥5 inches = 3.

Table 17. Estimated Compensation for Elderberry Shrubs Removed from project area

Location	Stem Diameter	Holes	Number of Stems	Elderberry Ratios (multiply number of stems by)	Elderberry Planting	Native Ratios	Associated Native Planting
Riparian	≥1 inch and ≤ 3 inches	Yes	1,524	4	5,588	2	10,580
Riparian	> 3 inches and < 5 inches	Yes	391	6	2,160	2	4,032
Riparian	≥ 5 inches	Yes	303	8	2,237	2	4,109
Totals			2,218		9,985		18,721

Based on the information in Table 17, the conservation area will need to be at least 120 acres in size to accommodate up to 120 elderberry shrubs, 9,985 elderberry cuttings or seedlings, and 18,721 native plants. However, to ensure accurate compensation, surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. The biologist will survey the area surrounding the shrub to be transplanted to ensure that there aren't additional elderberry shrubs that need to be removed. Surveys will consist of counting and measuring the diameter of each stem and examining elderberry shrubs for the presence of VELB exit holes. Survey results and an analysis of the number of elderberry seedlings/cuttings and associated native plants based on the survey results will be submitted to USFWS. The data collected during the surveys prior to transplantation will be used to determine if compensation requirements are being exceeded or if additional plantings are necessary. The conservation area in which the transplanted elderberry shrubs and seedlings are planted will be protected in perpetuity as habitat for VELB. The following conservation measures will also be implemented.

- When a 100-foot (or wider) buffer is established and maintained around elderberry shrubs, complete avoidance (i.e., no adverse effects) will be assumed.
- Where encroachment on the 100-foot buffer has been approved by the USFWS, 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.
- Contractors will be briefed on the need to avoid damaging elderberry shrubs and the possible penalties for not complying with these requirements.

- Signs will be erected every 50 feet along the edge of the avoidance area, identifying the area as an environmentally sensitive area.
- Any damage done to the buffer area will be restored.
- Buffer areas will continue to be protected after construction.
- No insecticides, herbicides, fertilizers, or other chemicals that might harm the beetle or its host plant will be used in the buffer areas.
- Trimming of elderberry plants may be subject to mitigation measures.
- Elderberry shrubs that cannot be avoided and can be accessed safely would be transplanted to an appropriate riparian area at least 100 feet from construction activities.
- If possible, elderberry shrubs would be transplanted during their dormant season (approximately November, after they have lost their leaves, through the first two weeks in February). If transplantation occurs during the growing season, increased mitigation ratios will apply.
- Any areas that receive transplanted elderberry shrubs and elderberry cuttings will be protected in perpetuity.
- The Corps will work to develop off-site compensation areas prior to or concurrent with any take of valley elderberry longhorn beetle habitat.
- Management of these lands will include all measures specified in USFWS's conservation guidelines (1999a) related to weed and litter control, fencing, and the placement of signs.
- Monitoring will occur for ten consecutive years or for seven non-consecutive years over a 15-year period. Annual monitoring reports will be submitted to USFWS.
- Off-site areas will be protected in perpetuity and have a funding source for maintenance (endowment).

2.4.3 Giant Garter Snake Conservation Measures

The following measures will be implemented to minimize effects on giant garter snake habitat that occurs within 200 feet of any construction activity for the West Sacramento Project. These measures are based on USFWS guidelines for restoration and standard avoidance measures included as appendices in USFWS (1997).

- Unless approved otherwise by USFWS, 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 participate in USFWS-approved worker environmental awareness program.

- A giant garter snake survey would be conducted 24 hours prior to construction in potential habitat. Should there be any interruption in work for greater than two weeks, a biologist would survey the project area again no later than 24 hours prior to the restart of work.
- Giant garter snakes encountered during construction activities 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.

If any giant garter snake habitat is impacted by construction of the West Sacramento Project, the following measures would be implemented to compensate for the habitat loss:

- Habitat (including aquatic and upland) temporarily impacted for one season (May 1–October 1) will be restored after construction by applying appropriate erosion control techniques and replanting/seeding with appropriate native plants.
- Habitat temporarily impacted for two seasons will be restored and replacement habitat will be created at a 2:1 ratio (disturbed to created acres).
- Habitat temporarily impacted for more than two seasons will be replaced at a 2:1 ratio (or restored plus 2:1 replacement).
- Habitat permanently impacted will be replaced at a 3:1 ratio.
- Habitat permanently or temporarily impacted outside of the May 1-October 1 work window will be created at a 2:1 ratio.
- All replacement habitats will include both upland and aquatic habitat components at a 2:1 ratio (upland to aquatic acres).
- One year of monitoring will be conducted for all restored areas. Ten years of monitoring will be conducted for created habitats. A monitoring report with photo documentation will be due to USFWS each year following implementation of restoration or habitat creation activities.
- The Corps will work to develop appropriate mitigation prior to or concurrent with any disturbance of giant garter snake habitat.
- Habitat will be protected in perpetuity and have an endowment attached for management and maintenance.

2.4.4 Additional Minimization and Conservation Measures

- Seek an ETL-approved vegetation variance exempting sites from vegetation removal prior to final design and construction phase for the Sacramento River project area.
- Minimize the removal of existing vegetation in the proposed project area. Any disturbance or removal of vegetation will be replaced with native riparian vegetation, outside of the vegetation-free zone, as established in the ETL.
- Implement best management practices (BMPs) to prevent slurry seeping out to river and require piping system on land side only.
- Stockpile construction materials such as portable equipment, vehicles, and supplies, at designated construction staging areas and barges, exclusive of any riparian and wetlands areas.
- Stockpile all liquid chemicals and supplies at a designated impermeable membrane fuel and refueling station with a 110% containment system.
- Erosion control measures (BMPs) including Storm Water Pollution Prevention Program and Water Pollution Control Program that minimize soil or sediment from entering the river. BMPs shall be installed, monitored for effectiveness, and maintained throughout construction operations to minimize effects to Federally listed fish and their designated critical habitat.
- Construction will be scheduled when listed terrestrial and aquatic species would be least likely to occur in the project area. If construction needs to extend into the timeframe that species are present, then coordination with the resource agencies will need to occur.
- 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.
- 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.
- Designating a Corps-appointed representative 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 shall be identified to the employees and contractors during an all employee education program conducted by the Corps.
- Screen any water pump intakes, as specified by NMFS and USFWS 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.

Furthermore, the Corps will seek to avoid and minimize construction effects on listed species and their critical habitat to the extent feasible. A number of measures will be applied to the entire West Sacramento project or specific actions, and other measures may be appropriate at specific locations within the West Sacramento study area. Avoidance activities to be implemented during final design and construction may include, but are not limited to, the following:

- Identifying all habitats containing, or with a substantial possibility of containing, listed terrestrial, wetland, and plant species in the potentially affected project areas. To the extent practicable efforts will be made to minimize effects by modifying engineering design to avoid potential direct and indirect effects.
- Incorporating sensitive habitat information into project bid specifications.
- Incorporating requirements for contractors to avoid identified sensitive habitats into project bid specifications.
- Minimizing vegetation removal to the extent feasible.
- Minimizing, to the extent possible, grubbing and contouring activities.

2.4.5 Summary of Environmental Commitments

Items below present a general summary of environmental commitments that the Corps will adhere to as part of the West Sacramento project.

The Corps will consult with the Services on acceptable compensation for shaded riverine aquatic (SRA) habitat (See Section 4.1.2) either by project constructed compensation sites or in combination with purchase of credits at a Services-approved mitigation bank where appropriate.

- The Corps will seek an ETL-approved vegetation variance exempting the Sacramento River sites from vegetation removal in the lower one-third of the waterside of the levee prior to final construction and design phase. Construction may require removal of vegetation on the upper two-thirds of the waterside and landside slope. Full ETL compliance would occur on the Sacramento and Yolo Bypasses, Yolo Bypass Toe Drain, South Cross levee, and the DWSC, Barge Canal, and Port of West Sacramento levee reaches. This approval process is in alignment with the Corps' Levee Safety Program's goal of maintaining public safety as the primary objective and assuring application of consistent and well-documented approaches. Removal of vegetation is only one part of the overall strategy of assuring that the levees will provide a level of protection consistent with Corps policy.
- The Corps will use a rock soil mixture to facilitate re-vegetation of the project sites that require bank protection work. A (70:30) rock to soil ratio would be implemented. The soil-rock mixture would be placed on top of the of the rock revetment along the Sacramento

River levees to allow native riparian vegetation to be planted to insure that SRA habitat lost is replaced or enhanced.

- In addition to an approved vegetation variance, the Corps will minimize the removal of existing vegetation in the proposed project area. Disturbance or removal of trees or larger woody vegetation will be replaced with native riparian species, outside of the vegetation-free zone, as established in the ETL.
- Construction will be scheduled when listed terrestrial and aquatic species would be least likely to occur in the project area. If construction needs to extend into the timeframe that species are present coordination with the resource agencies will occur.

2.5 Proposed Conservation and Mitigation Measures for the Southport EIP Project

If WSAFCA constructs the Southport EIP as a 408 action prior to construction of the overall West Sacramento Project, WSAFCA would implement the following conservation measures to avoid or minimize effects on Federally listed fish and wildlife species and their habitat. These measures would be included as conditions of any permissions granted by the Corps. Several additional conservation measures are proposed specifically for giant garter snake and VELB. To ensure their implementation, the following measures will be included in the project specifications.

2.5.1 General

Conservation Measure 1: Conduct Mandatory Biological Resources Awareness Training for All Project Personnel and Implement General Requirements

Before any ground-disturbing work (including vegetation clearing and grading) occurs in the Southport EIP Action Area, a USFWS-approved biologist will conduct a mandatory biological resources awareness training for all construction personnel about Federally listed species that could potentially occur onsite (VELB and giant garter snake). The training will include the natural history, representative photographs, and legal status of each Federally listed species and avoidance and minimization measures to be implemented. Proof of personnel attendance will be provided to USFWS within 1 week of the training. If new construction personnel are added to the Southport EIP project, the contractor will ensure that the new personnel receive the mandatory training before starting work. The subsequent training of personnel can include videotape of the initial training and/or the use of written materials rather than in-person training by a biologist. Requirements that will be followed by construction personnel are listed below.

- Where suitable habitat is present for listed species, WSAFCA will clearly delineate the construction limits through the use of survey tape, pin flags, orange barrier fencing, or other means, and prohibit any construction-related traffic outside these boundaries.
- Project-related vehicles will observe the posted speed limit on hard-surfaced roads and a 10-mile-per-hour speed limit on unpaved roads during travel in the project construction area.
- Project-related vehicles and construction equipment will restrict off-road travel to the designated construction areas.
- All food-related trash will be disposed of in closed containers and removed from the project construction area at least once per week during the construction period. Construction personnel will not feed or otherwise attract fish or wildlife to the project area.
- No pets or firearms will be allowed in the project area.
- To prevent possible resource damage from hazardous materials, such as motor oil or gasoline, construction personnel will not service vehicles or construction equipment outside designated staging areas.
- Any worker who inadvertently injures or kills a Federally listed species or finds one dead, injured, or entrapped will immediately report the incident to the biological monitor and construction foreman. The construction foreman will immediately notify WSAFCA, who will provide verbal notification to the USFWS Sacramento Endangered Species Office and/or the local CDFW warden or biologist within 1 working day. WSAFCA will follow up with written notification to USFWS or CDFW within 5 working days. The biological monitor will follow up with WSAFCA to ensure that the wildlife agencies were notified.
- The biological monitor will record all observations of Federally listed species on CNDDB field sheets and submit to CDFW.

Conservation Measure 2: Prepare and Implement a Stormwater Pollution Prevention Plan

Because ground disturbance would be greater than 1 acre, WSAFCA will obtain coverage under the U.S. Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) general construction activity stormwater permit. The Central Valley RWQCB administers the NPDES stormwater permit program in Yolo County. Obtaining coverage under the NPDES general construction activity permit generally requires that the project applicant prepare a stormwater pollution prevention plan (SWPPP) that describes the BMPs that will be implemented to control accelerated erosion, sedimentation, and other pollutants during and after project construction. The SWPPP will be prepared prior to commencing earth-moving construction activities.

The specific BMPs that will be incorporated into the erosion and sediment control plan and SWPPP will be site-specific and will be prepared by the construction contractor in accordance with the

Central Valley RWQCB's Field Manual. However, the plan likely will include, but not be limited to, one or more of the following standard erosion and sediment control BMPs.

- **Timing of construction.** The construction contractor will conduct all construction activities during the typical construction season to avoid ground disturbance during the rainy season.
- **Staging of construction equipment and materials.** To the extent possible, equipment and materials will be staged in areas that have already been disturbed. No equipment or materials would be stored in the floodway during the flood season.
- **Minimize soil and vegetation disturbance.** The construction contractor will minimize ground disturbance and the disturbance/destruction of existing vegetation. This will be accomplished in part through the establishment of designated equipment staging areas, ingress and egress corridors, and equipment exclusion zones prior to the commencement of any grading operations.
- **Stabilize grading spoils.** Grading spoils generated during the construction will be temporarily stockpiled in staging areas. Silt fences, fiber rolls, or similar devices will be installed around the base of the temporary stockpiles to intercept runoff and sediment during storm events. If necessary, temporary stockpiles may be covered with an appropriate geotextile to increase protection from wind and water erosion.
- **Install sediment barriers.** The construction contractor may install silt fences, fiber rolls, or similar devices to prevent sediment-laden runoff from leaving the construction area.
- **Stormwater drain inlet protection.** The construction contractor may install silt fences, drop inlet sediment traps, sandbag barriers, and/or other similar devices.
- **Permanent site stabilization.** The construction contractor will install structural and vegetative methods to permanently stabilize all graded or otherwise disturbed areas once construction is complete. Structural methods may include the installation of biodegradable fiber rolls and erosion control blankets. Vegetative methods may involve the application of organic mulch and tackifier and/or the application of an erosion control native seed mix. Implementation of a SWPPP will substantially minimize the potential for project-related erosion and associated adverse effects on water quality.

Conservation Measure 3: Prepare and Implement a Bentonite Slurry Spill Contingency Plan (Frac-Out Plan)

Before excavation begins, WSAFCA will ensure the contractor will prepare and implement a bentonite slurry spill contingency plan (BSSCP) for any excavation activities that use pressurized fluids (other than water). If the contactor prepares the plan, it will be subject to approval by the Corps, NMFS, and WSAFCA before excavation can begin. The BSSCP will include measures intended to minimize the potential for a frac-out (short for "fracture-out event") associated with excavation and tunneling activities; provide for the timely detection of frac-outs; and ensure an organized, timely, and minimum-effect response in the event of a frac-out and release of excavation fluid (bentonite). The BSSCP will require, at a minimum, the following measures.

- If a frac-out is identified, all work will stop, including the recycling of the bentonite fluid. In the event of a frac-out into water, the location and extent of the frac-out will be determined, and the frac-out will be monitored for 4 hours to determine whether the fluid congeals (bentonite will usually harden, effectively sealing the frac-out location).
- NMFS, CDFW, and the Central Valley RWQCB will be notified immediately of any spills and will be consulted regarding clean-up procedures. A Brady barrel will be on site and used if a frac-out occurs. Containment materials, such as straw bales, also will be on site prior to and during all operations, and a vacuum truck will be on retainer and available to be operational on site within 2 hours' notice. The site supervisor will take any necessary follow-up response actions in coordination with agency representatives. The site supervisor will coordinate the mobilization of equipment stored at staging areas (e.g., vacuum trucks), as needed.
- If the frac-out has reached the surface, any material contaminated with bentonite will be removed by hand to a depth of 1 foot, contained, and properly disposed of, as required by law. The drilling contractor will be responsible for ensuring that the bentonite is either properly disposed of at an approved Class II disposal facility or properly recycled in an approved manner.
- If the bentonite fluid congeals, no other actions, such as disturbance of the streambed, will be taken that potentially would suspend sediments in the water column.
- The site supervisor has overall responsibility for implementing this BSSCP. The site supervisor will be notified immediately when a frac-out is detected. The site supervisor will be responsible for ensuring that the biological monitor is aware of the frac-out; coordinating personnel, response, cleanup, and regulatory agency notification and coordination to ensure proper clean-up; coordinating disposal of recovered material; and timely reporting of the incident. The site supervisor will ensure all waste materials are properly containerized, labeled, and removed from the site to an approved Class II disposal facility by personnel experienced in the removal, transport, and disposal of drilling mud.
- The site supervisor will be familiar with the contents of this BSSCP and the conditions of approval under which the activity is permitted to take place. The site supervisor will have the authority to stop work and commit the resources (personnel and equipment) necessary to implement this plan. The site supervisor will ensure that a copy of this plan is available (onsite) and accessible to all construction personnel. The site supervisor will ensure that all workers are properly trained and familiar with the necessary procedures for response to a frac-out prior to commencement of excavation operations.

Conservation Measure 4: Prepare and Implement a Spill Prevention, Control, and Counter-Measure Plan

A spill prevention, control, and counter-measure plan (SPCCP) is intended to prevent any discharge of oil into navigable water or adjoining shorelines. WSAFCA or its contractor will develop and implement an SPCCP to minimize the potential for and 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 will be taken in the event of a spill (e.g., an oil spill from engine refueling will be immediately cleaned up with oil absorbents). The SPCCP will outline descriptions of containments facilities and practices such as double-walled tanks, containment berms, emergency shutoffs, drip pans, fueling procedures, and spill response kits. It will describe how and when employees are trained in proper handling procedure and spill prevention and response procedures.

WSAFCA will review and approve the SPCCP before onset of construction activities and routinely inspect the construction area to verify that the measures specified in the SPCCP are properly implemented and maintained. WSAFCA will notify its contractors immediately if there is a noncompliance issue and will require compliance.

The Federal reportable spill quantity for petroleum products, as defined in 40 CFR 110, is any oil spill that:

- Violates applicable water quality standards.
- Causes a film or sheen on or discoloration of the water surface or adjoining shoreline.
- Causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines.

If a spill is reportable, the contractor’s superintendent will notify WSAFCA, and WSAFCA will take action to contact the appropriate safety and cleanup crews to ensure that the SPCCP is followed. A written description of reportable releases must be submitted to the Central Valley RWQCB. This submittal must contain a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases will be documented on a spill report form.

If an appreciable spill occurs and results determine that project activities have adversely affected surface or groundwater quality, a detailed analysis will be performed by a registered environmental assessor or professional engineer to identify the likely cause of contamination. This analysis will conform to American Society for Testing and Materials standards and will include recommendations for reducing or eliminating the source or mechanisms of contamination. Based on this analysis, WSAFCA and its contractors will select and implement measures to control contamination, with a performance standard that surface water quality and groundwater quality must be returned to baseline conditions.

Conservation Measure 5: Monitor Turbidity in Adjacent Water Bodies

WSAFCA or its contractor will monitor turbidity in the adjacent water bodies, where applicable criteria apply, to determine whether turbidity is being affected by construction and ensure that construction does not affect turbidity levels, which ultimately increase the sediment loads.
The Water Quality Control Plan for the Central Valley RWQCB (Basin Plan) contains turbidity objectives for the Sacramento River. Specifically, the plan states that where natural turbidity is between 5 and 50 nephelometric turbidity units (NTUs), turbidity levels may not be elevated by 20% above ambient conditions. Where ambient conditions are between 50 and 100 NTUs, conditions may not be increased by more than 10 NTUs (Central Valley RWQCB 2009).

WSAFCA or its contractor will monitor ambient turbidity conditions upstream during construction and adhere to the Surface Water Quality Ambient Monitoring Program requirements for turbidity monitoring. Monitoring will continue approximately 300 feet downstream of construction activities to determine whether turbidity is being affected by construction. Grab samples will be collected at a downstream location that is representative of the flow near the construction site. If there is a visible sediment plume being created from construction, the sample will represent this plume. Monitoring will occur hourly when construction encroaches into the Sacramento River. If construction does not encroach into the river, the monitoring will occur once a week on a random basis.

If turbidity limits exceed Basin Plan standards, construction-related earth-disturbing activities will slow to a point that results in alleviating the problem. WSAFCA will notify the Central Valley RWQCB of the issue and provide an explanation of the cause.

Conservation Measure 6: Prepare and Implement a Mitigation and Monitoring Plan

A draft MMP for the restoration areas is being developed and will be approved by the Corps, NMFS, USFWS, and CDFW before implementation of the Southport EIP project. The restoration objectives of the plan are listed below.

- Provide compensatory mitigation credits for impacts on protected land cover types and to special-status species and potential habitat for these species.
- Maximize SRA cover/nearshore habitat, over and above current erosion stabilization efforts using biotechnical methods.
- Enhance setback ecological values using topographic and vegetation/habitat heterogeneity.

- Restore portions of the historic Sacramento River floodplain (i.e., waters of the United States).
- Restore riparian and oak woodland habitat on the restored floodplain that will create continuous habitat corridors for fish and wildlife movement.
- Design habitat features to minimize future maintenance obligations (e.g., reduce opportunities for sediment and debris accumulation).
- Design floodplain planting and vegetation management schemes to avoid undesirable hydraulic and sediment transport impacts to the offset levee and offset area.
- Comply with current Corps levee vegetation policy to balance habitat needs with flood management objectives.

The monitoring objectives of the plan are listed below.

- Monitor and evaluate the hydrologic and hydraulic performance of the restored floodplain relative to the ecological design criteria for the target species.
- Monitor and evaluate the success of the riparian/wetland plantings and other habitat features (e.g., IWM) in compensating, restoring, or enhancing fish and wildlife habitat values on the levee slopes and offset areas.
- Monitor and evaluate the effectiveness of the grading and drainage features in preventing fish stranding (see Fish Stranding below).
- Monitor the occurrence and extent of potential sedimentation and scour that may compromise the success of the habitat restoration and mitigation components of the project.

The MMP will include representative plans and cross sections of the Southport EIP Proposed Action elements; fish stranding and vegetation monitoring methods; habitat compensation and restoration success criteria; and a protocol for implementing remedial actions should any success criteria not be met. The existing O&M requirements and practices will also be incorporated into the plan. Annual monitoring reports that describe each year's monitoring activities and progress toward the success criteria would be submitted to the resource agencies during the course of the monitoring period. Monitoring would be conducted until the projected benefits of the compensation and restoration actions have been substantially achieved.

2.5.2 Valley Elderberry Longhorn Beetle

Conservation measures for VELB are based on USFWS's 1999 *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (Conservation Guidelines) (USFWS 1999a).

Conservation Measure 7: Fence Elderberry Shrubs to be Protected and Monitor Fencing during Construction

Elderberry shrubs and clusters (*Sambucus* spp.) within 100 feet of the Southport EIP construction area that will not be removed will be protected during construction. A qualified biologist (i.e., with elderberry/VELB experience), under contract with WSAFCA, will mark the elderberry shrubs and clusters that will be protected during construction. Orange construction barrier fencing will be placed at the edge of the respective buffer areas. The buffer area distances will be proposed by the biologist and approved by USFWS. No construction activities will be permitted within the buffer zone other than those activities necessary to erect the fencing. Signs will be posted every 50 feet along the perimeter of the buffer area fencing. The signs will contain the following information:

> *This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment.*

In some cases, where the elderberry shrub dripline is within 10 feet of the work area, k-rails will be placed at the shrub's dripline to provide additional protection to the shrub from construction equipment and activities. Temporary fences around the elderberry shrubs and k-rails at shrub driplines will be installed as the first order of work. Temporary fences will be furnished, constructed, maintained, and later removed, as shown on the plans, as specified in the special provisions, and as directed by the project engineer. Temporary fencing will be 4 feet high, commercial-quality woven polypropylene, and orange in color.

Buffer area fences around elderberry shrubs will be inspected weekly by a qualified biological monitor during ground-disturbing activities and monthly after ground-disturbing activities until construction of the Southport EIP is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around elderberry shrubs throughout construction. Biological inspection reports will be provided to the project lead and USFWS.

Conservation Measure 8: Conduct Stem Counts Prior to Elderberry Shrub Transplantation

Surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. The biologist will survey the area surrounding the shrub to be transplanted to ensure that there aren't additional elderberry shrubs that need to be removed. Surveys will consist of counting and measuring the diameter of each stem and examining elderberry shrubs for the presence of VELB exit holes. Survey results and an analysis of the number of elderberry seedlings/cuttings and associated native plants based on the survey results will be submitted to USFWS. Elderberry seedlings/cuttings and associated native plants will be planted prior to transplantation of elderberry shrubs. The data collected during the surveys prior to transplantation will be used to determine if compensation requirements are being exceeded or if additional plantings are necessary. Because the Southport EIP would be constructed potentially over a 3-year period, elderberry survey data for each year will be used to rectify any discrepancies in compensation and to ensure full mitigation of impacts on VELB.

Conservation Measure 9: Water Down Construction Area to Control Dust

The construction contractor will ensure that the project construction area will be watered down as necessary to prevent dirt from becoming airborne and accumulating on elderberry shrubs within the 100–foot buffer.

Conservation Measure 10: Compensate for Direct Effects on Valley Elderberry Longhorn Beetle Habitat

Before construction begins, compensation will be implemented for direct effects on elderberry shrubs by transplanting shrubs that cannot be avoided to a USFWS-approved conservation area (described below). Elderberry seedlings or cuttings and associated native species will also be planted in the conservation area. Each elderberry stem measuring 1 inch or greater in diameter at ground level that is adversely affected (i.e., transplanted or destroyed) would be replaced in the conservation area, with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). The numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether the shrub lies in a riparian or nonriparian area. Stock of either seedlings or cuttings would be obtained from local sources (including the Southport EIP Action Area, if acceptable to USFWS). At the discretion of USFWS, shrubs that are unlikely to survive transplantation because of poor condition or location, or a plant that would be extremely difficult to move because of access problems, may be exempted from transplantation. In cases in which transplantation is not possible, minimization ratios would be increased to offset the additional habitat loss.

The relocation of the elderberry shrubs will be conducted according to USFWS-approved procedures outlined in the Conservation Guidelines (USWFS 1999a). Elderberry shrubs within the project construction area that cannot be avoided will be transplanted during the plant's dormant phase (November through the first 2 weeks of February). A qualified biological monitor will remain onsite while the shrubs are being transplanted.

During field surveys, 106 elderberry shrubs were identified in the study area, but only 41 elderberry shrubs were identified in the Action Area (Appendix B, Figure 6 and Appendix C). Eighteen shrubs would be directly affected and the remaining 23 shrubs would be indirectly affected (see Table 22 in Chapter 3). Property inaccessibility and the high density of vegetation surrounding several elderberry shrubs limited the number of elderberry shrubs that could be surveyed for exit holes and stem counts. For this reason, compensation for the removal of shrubs 33, 39b, 41a, and 41b was estimated based on the average number of stems in each stem diameter range for the shrubs that could be surveyed. In addition, an assumption was made that there were exit holes in the four shrubs that could not be surveyed. Table 18 shows the stem counts for elderberry shrubs directly affected in the Southport EIP Action Area and Table 19 shows the estimated compensation. The stem averages are as follows.

- Number of stems ≥1 inch and ≤3 inches = 16.
- Number of stems >3 inches and <5 inches = 4.
- Number of stems ≥5 inches = 3.

Table 18. Summary of Stem Counts for Elderberry Shrubs Directly Affected by the Southport EIP.

	Presence of Exit Holes?	**Riparian Habitat?**	**1-3 Inches**	**3-5 Inches**	**> 5 Inches**
6	N	Y	60	5	9
7	N	Y	33	10	18
8	N	Y	8	5	2
9	N	Y	30	2	8
10	Y	Y	8	4	2
23	Y	Y	3	3	1
32	N	N	3	1	1
33 [1]	Y	N	16	4	3
34	Y	N	12	6	10
39a	N	N	3	0	0
39b [2]	Y	N	16	4	3
41a [2]	Y	N	16	4	3
41b [2]	Y	N	16	4	3
41c	Y	N	5	7	2
52	Y	Y	6	1	1
53	Y	N	29	17	3
98	N	Y	4	0	0
100	Y	Y	8	2	0
Direct Total			**276**	**79**	**69**

[1] Shrubs could not be surveyed because there was no property access. Number of stems was estimated based on average of all counted stems. See text for a description. In addition, exit holes were assumed to be present in shrub 33.
[2] Shrubs that could not be surveyed because they were covered in grapevines or poison oak. Number of stems was estimated based on average of all counted stems. See text for a description. In addition, exit holes were assumed to be present in shrubs 39b, 41a, and 41b.

Table 19. Estimated Compensation for Elderberry Shrubs Removed for the Southport EIP.

Location	Stem Diameter	Holes	Number of Stems	Elderberry Ratios (multiply number of stems by)	Elderberry Plantings	Native Ratios	Associated Native Plantings
Non-riparian	1-3 Inches	N	6	1	6	1	6
		Y	135	2	270	2	540
Non-riparian	3-5 Inches	N	1	2	2	1	2
		Y	22	4	88	2	176
Non-riparian	> 5 Inches	N	1	3	3	1	3
		Y	37	6	222	2	444
Riparian	1-3 Inches	N	110	2	220	1	220
		Y	25	4	100	2	200
Riparian	3-5 Inches	N	46	8	138	1	138
		Y	10	6	60	2	120
Riparian	> 5 Inches	N	27	4	108	1	108
		Y	4	8	32	2	64
Totals			**424**		**1,249**		**2,021**

Based on the information in Table 19, the conservation area will be at least 13.5 acres in size to accommodate up to 18 elderberry shrubs, 1,249 elderberry cuttings or seedlings, and 2,021 native plants. The conservation area in which the transplanted elderberry shrubs and seedlings are planted will be protected in perpetuity as habitat for VELB.

Evidence of VELB occurrence in the conservation area, the condition of the elderberry shrubs in the conservation area, and the general condition of the conservation area itself will be monitored over a period of 10 consecutive years or for 7 years over a 15-year period from the date of transplanting. WSAFCA will be responsible for funding and providing monitoring reports to USFWS in each of the years in which a monitoring report is required. As specified in the Conservation Guidelines, the report will include information on timing and rate of irrigation, growth rates, and survival rates and mortality.

To meet the success criteria specified in the Conservation Guidelines, a minimum survival rate of 60% of the original number of elderberry replacement plantings and associated native plants must be maintained throughout the monitoring period.

Proposed Conservation Area

Approximately 120 acres of habitat floodplain habitat will be restored or enhanced as part of implementation of the Southport EIP. The required portion of these acres of riparian habitat will be used as VELB mitigation.

2.5.3 Giant Garter Snake

Conservation measures for giant garter snake were developed using portions of the *Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties, California* (USFWS 1997).

Conservation Measure 11: Conduct Construction Activities during the Active Period for Giant Garter Snake

To the maximum extent possible, all Southport EIP construction activity within giant garter snake aquatic and upland habitat within 200 feet of aquatic habitat will be conducted during the snake's active period (May 1–October 1). During this time frame, potential for injury and mortality are lessened because snakes are actively moving and avoiding danger. Construction of the setback levee in Segments B through F would begin in Year 1. The setback levee and the remaining flood risk – reduction measures for all segments would be completed in Year 2. Some preparation of construction may occur during the 2014 construction season, but no changes would be made to the existing levee prism. The construction season is typically from April 15 to October 31, subject to conditions. Because construction may extend into the giant garter snakes dormant period (October 2 to April 30), additional protective measures will be implemented at these locations (see Conservation Measure 14 below).

Conservation Measure 12: Install and Maintain Construction Barrier Fencing around Suitable Giant Garter Snake Habitat

To reduce the likelihood of giant garter snakes entering the Southport EIP construction area, exclusion fencing and orange barrier fencing will be installed along the portions of the construction area that are within 200 feet of suitable aquatic and upland habitat. The exclusion and barrier fencing will be installed during the active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during this activity.

The construction specifications will require a provision to retain a qualified biologist to identify the areas that are to be avoided during construction. Areas adjacent to the directly affected area required for construction, including staging and access, will be fenced off to avoid disturbance in these areas. Before construction, the contractor will work with the qualified biologist to identify the locations for the barrier fencing and will place flags or flagging around the areas to be protected to indicate the locations of the barrier fences. The protected area will be clearly identified on the construction specifications. The fencing will be installed the maximum distance practicable from the aquatic habitat areas and will be in place before construction activities are initiated.

The barrier fencing will consist of 4-foot-tall erosion fencing buried at least 6 to 8 inches below ground level. The barrier fencing will ensure that giant garter snakes are excluded from the construction area and that suitable upland and aquatic habitat is protected throughout construction. The exclusion fencing will be commercial-quality, woven polypropylene, orange in color, and 4 feet high (Tensor Polygrid or equivalent). The fencing will be tightly strung on posts with a maximum of 10-foot spacing.

Barrier and exclusion fences will be inspected daily by a qualified biological monitor during ground-disturbing activities and weekly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around giant garter snake habitat throughout construction. Biological inspection reports will be provided to the project lead and USFWS.

Conservation Measure 13: Minimize Potential Impacts on Giant Garter Snake Habitat

The following measures will be implemented to minimize potential impacts on giant garter snake habitat.

- Staging areas will be located at least 200 feet from suitable giant garter snake habitat.
- Any dewatered habitat will remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.
- Vegetation clearing within 200 feet of the banks of suitable giant garter snake aquatic habitat will be limited to the minimum area necessary. Avoided giant garter snake habitat within or adjacent to the Action Area will be flagged and designated as an environmentally sensitive area, to be avoided by all construction personnel.
- The movement of heavy equipment within 200 feet of the banks of suitable giant garter snake aquatic habitat will be confined to designated haul routes to minimize habitat disturbance.

Conservation Measure 14: Conduct Preconstruction Surveys and Monitoring for Giant Garter Snake

Prior to ground-disturbing activities within 200 feet of suitable habitat, a USFWS-approved biological monitor will conduct a preconstruction survey of suitable aquatic and upland habitat and inspect exclusion and orange barrier fencing to ensure they are both in good working order each morning. If any snakes are observed within the construction area at any other time during construction the USFWS-approved biological monitor will be contacted to survey the site for giant garter snakes. The biological monitor will have the authority to stop construction activities until appropriate corrective measures have been completed or it is determined that the snake will not be harmed. Giant garter snakes encountered during construction activities will be allowed to move away from construction activities on their own. If unable to move away on their own, trapped or injured giant garter snakes will only be removed by the USFWS-approved biological monitor and will be placed in the nearest suitable habitat that is outside of the construction area. The biological monitor will immediately report these activities to USFWS by phone and will provide a written account of the details of the incident within 24 hours.

Once all initial ground-disturbing activities are completed, the biological monitor will perform weekly checks of the site for the duration of construction in order to ensure that construction barrier fences and exclusion fences are in good order, trenches are being covered, project personnel are conducting checks beneath parked vehicles prior to their movement, and that all other required biological protection measures are being complied with. The biological monitor will document the results of monitoring on construction monitoring log sheets, which will be provided to USFWS within 1 week of each monitoring visit.

Conservation Measure 15: Provide Escape Ramps or Cover Open Trenches at the End of Each Day

To avoid entrapment of giant garter snake, thereby preventing injury or mortality resulting from falling into trenches, all excavated areas more than 1 foot deep will be provided with one or more escape ramps constructed of earth fill or wooden planks at the end of each workday. If escape ramps cannot be provided, then holes or trenches will be covered with plywood or other hard material. The biological monitor or construction personnel designated by the contractor will be responsible for thoroughly inspecting trenches for the presence of giant garter snakes at the beginning of each workday. If any individuals have become trapped, the USFWS-approved biological monitor will be contacted to relocate the snake, and no work will occur in that area until approved by the biologist.

Conservation Measure 16: Implement Additional Protective Measures during Work in Suitable Habitat during the Giant Garter Snake Dormant Period

The following additional protective measures will be implemented for the Southport EIP during time periods when work must occur during the giant garter snake dormant period (October 2–April 30), when snakes are more vulnerable to injury and mortality.

- A full-time USFWS-approved biological monitor will be onsite for the duration of construction activities.
- All emergent vegetation and vegetation within 200 feet of suitable aquatic habitat will be cleared prior to the giant garter snake hibernation period (i.e., vegetation clearing must be completed by October 1).
- Exclusion and barrier fencing will be installed around the perimeter of the work area and across suitable aquatic habitat where activities associated with levee slope flattening and pipe reconstruction activities would occur. The fencing should enclose the work area to the maximum extent possible to prevent giant garter snakes from entering the work area. Fencing will be installed during the active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during fence installation. The USFWS-

approved biological monitor will work with the contractor to determine where fencing should be placed and will monitor fence installation. The barrier fencing will consist of 3- to 4-foot-tall erosion fencing buried at least 6 to 8 inches below ground level. The barrier fencing will minimize opportunities for giant garter snake hibernation in the adjacent upland area (between canal and existing levee).

Portions of the construction area that are temporarily disturbed during construction will be revegetated with emergent vegetation and adjacent disturbed upland habitat will be revegetated with native grasses and forbs after construction is complete.

Conservation Measure 17: Restore Temporarily Disturbed Aquatic and Upland Habitat to Pre-project Conditions

Upon completion of the Southport EIP,155 acres of suitable upland habitat will be restored in the borrow areas for giant garter snake to pre-project conditions. There would be no temporary loss of aquatic habitat. All of the temporary habitat impacts will occur in the borrow areas. The actual temporary impacts from borrow activities will be substantially less pending an analysis on the suitability of materials.

Suitable upland habitat for giant garter snakes consists of fallow agricultural fields and nonnative annual grassland. Cultivated and disked agricultural fields were not considered suitable upland habitat for giant garter snake because they are frequently disturbed during farming activities. Temporarily affected upland habitat would be restored to pre-project conditions within a maximum of one season (a season is defined as the calendar year between May 1 and October 1 [USFWS 1997]) to avoid requirements for compensation. Restoration of upland habitat will be detailed in a mitigation and monitoring plan that will be reviewed and approved by USACE and USFWS prior to the start of construction.

Conservation Measure 18: Compensate for Direct Effects on Giant Garter Snake

The permanent loss of 2.24 acres of upland habitat would be compensated for by restoring habitat onsite or by purchasing credits from a USFWS and CDFW approved mitigation bank. There would be no permanent loss of aquatic habitat.

3.0 Federally Protected Species and Critical Habitat

Federally protected species and critical habitat that may be affected by the West Sacramento Project and Southport EIP were determined through consultation with USFWS and NMFS. The Central Valley fall-/late fall–run Chinook salmon, which is an Evolutionarily Significant Unit (ESU) of special concern but is not Federally listed, is included because the project's effects on EFH must also be assessed.

3.1 Valley Elderberry Longhorn Beetle

Status and Distribution

The valley elderberry longhorn beetle is listed as a threatened species under the ESA (USFWS 1980). USFWS has undertaken a comprehensive study, known as a 12-month review, to determine whether or not to propose the beetle for delisting (USFWS 2011). According to the USFWS, delisting may be warranted because many new locations of the beetle have been identified since its listing, destruction of habitat has slowed greatly, and efforts have resulted in the protection of significant acreage of habitat (Talley et al. 2006).

The valley elderberry longhorn beetle's range extends from southern Shasta County to Fresno County (Talley et al. 2006). Along the eastern edge of the species' range, adult beetles have been found in the foothills of the Sierra Nevada at elevations up to 2,220 feet, and beetle exit holes have been located on elderberry plants at elevations up to 2,940 feet. Along the western edge of the species' range, adult beetles have been found on the eastern slopes of the Coast Ranges at elevations of up to 500 feet, and beetle exit holes have been detected on elderberry plants at elevations up to 730 feet (Barr 1991).

Several CNDDB (CDFW 2013a) records of VELB are reported to occur in the West Sacramento study area along the Sacramento River north and south levee reaches. Though not reported to occur in other levee reaches within the study area, VELB has potential to occur wherever elderberry shrubs with branches sized 1 inch or greater at ground level occur.

Life History and Habitat Requirements

Because historic loss of riparian habitat in the region has already occurred, the rate of riparian habitat loss has slowed significantly over the last 30 years. During this period, incidental take of habitat has been authorized primarily for urbanization, transportation, water management, and flood control, on the order of 10,000 to 20,000 acres. Several habitat conservation plans are being developed to allow for continued urbanization of the Sacramento Valley (Talley et al. 2006).

Approximately 50,000 acres of existing riparian habitat in the Central Valley, primarily in the Sacramento Valley, have been protected by Federal, State, and local agencies as well as private organizations. Additionally, restoration of more than 5,000 acres of habitat has been initiated throughout the beetle's range (Talley et al. 2006). Mitigation needed for the West Sacramento project would be performed in place or there would be purchasing of mitigation credits from nearby banks.

Valley elderberry longhorn beetle is only found in close association with its host plant, elderberry shrubs (*Sambucus* spp.). Elderberry shrubs are found in or near riparian and oak woodland habitats. The valley elderberry longhorn beetle's life history is assumed to follow a sequence of events similar to those of related taxa. Female beetles deposit eggs in crevices in the bark of living elderberry shrubs. Presumably, the eggs hatch shortly after they are laid, and the larvae bore into the pith of the trunk or stem. When larvae are ready to pupate, they move through the pith of the plant, open an emergence hole through the bark, and return to the pith for pupation. Adults exit through the emergence holes and can sometimes be found on elderberry foliage, flowers, or stems or on adjacent vegetation. The entire life cycle of the valley elderberry longhorn beetle is thought to encompass 2 years, from the time eggs are laid and hatch until adults emerge and die (USFWS 1984).

The presence of exit holes in elderberry stems indicates previous valley elderberry longhorn beetle habitat use. Exit holes are cylindrical and approximately 0.25 inch in diameter. Exit holes can be found on stems that are 1 or more inches in diameter. The holes may be located on the stems from a few inches to about 9 to 10 feet above the ground (Barr 1991).

Factors Affecting Abundance

The valley elderberry longhorn beetle distribution decline is most likely related to the extensive loss of riparian forests in the Central Valley, which has reduced the amount of available habitat for the species, and has most likely decreased and fragmented the species' range (USFWS 1984).

Insecticide drift from cultivated fields and orchards adjacent to elderberry plants may affect valley elderberry longhorn beetle populations, if drift occurs at a time when adults are present on the shrubs (Barr 1991). Herbicide drift from agricultural fields and orchards can likewise affect the health of elderberry plants, thereby reducing their quantity and quality as valley elderberry longhorn beetle habitat.

The invasive Argentine ant (*Linepithema humile*) has been spreading in riparian habitats and may affect survival of the valley elderberry longhorn beetle. Argentine ants may predate valley elderberry longhorn beetle eggs although this interaction needs further exploration (Huxel 2000). The spread of invasive exotic plants (e.g., giant reed [*Arundo donax*] may also negatively affect the valley elderberry longhorn beetle by affecting supporting riparian habitats. The presence of giant reed promotes a more frequent fire cycle and homogenous plant community (Talley et al. 2006).

3.2 Fish Species

Six fish species' ESUs or Distinct Population Segments (DPSs) and critical habitats are addressed below. These include Sacramento River winter-run Chinook salmon ESU, Central Valley spring-run Chinook salmon ESU, Central Valley fall-/late fall–run Chinook salmon ESU, Central Valley steelhead DPS, delta smelt, and green sturgeon southern DPS.

3.2.1 Sacramento River Winter-Run Chinook Salmon Evolutionarily Significant Unit

Status and Distribution

The Sacramento River winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*) was listed as threatened under the Federal ESA on August 4, 1989 (NMFS 1989). NMFS subsequently upgraded the Federal listing to endangered on January 4, 1994 (NMFS 1994). NMFS designated critical habitat for Sacramento River winter-run Chinook salmon on June 16, 1993 (NMFS 1993a). The ESU includes all naturally spawned populations of winter-run Chinook in the Sacramento River and its tributaries, as well as populations from two artificial propagation programs, one at the Livingston Stone National Fish Hatchery and the other at Bodega Marine Laboratory (NMFS 2005a).

Prior to construction of Shasta Dam, winter-run Chinook salmon spawned in the upper reaches of the Sacramento River, the McCloud River, and the lower Pit River. Spawning is now restricted to approximately 44 miles of the mainstem Sacramento River, immediately downstream of Keswick Dam (Yoshiyama et al. 1998). The abundance of winter-run Chinook salmon in the Sacramento River before Shasta Dam was constructed, is unknown. Some biologists believe the run was relatively small, possibly consisting of a few thousand fish (Slater 1963). Others, relying on anecdotal accounts, believe the run could have numbered more than 200,000 fish (NMFS 1993b). During the mid-1960s, more than 20 years after the construction of Shasta Dam, the population exceeded 80,000 fish (USBR 1986). The population declined substantially during the 1970s and 1980s.

In 1989, winter-run Chinook salmon escapement was estimated at 696 adults. Escapement continued to decline, diminishing to an estimated 430 fish in 1990 and 211 fish in 1991 (CDFW 2013b). The rapid decline in escapement during the late 1980s and early 1990s prompted listing of the winter-run Chinook salmon as endangered under the California ESA and the Federal ESA. Escapement in 1992 was estimated to be 1,240 fish, indicating good survival of the 1989 class. NMFS data indicates that the population has increased during the late 1990s through 2001. In 1996, returning spawners numbered 1,337 fish and in 2001, returning adults were estimated to be 8,224 (CDFW 2013b). Despite increased efforts to maintain and enhance the population of winter-run Chinook salmon by various entities, in their final listing determination of June 28, 2005, NMFS again found “that the Sacramento River winter-run Chinook salmon ESU in total is in danger of extinction throughout all or a significant portion of its range” and concludes that the ESU continues to warrant listing as an endangered species under the Federal ESA (NMFS 2005a).

Life History

Winter-run Chinook salmon spend 1 to 3 years in the ocean. Adult winter-run Chinook salmon leave the ocean and migrate through the Delta into the Sacramento River from December through July with peak migration in March. Adults spawn from mid-April through August (Moyle 2002). Egg incubation continues through October. The primary spawning habitat in the Sacramento River is above Red Bluff Diversion Dam at RM 243, although spawning has been observed downstream as far as RM

218 (NMFS 2001). Spawning success below RBDD may be limited primarily by warm water temperatures (Hallock and Fisher 1985; Yoshiyama et al. 1998).

Downstream movement of juvenile winter-run Chinook salmon begins in August, soon after fry emerge. The peak abundance of juveniles moving downstream at Red Bluff occurs in September and October (Vogel and Marine 1991). Juvenile Chinook salmon move downstream from spawning areas in response to many factors, which may include inherited behavior, habitat availability, flow, competition for space and food, and water temperature. The numbers of juveniles that move and the timing of movement are highly variable. Storm events and their resulting high flows and turbidity appear to trigger downstream movement of substantial numbers of juvenile Chinook salmon.

Winter-run Chinook salmon smolts (i.e., juveniles that are physiologically ready to enter seawater) may migrate through the Delta and San Francisco Bay to the ocean from November through May (Yoshiyama et al. 1998). The Sacramento River channel is the main migration route through the Delta. However, the Yolo Bypass also provides significant outmigration passage during higher flow events. During winter in the Sacramento–San Joaquin system, juveniles rear on seasonally inundated floodplains. Sommer et al. (2001) found higher growth and survival rates of juvenile Chinook salmon reared on the Yolo Bypass floodplain, than those that reared in the mainstem Sacramento River.

Factors Affecting Abundance

One of the main factors in the decline of Chinook salmon is habitat loss and degradation. On the Sacramento River, Shasta Dam blocked access to historical spawning and rearing habitat. Other factors affecting abundance include the effects of reservoir operations on water temperature, harvesting and fishing pressure, entrainment in diversions, contaminants, predation by non-native species, and interaction with hatchery stock (Corps 2000b).

In the Sacramento River, operation of the Central Valley Project and State Water Project influences river flow. Low flows can reduce habitat area and adversely affect water quality. The resulting warm water temperatures and low dissolved oxygen levels can stress incubating eggs and rearing juvenile winter-run Chinook salmon. Low flow may affect migration of juveniles and adults through increased water temperature or reduced velocity that slows downstream movement of juveniles. Low flow, in combination with diversions, may result in higher entrainment losses at the State and Federal pumping plants in the south Delta (Corps 2000b).

In the Delta, flow drawn through the Delta Cross Channel and Georgiana Slough transports some percentage of downstream migrating salmon into the central Delta. The number of juveniles entering the DCC and Georgiana Slough is assumed to be proportional to the flow volume diverted from the Sacramento River (CDFG 1987). Survival of juvenile Chinook salmon that are drawn into the central Delta is lower than survival of juvenile Chinook salmon that remain in the Sacramento River channel.

Critical Habitat/Essential Fish Habitat

Within the West Sacramento GRR study area, the Sacramento River is considered to be critical habitat for winter-run Chinook salmon. Critical habitat includes the water column, river bottom, and adjacent riparian zone which fry and juveniles use for rearing (NMFS 2006b). The conservation value of critical habitat in the study area is high because it supports both recruitment and survival of juveniles and adults (NMFS 2006a).

EFH is defined as those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. EFH includes currently and historically accessible habitat. All levee reaches within the West Sacramento GRR study area are considered to be essential fish habitat for winter-run Chinook salmon except for the South Cross toe drain.

3.2.2 Central Valley Spring-Run Chinook Salmon Evolutionarily Significant Unit

Status and Distribution

The Central Valley spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*) was Federally listed as threatened on September 16, 1999 (NMFS 1999). Its threatened status was reaffirmed in NMFS's final listing determination issued on June 28, 2005 (NMFS 2005a). Critical habitat for Central Valley spring-run Chinook salmon was designated by NMFS on September 2, 2005 (NMFS 2005b). The ESU includes all naturally spawned spring-run Chinook salmon in the Sacramento River and its tributaries. Naturally spawned fish of hatchery origin in the Feather and Yuba Rivers as well as hatchery spawned fish in the Feather River are also included as a part of this ESU (NMFS 2005a).

Spring-run Chinook salmon may have once been the most abundant of Central Valley Chinook salmon (Mills and Fisher 1994), historically occupying the upstream reaches of all major river systems in the Central Valley where there were no natural barriers. Central Valley spring-run Chinook salmon are now restricted to the upper Sacramento River downstream of Keswick Dam; the Feather River downstream of Oroville Dam; the Yuba River downstream of Englebright Dam; several perennial tributaries of the Sacramento River (e.g., Deer, Mill, and Butte creeks); and the Delta.

The abundance of Central Valley spring-run Chinook salmon escapement, as measured by the number of adults returning to spawn from 1960 to 2013, averaged 10,236 adults for in-river natural spawners and 2,364 average adults returning to hatcheries (CDFW 2013b). Spring-run Chinook salmon spawn in the early fall and have interbred with fall-run Chinook salmon in the Sacramento and Feather Rivers. Genetically uncontaminated populations may exist in Deer Creek, Mill Creek, Butte Creek, and other eastside tributaries of the Sacramento River.

Life History

Adult spring-run Chinook salmon enter the mainstem Sacramento River from March through September, with the peak upstream migration occurring from May through June (Yoshiyama et al. 1998). Adults generally enter tributaries from the Sacramento River between mid-April and mid-June (Lindley et al. 2006 as cited in NMFS 2006b). Spring-run Chinook salmon are sexually immature during upstream migration, and adults hold in deep, cold pools near spawning habitat until spawning commences in late summer and fall. Spring-run Chinook salmon spawn in the upper reaches of the mainstem Sacramento River and tributary streams (USFWS 1995), with the largest tributary runs occurring in Butte, Deer, and Mill Creek's (Yoshiyama et al. 1998). Spawning typically begins in late August and may continue through October. Juveniles emerge in November and December in most locations but may emerge later when water temperature is cooler. Newly emerged fry remain in shallow, low-velocity edgewater (CDFG 1998).

Juvenile spring-run Chinook salmon typically spend up to one year rearing in fresh water before migrating to sea as yearlings, but some may migrate downstream as young-of-year juveniles. Rearing takes place in their natal streams, the mainstem of the Sacramento River, inundated floodplains (including the Sutter and Yolo bypasses), and the Delta. Based on observations in Butte Creek and the Sacramento River, young-of-year juveniles typically migrate from November through May. Yearling spring-run Chinook salmon migrate from October to March, with peak migration in November (Cramer and Demko 1997; Hill and Webber 1999). Downstream migration of yearlings typically coincides with the onset of the winter storm season, and migration may continue through March (CDFG 1998).

Factors Affecting Abundance

Main factors in the decline of spring-run Chinook salmon populations are habitat loss and degradation. Dams have blocked access to historical spawning and rearing habitat. Other factors affecting abundance of spring-run Chinook salmon include harvest, entrainment in diversions, contaminants, predation by non-native species, and interbreeding with fall-run Chinook salmon and hatchery stocks (Corps 2000b).

In the Sacramento River and its major tributaries, operation of the CVP and SWP controls river flow. Low flows limit habitat area and adversely affect water quality, such as warm water temperature and low dissolved oxygen that stress incubating eggs and rearing juveniles. Low flow may affect migration of juveniles and adults through inadequate water depth to support passage, or through reduced velocity that slows the downstream movement of juveniles. Low flow, in combination with diversions, may result in higher entrainment losses (Corps 2000b).

In the Delta, flow drawn through the Delta Cross Channel and Georgiana Slough transports some portion of downstream migrants into the central Delta. The number of juveniles entering the Delta Cross Channel and Georgiana Slough is assumed to be proportional to the flow volume diverted from the Sacramento River (CDFG 1987). Survival of juvenile Chinook salmon that are drawn into the central Delta is lower than survival of juvenile Chinook salmon that remains in the Sacramento River channel.

Critical Habitat/Essential Fish Habitat

Critical habitat for spring-run Chinook salmon includes all river channels and sloughs within the West Sacramento GRR study area (NMFS 2006b). The DWSC and South Cross toe drain are excluded from this designation. Critical habitat includes the stream channels and the lateral extent as defined by the ordinary high-water line or bank-full elevation. Primary constituent elements of critical habitat in the study area include: (1) freshwater rearing sites that have adequate water quality and quantity, floodplain connectivity, and natural cover that supports juvenile growth and mobility; and (2) freshwater migration corridors that support adequate water quantity and quality as well as natural cover to provide food and migration pathways for juveniles as well as adults (NMFS 2005e, 2006b). The conservation value of critical habitat in the study area is high because it supports both recruitment and survival of juveniles and adults (NMFS 2006a).

EFH is defined as those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. EFH includes currently and historically accessible habitat. All levee reaches within the West Sacramento GRR study area are considered to be EFH for spring-run Chinook salmon except for the South Cross toe drain.

3.2.3 Central Valley Fall-/Late Fall–Run Chinook Salmon Evolutionarily Significant Unit

Status and Distribution

The Central Valley fall-/late fall-run Chinook salmon ESU (*Oncorhynchus tshawytscha*) is not listed under the Federal ESA. On March 9, 1998, NMFS issued a proposed rule to list fall-run Chinook salmon as threatened (NMFS 1998a). However, on September 16, 1999, NMFS determined that the species did not warrant listing (NMFS 1999). On April 15, 2004, NMFS classified Central Valley fall-/late fall-run Chinook salmon as a species of concern (NMFS 2004). However, EFH is designated for this species.

The Central Valley fall-/late fall-run Chinook salmon ESU includes all naturally spawned populations of fall-run Chinook salmon in the Sacramento and San Joaquin river basins and their tributaries. Central Valley fall-/late fall-run Chinook salmon are currently the most abundant and widespread salmon runs in California (Mills et al. 1997), representing about 80% of the total Chinook salmon produced in the Sacramento River drainage (Kjelson et al. 1982). The most abundant spawning populations of fall-/late fall-run Chinook salmon occur in the Sacramento, Feather, Yuba, and American rivers (Mills and Fisher 1994). Fall-run Chinook salmon in the Sacramento, Feather, and American Rivers have a relatively large hatchery component, from 1952 to 2013 the average was 57,508 fish. The average escapement in-river on the Sacramento and San Joaquin system from 1960 to 2013 was 264,475 (CDFW 2013b).

Life History

Adult fall-run Chinook salmon migrate into the Sacramento River and its tributaries from June through December in mature condition and spawn from late September through December, soon after arriving at their spawning grounds (Yoshiyama et al. 1998). The spawning peak occurs in October and November. Emergence occurs from December through March, and juveniles migrate downstream to the ocean soon after emerging, rearing in fresh water for only a few months. Smolt outmigration typically occurs from March through July (Yoshiyama et al. 1998).

Late fall-run Chinook salmon migrate upstream before they are sexually mature, and hold near spawning grounds for 1 to 3 months before spawning. Upstream migration takes place from October through April and spawning occurs from late January through April, with peak spawning in February and March (Yoshiyama et al. 1998). Fry emerge from April through June. Juvenile late fall-run Chinook salmon rear in their natal streams during the summer, and in some streams they remain throughout the year. Smolt outmigration can occur from November through May (Yoshiyama et al. 1998).

Factors Affecting Abundance

Factors affecting abundance of fall-/late fall-run Chinook salmon are similar to factors affecting abundance of winter- and spring-run Chinook salmon, i.e., habitat loss and degradation. Fall-run Chinook salmon, however, typically use spawning habitat farther downstream than the spawning habitat used by spring- and winter-run Chinook salmon. The effect of dams on spawning habitat area for fall-run Chinook salmon is not as severe as for other runs, although access to substantial spawning habitat area has been blocked by dams.

Critical Habitat/Essential Fish Habitat

Critical habitat is not designated for fall-/late fall-run Chinook salmon, however EFH is designated for this species. EFH is defined as those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. EFH includes currently and historically accessible habitat. All levee reaches within the West Sacramento GRR study area are considered to be EFH for fall-/late fall-run Chinook salmon except for the South Cross toe drain.

3.2.4 Central Valley Steelhead Distinct Population Segment

Status and Distribution

The Central Valley steelhead (*Oncorhynchus mykiss*) DPS was Federally listed as threatened on March 19, 1998 (NMFS 1998b). The threatened status of Central Valley steelhead was reaffirmed in NMFS's final listing determination on January 5, 2006 (NMFS 2006a); at the same time NMFS also adopted the term DPS, in place of ESU, to describe Central Valley steelhead and other population segments of this species. NMFS originally designated critical habitat for Central Valley steelhead on February 16, 2000 (NMFS 2000). However, following a lawsuit (*National Association of Home Builders et al. v. Donald L. Evans, Secretary of Commerce, et al.*), NMFS decided to rescind the listing and re-evaluate how to classify critical habitat for several DPSs of steelhead.

Critical habitat for Central Valley steelhead was re-designated by NMFS on September 2, 2005 (NMFS 2005b). The DPS includes all naturally spawned populations of steelhead in the Sacramento and San Joaquin rivers and their tributaries, excluding steelhead from San Francisco and San Pablo Bays and their tributaries. Artificially propagated fish from the Coleman and Feather River hatcheries are included in the DPS (NMFS 2006a).

Steelhead ranged throughout the tributaries of the Sacramento and San Joaquin Rivers prior to dam construction, water development, and watershed perturbation dating from the 19th and 20th centuries. Wild stocks are now mostly confined to the upper Sacramento River downstream of Keswick Dam; upper Sacramento River tributaries such as Deer, Mill, and Antelope Creeks; and the Yuba River downstream of Englebright Dam. Populations may also exist in Big Chico and Butte Creeks and a few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996). The abundance of naturally reproducing Central Valley steelhead, as measured by the number of adults returning to spawn, is largely unknown. Natural escapement in 1995 was estimated to be about 1,000 adults each for Mill and Deer Creeks and the Yuba River (S. P. Cramer and Associates 1995). Hatchery returns have averaged around 10,000 adults (Mills and Fisher 1994). The most recent annual estimate of adults spawning upstream of Red Bluff Diversion Dam is less than 2,000 fish (NMFS 2006a).

Life History

Central Valley steelhead have one of the most complex life histories of any salmonid species, exhibiting both anadromous and freshwater resident life histories. Freshwater residents typically are referred to as rainbow trout, and those exhibiting an anadromous life history are called steelhead (NMFS 1999). Steelhead exhibit highly variable life history patterns throughout their range but are broadly categorized into winter and summer reproductive ecotypes. Winter steelhead are the most widespread reproductive ecotype and the only type currently present in Central Valley streams (McEwan and Jackson 1996). Winter steelhead become sexually mature in the ocean, enter spawning streams in summer, fall or winter, and spawn a few months later in winter or late spring (Meehan and Bjornn 1991; Behnke 1992).

In the Sacramento River, adult winter steelhead migrate upstream during most months of the year, beginning in July, peaking in September, and continuing through February or March (Hallock 1987). Spawning occurs primarily from January through March, but may begin as early as late December and may extend through April (Hallock 1987). Individual steelhead may spawn more than once, returning to the ocean between each spawning migration.

Juvenile steelhead rear a minimum of one and typically two or more years in fresh water before migrating to the ocean as smolts. Juvenile migration to the ocean generally occurs from December through August. The peak months of juvenile migration are January to May (McEwan 2001). The importance of main channel and floodplain habitats to steelhead in the lower Sacramento River and upper Delta is not well understood. Steelhead smolts have been found in the Yolo Bypass during the period of winter and spring inundation (Sommer 2002), but the importance of this and other floodplain areas in the lower Sacramento River and upper Delta is not yet clear.

Factors Affecting Abundance

The decline in steelhead populations is attributable to changes in habitat quality and quantity. The availability of steelhead habitat in the Central Valley has been reduced by as much as 95% or more due to barriers created by dams (NMFS 1996a). Populations have been most severely affected by dams blocking access to the headwaters of all major tributaries; consequently, most runs are maintained through artificial production. The decline of naturally produced Central Valley steelhead has been more precipitous than that of hatchery stocks. Populations in the range's southern portion have experienced the most severe declines (NMFS 1996b). Other factors contributing to the decline of steelhead in the Central Valley are mining, agriculture, urbanization, logging, harvest, hatchery influences, flow management (including reservoir operations), hydropower generation, and water diversion and extraction (NMFS 1996a).

Critical Habitat/Essential Fish Habitat

Habitat for endangered or threatened anadromous fish is designated as critical habitat under the ESA and as EFH under the MSA. No EFH has been designated for steelhead. Critical habitat for Central Valley steelhead includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-waterline or bank-full elevation. The DWSC and the South Cross toe drain are not designated as critical habitat for steelhead. Primary constituent elements of critical habitat are as described for spring-run Chinook salmon (NMFS 2006b).

3.2.5 Delta Smelt

Status and Distribution

Delta smelt (*Hypomesus transpacificus*) was Federally listed as threatened on March 5, 1993 (USFWS 1993) and critical habitat was designated on December 19, 1994 (USFWS 1994). Population trends and abundance of Delta smelt are poorly understood due to their short life span (1 year). Based on data from 21 years of monthly sampling in Suisun Marsh, Delta smelt appear to be experiencing long-term declines (Matern et al. 2002). Summer tow-net and fall/mid-water trawl data show fluctuating annual abundance from 1991 through 1996, with an increasing trend in the late 1990s, followed by an overall decline in abundance since 1999 (Bryant and Souza 2004).

Life History

Delta smelt are endemic to the Sacramento-San Joaquin estuary and are found seasonally in Suisun Bay and Suisun Marsh. They typically are found in shallow water (less than 10 feet) where salinity ranges from 2 to 7 parts per thousand (ppt), although they have been observed at salinities between 0 and 18.4 ppt. Delta smelt have relatively low fecundity and most live for 1 year. They feed on planktonic copepods, cladocerans, amphipods, and insect larva (Moyle 2002).

Delta smelt are semi-anadromous. During their spawning migration, adults move into the freshwater channels and sloughs of the Delta between December and January. Spawning occurs between January and July, with peak spawning from April through mid-May (Moyle 2002). Spawning locations in the Delta have not been identified and are inferred from larval catches (Bennett 2005). Larval fish have been observed in Montezuma Slough; Suisun Slough in Suisun Marsh; the Napa River estuary; the Sacramento River above Rio Vista; and Cache, Lindsey, Georgiana, Prospect, Beaver, Hog, Sycamore, and Barker sloughs (Wang 1986, Moyle 2002, Stillwater Sciences 2006, and USFWS 1996). Spawning was also observed in the Sacramento River up to Garcia Bend (RM 51) during drought conditions, as a result of increased saltwater intrusion that moved Delta smelt spawning and rearing farther inland (Wang and Brown 1993).

Laboratory experiments have found eggs to be adhesive, demersal, and usually attached to substrate composed of gravel, sand, or other submerged material (Moyle 2002, Wang 1991). Hatching takes approximately 9 to 13 days, and larvae begin feeding 4 to 5 days later. Newly hatched larvae contain a large oil globule that makes them semi-buoyant and allows them to stay near the bottom. As their fins and swim bladder develop, they move higher into the water column and are transported downstream to the open waters of the estuary (Moyle 2002).

Factors Affecting Abundance

Diversions and Delta inflow and outflow may affect survival of Delta smelt. In water exported at the South Delta Central Valley Project and State Water Project export facilities, estimates of Delta smelt entrainment suggest a population decline in the early 1980s, mirroring the decline indicated by mid-water trawl, summer tow-net, Kodiak trawl, and beach seine data (Bennett 2005). Diversions and upstream storage, including operation of the Central Valley Project and State Water Project, control Delta inflow and outflow during most months. Reduced Delta flow may inhibit or slow movement of larvae and juveniles to estuarine rearing habitat and into deeper and narrower channels of the Delta, resulting in lower prey availability and increased mortality from predators (Moyle 2002). Low Delta flow also may increase entrainment in diversions, including entrainment at the Central Valley Project and State Water Project export pumps (Moyle 2002). Additional factors affecting Delta smelt abundance include extremely high river outflow that increases entrainment at export facilities, changes in prey abundance and composition, predation by nonnative species, toxic substances, disease, and loss of genetic integrity through interbreeding with the introduced Wagasaki smelt (Moyle 2002; CDFG 2000; Bennett 2005).

Critical Habitat

Critical habitat for Delta smelt consists of 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 contiguous waters in the Delta (USFWS 1994). Critical habitat for Delta smelt is designated in the following California counties: Alameda, Contra Costa, Sacramento, San Joaquin, Solano, and Yolo (USFWS 2003). Critical habitat in the West Sacramento GRR study area includes the Sacramento River up to the I Street Bridge, Yolo Bypass just above Interstate 80 at the railroad tracks, and the DWSC. Primary constituent elements of critical habitat determined to be essential to the conservation of the species include: physical habitat, water, river flow, and salinity concentrations required to maintain Delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (USFWS 2006a).

3.2.6 Green Sturgeon Southern Distinct Population Segment

Status and Distribution

On January 23, 2003, NMFS determined that green sturgeon (*Acipenser medirostris*) are comprised of two populations, a northern and a southern DPS (NMFS 2003). The northern DPS includes populations extending from the Eel River northward, and the southern DPS includes populations south of the Eel River to the Sacramento River. The Sacramento River supports the southernmost spawning population of green sturgeon (Moyle 2002). On April 6, 2005, NMFS determined that the northern DPS does not warrant listing under the ESA, but it remains on the Species of Concern List (NMFS 2005c). On April 7, 2006, NMFS determined that the southern DPS of green sturgeon was threatened under the Federal ESA (NMFS 2006c). On October 9, 2009, NMFS (74 CFR 52300) designated critical habitat for the green sturgeon southern DPS throughout most of its occupied range.

Green sturgeon were classified as a Class 1 Species of Special Concern by the California Department of Fish and Game (CDFG) in 1995 (Moyle et al. 1995). Class 1 Species of Special Concern are those that conform to the State definitions of threatened or endangered and could qualify for addition to the official list. On March 20, 2006, emergency green sturgeon regulations were put into effect by CDFG requiring a year-round zero bag limit of green sturgeon in all areas of the state (CDFG 2006).

Life History

The green sturgeon is anadromous, but it is the most marine-oriented of the sturgeon species and has been found in near shore marine waters from Mexico to the Bering Sea (NMFS 2005c). The southern DPS has a spawning population in the Sacramento River (NMFS 2005d) and more recently spawning has been observed in the lower Feather River, a tributary of the Sacramento River (Seesholtz et al. 2012). Adults typically migrate upstream into rivers between late February and late July. Spawning occurs from March to July, with peak spawning from mid-April to mid-June. Green sturgeon are believed to spawn every 3 to 5 years, although recent evidence indicates that spawning may be as frequent as every 2 years (NMFS 2005c). Little is known about the specific spawning habitat preferences of green sturgeon. Adult green sturgeon are believed to broadcast their eggs in deep, fast water over large cobble substrate, where the eggs settle into the interstitial spaces (Moyle 2002). Spawning is generally associated with water temperatures from 46 to 57 degrees Fahrenheit (°F). In the Central Valley, spawning occurs in the Sacramento River upstream of Hamilton City, perhaps as far upstream as Keswick Dam (Adams et al. 2002) and the lower Feather River (Seesholtz et al. 2012).

Green sturgeon eggs hatch in approximately 8 days at 55°F (Moyle 2002). Larvae begin feeding 10 days after hatching. Metamorphosis to the juvenile stage is complete within 45 days of hatching. Juveniles spend 1 to 4 years in fresh and estuarine waters and migrate to salt water at lengths of 300 to 750 millimeters (mm) (NMFS 2005c).

Little is known about movements, habitat use, and feeding habits of green sturgeon. Green sturgeon have been salvaged at the state and Federal fish collection facilities in every month, indicating that they are present in the Delta year-round. Juveniles and adults are reported to feed on benthic invertebrates, including shrimp and amphipods, and small fish (NMFS 2005c).

Factors Affecting Abundance

The historical decline of the southern DPS of green sturgeon has been largely attributed to the reduction of spawning habitat area. Keswick and Shasta Dams on the Sacramento River and Oroville Dam on the Feather River are impassable barriers that prevent green sturgeon from accessing what were likely historical spawning grounds upstream of these dams. Other potential migration barriers or impediments include the Sacramento Deep Water Ship Channel locks, Fremont Weir, Sutter Bypass, the Delta Cross Channel, and Shanghai Bench and Sunset Pumps on the Feather River. Other factors that have been identified as potential threats to green sturgeon are reductions in freshwater outflow in the Delta during larval dispersal and rearing, high water temperatures during spawning and incubation, entrainment by water diversions, contaminants, predation and other impacts by introduced species, and poaching (NMFS 2005c).

Critical Habitat/Essential Fish Habitat

There is no EFH designated for green sturgeon. Designated critical habitat for the southern DPS of green sturgeon includes the Sacramento River downstream of Keswick Dam, the Feather River downstream of Oroville Dam, and the Yuba River downstream of Daguerre Dam; portions of Sutter and Yolo Bypasses; the legal Delta, excluding Five Mile Slough, Seven Mile Slough, Snodgrass Slough, Tom Paine Slough and Trapper Slough; and San Francisco, San Pablo, and Suisun bays. Freshwater habitat of green sturgeon varies in function, depending on location within the Sacramento River watershed. Spawning areas currently are limited to accessible reaches of the Sacramento River upstream of Hamilton City , downstream of Keswick Dam (CDFG 2002) and portions of the Feather River (Seesholtz et al. 2012). Preferred spawning habitats are thought to contain large cobble in deep and cool pools with turbulent water (CDFG 2002; Moyle 2002; Adams et al. 2002). Sufficient flows are needed to sufficiently oxygenate and limit disease and fungal infection of recently laid eggs (Deng et al. 2002). Within the Sacramento River, spawning appears to be triggered by large increases in water flow during spawning (Brown and Michniuk 2007).

3.3 Reptile Species

One Federally listed reptile species was identified in the USFWS database records as utilizing parts of the West Sacramento project study area: the giant garter snake (*Thamnophis gigas*).

3.3.1 Giant Garter Snake

Status and Distribution

The giant garter snake (*Thamnophis gigas*) is Federally listed as a threatened species under the ESA. Currently, this species is only known from 13 isolated population clusters within the Central Valley, from Chico to an area just southwest of Fresno (USFWS 1997).

There are no CNDDB (CDFW 2013a) records for giant garter snakes within the study area, although there are several occurrences within 10 miles of the study area. The closest of these occurrences is located approximately 3 miles from the study area in a drainage canal. This record is labeled as sensitive, and therefore, provides no specifics on location or type of observation. Other recorded occurrences within 10 miles of the study area include records for one juvenile located in a drainage canal 1.5 miles south of Del Paso Road, one adult found within the Yolo Bypass 0.75 mile south of I-80, and numerous other records that are labeled as sensitive (CDFW 2013a). Within the study area, emergent wetlands and open water areas in sloughs, canals, or vegetated ditches in the Yolo and Sacramento Bypasses, within the Yolo Bypass toe drain, DWSC and areas of the South Cross toe drain have the highest potential to support giant garter snakes. Water areas with little to no aquatic or upland vegetation could provide marginal or seasonal habitat. Throughout the study area, other emergent wetlands and open water areas could provide suitable aquatic habitat and the upland areas adjacent to these aquatic habitats could provide winter hibernacula and dry refugia required by this snake.

Life History

The giant garter snake inhabits agricultural wetlands and associated waterways, including irrigation and drainage canals, rice fields, marshes, sloughs, ponds, low- gradient streams, and adjacent uplands. They have also been observed to use revetment as cover (Wylie et al. 2002). Giant garter snakes are believed to be most numerous in rice-growing regions (USFWS 1999b). Giant garter snakes are typically absent from the larger rivers; wetlands with sand, gravel, or rock substrates; and riparian areas lacking suitable basking sites or suitable prey populations (Hansen and Brode 1980; Brode 1988; USFWS 1999b). The giant garter snake hibernates from October to March in abandoned burrows of small mammals located above prevailing flood elevations (Fisher et al. 1994), and breeds during March and April.

Factors Affecting Abundance

Giant garter snakes have been reduced in distribution and abundance due to habitat loss and degradation throughout the Central Valley. Several factors may degrade habitat for giant garter snakes, including upstream watershed modifications, water storage and diversion projects, and urban and agricultural development. Contamination from agricultural runoff may also have detrimental effects. On-going agricultural practices such as tilling, grading, harvesting and operation of other equipment may also result in mortality and increased rates of predation. Clearing and maintenance of irrigation canals and draining of rice fields may also result in mortality and degradation of habitat (USFWS 1999b).

3.4 Birds

Special status bird species with the potential to occur near or in the West Sacramento project study area are listed below (Table 20), Species protected under the Migratory Bird Treaty Act (MBTA) such as the bald eagle (*Haliaeetus leucocephalus*) may occur transiently during the winter months, although suitable nesting habitat is not present. CNDDB (CDFW 2013a) data for actual species present in the North and South Basin study area's are located below in Figures 18 and 19.

Table 20. California Natural Diversity Database Species List for Yolo and Sacramento County.

Common Name	Scientific Name	Status[a] Federal/State
white-tailed kite	*Elanus leucurus*	-/FP
Swainson's hawk	*Buteo swainsoni*	-/T
loggerhead shrike	*Lanius ludovicianus*	-/SSC
bank swallow	*Riparia riparia*	-/T
tricolored blackbird	*Agelaius tricolor*	-/SSC
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	-/SSC
purple martin	*Progne subis*	-/SSC
northern harrier	*Circus cyaneus*	-/SSC
western burrowing owl	*Athene cunicularia hypugea*	-/SSC

[a] Status explanations:

– = no listing

E = listed as endangered under the California Endangered Species Act

T = listed as threatened under the California Endangered Species Act

FP = fully protected under the California Fish and Game Code

SSC = species of special concern in California

Figure 18. Special Status Bird Species in the West Sacramento North Basin, August 26, 2013.

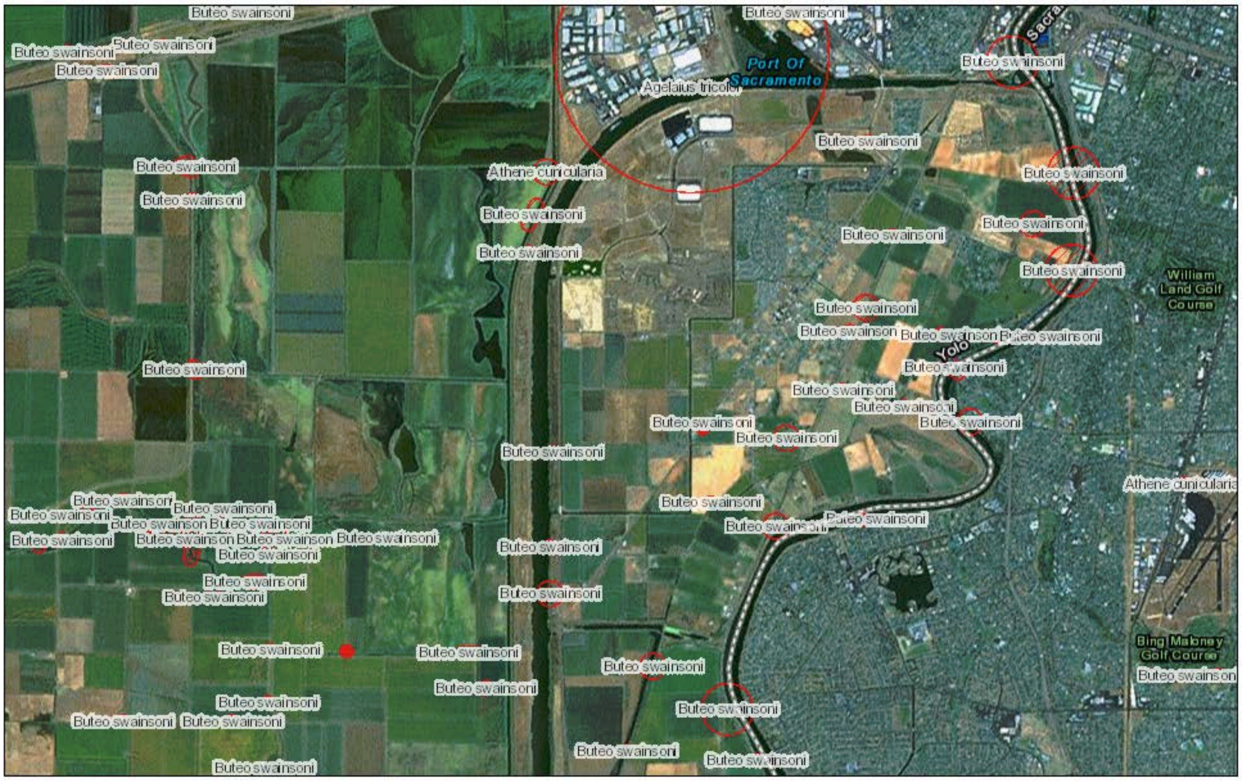

Figure 19. Special Status Bird Species in the West Sacramento South Basin, August 26, 2013.

3.5 Mammals

Special status mammal species with the potential to occur near or in the West Sacramento GRR North and South Basin study area are listed below (Table 21). CNDDB (CDFW 2013a) data for actual species present in the North study area are located below in Figure 20. CNDDB (CDFW 2013a) indicates that there were no special status species present in the South Basin of the study area.

Table 21. California Natural Diversity Database Species List for Yolo and Sacramento County.

Common Name	Scientific Name	Status[a] Federal/State
hoary bat	*Lasiurus cinereus*	-/SSC
pallid bat	*Antrozous pallidus*	-/SSC
western red bat	*Lasiurus blossevillii*	-/SSC

[a] Status explanations:
– = no listing
E = listed as endangered under the California Endangered Species Act
T = listed as threatened under the California Endangered Species Act
FP = fully protected under the California Fish and Game Code
SSC = species of special concern in California

Figure 20. Special Status Mammal Species in the West Sacramento North Basin, August 28, 2013.

4.0 Environmental Baseline

This section describes the physical conditions and special status species habitat and presence within the West Sacramento project and Southport EIP study areas. These conditions are first presented generally throughout the West Sacramento project study area and then site specific SRA is analyzed as well as affected species in the West Sacramento project study area. The environmental baseline provides information necessary to determine if the proposed action would jeopardize the continued existence of species being considered, and if the project can support long-term survival of these species in the study area.

For the Southport EIP, the environmental baseline is described in consideration of “the past and present impacts of all Federal, state, or private actions and other human activities in an Action Area, the anticipated impacts of all proposed Federal projects in an Action Area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process” (50 CFR §402.02). This section describes the general physical conditions and associated vegetation, wildlife, and fisheries resources in the lower Sacramento River and Southport EIP Action Area.

The West Sacramento project study area includes the mainstem Sacramento River 11.4 miles from the Sacramento Bypass south to the South Cross Levee. The study area also includes the Yolo Bypass, DWSC, Barge Canal, Port of West Sacramento, upper Yolo Bypass toe drain, and the South Cross toe drain. The Southport EIP study area is focused on the Sacramento River reach south of the Barge Canal.

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). However, there is a short reach of setback levee in this reach, on the west bank of the Sacramento River at River Mile 57.2, just downstream of where the Barge Canal connects to the river in West Sacramento. The setback levee at River Mile 57.2 was constructed by the Corps under the Sacramento River Bank Protection Project (SRBPP).

The natural banks and adjacent floodplains of the Sacramento River 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 river, 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).

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.

Descriptions of baseline conditions are based on information published in peer-reviewed scientific literature, resource agency publications, as well as aerial photography viewed in Google Earth Pro within the project area. Baseline conditions are described with a focus on features that affect habitat conditions for threatened and endangered species, including Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, delta smelt, green sturgeon, giant garter snake, and the valley elderberry longhorn beetle.

4.1 West Sacramento GRR Baseline

The West Sacramento project study area consists of primarily riparian scrub-shrub habitat. Early riparian habitat may be called scrub-shrub. Scrub-shrub generally refers to areas where the woody riparian canopy is composed of trees or shrubs approximately 20 feet high. Species that are typically found in these habitats include young cottonwood, willow, elderberry, buttonbush, Himalaya blackberry, wild grape, and poison oak. In very dense stands there may be no understory; however, in open canopies, understory vegetation may consist of an herbaceous layer of sedges, rushes, grasses, and forbs. Provided disturbance of the area is low, the scrub-shrub may acquire enough overstory cover to become riparian forest within 20 years.

Riparian forest typically has a dominant overstory of cottonwood, California sycamore, or valley oak. Species found in the scrub-shrub would make up the sub canopy and could also include white alder 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 are also found in riparian communities.

The herbaceous ruderal habitat 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, 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 project area.

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-Specific Analysis of Riparian Vegetation

Analysis of total linear feet (lf) of SRA in the West Sacramento study area was conducted using Google Earth Pro for the levee reaches on the Sacramento River North and South and Port North and South areas (Table 22). The Sacramento Bypass Training levee, Yolo Bypass, and South Cross levee reaches were not evaluated because there is minimal, if any, SRA associated with these reaches. There also could be the potential for habitat removal in the Sacramento Bypass during the widening process but will wait for analysis once future designs are presented.

The Corps would need to remove some SRA habitat in order to place rock along the river bank, but more than half of the existing SRA habitat along the 11 miles of Sacramento River levees would remain in place. A variance would also be sought for these levee reaches, allowing 34 acres of riparian habitat on the lower one-third of the slope to 15 feet waterward of the waterside levee toe to remain in place. As a result, the SRA habitat along the river would continue to grow at a natural rate and would likely increase over time.

Table 22. Summary of Reach-Specific SRA Analysis[1].

REACH	LINEAR FEET (lf) of SRA	REACH	LINEAR FEET (lf) of SRA
Port North Levee	2,468	Sac. River North Levee	27,241
Port South Levee	2,602	Sac. River South Levee	16,047
Total SRA for Study Area: 48,358 lf			

[1] Numbers were obtained using aerial photography and are estimates. Numbers are rounded.

4.2 Southport EIP Baseline

4.2.1 Lower Sacramento River in the Southport EIP Action Area

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.

The Southport EIP Action Area is located in Region 1b of the SRBPP regional planning area, which includes the mainstem Sacramento River from Isleton (RM 20) to the Feather River confluence at Verona. Downstream from the Feather River confluence, the Sacramento River channel is moderately sinuous (average sinuosity of 1.3) and confined on both sides by natural and man-made levees that restrict further channel migration. The channel in this reach is uniform in width and typically narrower and deeper relative to the upstream reach due to scour caused by lateral confinement and the concentration of shear forces on the channel bed (Brice 1977).

The natural banks and adjacent floodplains 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 (NMFS 2008). The present day channels are flanked by fine-grained cohesive banks with erosion due to both mass failures and fluvial erosion (Harvey 2002).

Within this portion of the Sacramento River, bank erosion and lateral migration of the channel is generally limited to a distance of 50 to 100 feet between the levee and river bank. These areas may be occupied by a narrow strip of riparian forest or riparian scrub/shrub. Based on aerial photo-interpretation of 1-foot resolution Digital Globe imagery (2008), many areas between the channel edge and closely set levees support either very little vegetation or a low density cover of weedy herbaceous plants (ruderal species). Bank revetments currently account for two-thirds of the region-wide shorelines based on data obtained from the Corps' revetment database (USFWS 2002; Corps 2006). The bank revetment composition includes medium to large (quarry) rock, rubble, and cobbles. The majority of revetments present at the erosion sites and along the banks without erosion sites is large (>20 inches) rock. The presence of levees and bank revetments and the loss of wide expanses of riparian forest currently limit IWM recruitment, bank erosion, and point bar formation, which in turn limit habitat diversity that would normally result from such natural processes.

Reaches throughout the SRBPP planning 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. Many native fish species are adapted to rear in flooded, shallow water areas that provide abundant cover and prey. As a consequence of habitat alterations, and the introduction of non-native species and pollutants, some native fish species are now extinct while most others are reduced in numbers (Moyle 2002).
Levee repair and bank protection projects conducted recently by the Corps and the California Department of Water Resources (DWR) in the SRBPP planning area have included onsite and offsite elements to compensate for the loss of SRA cover, riparian, and floodplain habitat to address the specific conservation and recovery needs of listed fish and wildlife species. These elements include setback levees, riparian and wetland planting benches, and IWM installation.

The quantification of existing SRA cover nearshore and floodplain habitat conditions in the Southport EIP project area, as measured by the Standard Assessment Methodology (SAM), is described in Appendix C.

4.2.2 Land Cover Types

Sixteen land cover types were identified in the project area. Table 23 includes the mapped acreages for each land cover type. Nine of the land cover types are considered natural communities: all four riparian habitats, emergent marsh, valley oak woodland, walnut woodland, nonnative annual grassland, pond, and perennial drainage. The other cover types are associated with human activities: all three agricultural field types, walnut orchard, agricultural ditch, and developed/landscaped. Because land cover types were not mapped to include the Southport EIP Action Area, acreages of land cover for the entire Action Area are not shown in this table. Each of the land cover types is discussed below.

Table 23. Land Cover Types and Acreage in the Southport EIP Action Area.

Land Cover Type	Acreage
Cottonwood riparian woodland	29.48
Valley oak riparian woodland	5.66
Walnut riparian woodland	2.19
Riparian scrub	13.23
Valley oak woodland	42.06
Walnut woodland	0.71
Emergent wetland	6.28
Nonnative annual grassland	57.15
Cultivated agricultural field	297.53
Disked/plowed agricultural field	144.50
Fallow agricultural field	1,112.82
Walnut orchard	12.03
Perennial drainage (Sacramento River)	63.65
Ditch	21.02
Developed/landscaped	113.56
Total project area	**1,921.87**

Riparian Communities

Riparian communities in general are some of the richest community types in terms of structural and biotic diversity of any plant community found in California. Riparian vegetation provides three important functions in addition to that of wildlife habitat: (1) acts as a travel lane between the river and adjacent uplands, providing an important migratory corridor for wildlife; (2) filters out pollutants, thus protecting water quality; and (3) helps to reduce the severity of floods by stabilizing riverbanks. Despite widespread disturbances resulting from urbanization, agricultural conversion, and grazing, riparian forests remain important wildlife resources because of their scarcity regionally and statewide and because riparian communities are used by a large variety of wildlife species.

Cottonwood Riparian Woodland

Cottonwood riparian woodland occurs on the sides of the Sacramento River levee, primarily on the water side, and also surrounds the Bees Lakes area. It also occurs along some agricultural ditches. The project area contains a total of 29.48 acres of cottonwood riparian woodland. The dominant overstory species are Fremont cottonwood (*Populus fremontii* ssp. *fremontii*), Goodding's black willow (*Salix gooddingii*), valley oak (*Quercus lobata*), and northern California black walnut (*Juglans hindsii*). The shrub layer is relatively open and contains small valley oaks, box elder (*Acer negundo* var. *californicum*), and tree tobacco (*Nicotiana glauca*). Blue elderberry (*Sambucus nigra*) shrubs also occur in several areas of this woodland. Representative species observed in the herbaceous understory are mugwort (*Artemisia douglasiana*), rough cocklebur (*Xanthium strumarium*), and cudweed (*Gnaphalium luteo-album*).

Some of the trees in the cottonwood riparian woodland meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance. Riparian woodland (Great Valley cottonwood riparian) is identified as a sensitive natural community by the CNDDB (CDFG 2003). CDFW has adopted a no-net-loss policy for riparian habitat values, and the USFWS mitigation policy identifies California's riparian habitats in Resource Category 2, for which no net loss of existing habitat value is recommended (46 FR 7644).

Valley Oak Riparian Woodland

Valley oak riparian woodland occurs on the water side of the Sacramento River levee and along larger irrigation ditches in the project area. Approximately 5.66 acres of valley oak riparian woodland are present in the project area. Plant species associated with valley oak riparian woodland include valley oak, sandbar willow (*Salix exigua*), red willow (*Salix laevigata*), poison-oak and Himalayan blackberry.

As described above for the cottonwood riparian woodland, some of the trees in the valley oak riparian woodland meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance, and CDFW and USFWS policies support protection of riparian habitats. Valley oak riparian woodland (Great Valley valley oak riparian) is identified as a sensitive natural community by the CNDDB (CDFG 2003).

Walnut Riparian Woodland

Walnut riparian woodland occurs along an agricultural ditch in the project area. Approximately 2.19 acres of walnut riparian woodland is in the project area. The dominant overstory species are northern California black walnut and valley oak. The understory is dominated by Himalayan blackberry.

As described above for the cottonwood riparian woodland, some of the trees in the valley oak riparian woodland meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance, and CDFW and USFWS policies support protection of riparian habitats. Naturally occurring California walnut woodland is identified as a sensitive natural community by the CNDDB (CDFG 2003), although the walnut riparian woodland in the project area was most likely planted along the parcel border where it occurs.

Riparian Scrub

Riparian scrub occurs intermittently on the water side of the Sacramento River levee and along some ditches in the project area. Approximately 13.23 acres of riparian scrub are in the project area. The dominant overstory species are willows and saplings of riparian trees found in the riparian woodland land cover types, and elderberry shrubs also occur along some ditches. Woody vegetation in this community is lower-growing than that found in the woodland communities. Some areas of riparian scrub occur where rock has been placed on the levee for erosion control.

Most of the trees in the riparian scrub community are too small to meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance. Although riparian scrub is not specifically identified as a sensitive natural community by the CNDDB (CDFG 2003), it may represent an early successional stage of the mature riparian woodland communities. CDFW has adopted a no-net-loss policy for riparian habitat values, and the USFWS mitigation policy identifies California's riparian habitats in Resource Category 2, for which no net loss of existing habitat value is recommended (46 FR 7644).

<u>Nonriparian Woodland Communities</u>

Valley Oak Woodland

Valley oak woodland occurs in stands ranging in size from a few trees to several acres and covers approximately 42.06 acres in the project area. This cover type is distinguished from the oak riparian type by not being associated with a drainage. The dominant overstory species is valley oak, although other tree species are present, including interior live oak (*Quercus wislizeni*) and northern California black walnut. Understory shrub species include Himalayan blackberry and elderberry, and herbaceous grassland species are also present.

Some of the trees in the valley oak woodland meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance. Valley oak woodland is identified as a sensitive natural community by the CNDDB (CDFG 2003).

Walnut Woodland

One approximately 0.71-acre grove of walnut woodland occurs in the project area north of Linden Road near the intersection with South River Road. The trees are northern California black walnut and are not associated with any drainage. Although native stands of northern California black walnut are considered special-status species (California Native Plant Society [CNPS] List 1B.1) and California walnut woodland is identified as a sensitive natural community by the CNDDB (CDFG 2003), the grove of trees in the project area most likely is planted and not a native occurrence. The trees, therefore, would not be considered special-status species. However, some of the trees in the walnut woodland meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance.

Wetland Community

Emergent Wetland

Emergent wetland vegetation occurs in undredged agricultural ditches, in the southernmost borrow area, and in patches along the DWSC in the project area and covers approximately 6.28 acres. The agricultural ditches included in the emergent wetland category support 50% or more cover of wetland vegetation. Ditches that had minimal wetland vegetation at the time of the field survey are discussed below in Open Water Areas. It should be noted that annual maintenance of ditches and the DWSC may cause the location and extent of emergent wetland to vary.

Where present, wetland vegetation along the majority of irrigation ditches in the project area consisted of cattails (*Typha* sp.), bulrush (*Schoenoplectus* sp.), and Himalayan blackberry. These irrigation ditches likely would be considered waters of the United States by the Corps because they are hydrologically connected to the Main Drain, which carries water from the Sacramento River that is pumped back into the DWSC.

Emergent wetlands in the DWSC are vegetated by tule (*Schoenoplectus acutus*), narrow-leaved cattail (*Typha angustifolia*), knotweed (*Persicaria* [*Polygonum*] *hydropiperoides*), and monkeyflower (*Mimulus guttatus*), as well as English plantain (*Plantago lanceolata*) and dallisgrass (*Paspalum dilatatum*). Some emergent wetlands were vegetated almost entirely by tule and narrow-leaved cattail.

Herbaceous Community

Nonnative Annual Grassland

Nonnative annual grassland occurs throughout the project area on levee slopes, along roadsides, and in undeveloped parcels. Two areas of pasture associated with residences are primarily annual grasses that are grazed by horses and were mapped as nonnative annual grassland. Similar vegetation occurs in the fallow agricultural fields, described below, but those areas are larger and are subject to intermittent cultivation. The project area contains 57.15 acres of nonnative annual grassland.

The nonnative annual grassland is dominated by naturalized annual grasses with intermixed perennial and annual forbs. Grasses commonly observed in the project area are foxtail barley (*Hordeum murinum* ssp. *leporinum*), ripgut brome (*Bromus diandrus*), Italian ryegrass (*Lolium multiforum*), and soft chess (*Bromus hordeaceus*). Other grasses observed were wild oats (*Avena* spp.), Bermuda grass (*Cynodon dactylon*), and rattail fescue (*Vulpia myuros* var. *myuros*). Forbs commonly observed in annual grasslands in the project area are yellow star-thistle (*Centaurea solstitialis*), prickly lettuce (*Lactuca serriola*), bristly ox-tongue (*Picris echioides*), sweet fennel (*Foeniculum vulgare*), Italian thistle (*Carduus pycnocephalus*), horseweed (*Conyza canadensis*), black mustard (*Brassica nigra*), fireweed (*Epilobium brachycarpum*), broad-leaf pepper grass (*Lepidium latifolium*), common sunflower (*Helianthus annuus*), pigweed (*Chenopodium* sp.), cheeseweed (*Malva parviflora*), bindweed (*Convolvulus arvensis*), and telegraph weed (*Heterotheca grandiflora*). The annual grasslands in the project area contain a relatively large proportion of ruderal species, likely because of substantial disturbance from human activities. Elderberry shrubs occur in several areas of nonnative annual grassland.

Agricultural Communities

Cultivated Agricultural Field

Cultivated agricultural field includes large parcels of wheat, ryegrass, and row crops that were in active cultivation at the time of the 2011 and 2012 field surveys. These areas could be transitioned to either fallow or disked/plowed conditions at other times. Cultivated agricultural field covers approximately 297.53 acres in the project area.

Disked/Plowed Agricultural Field

Disked or plowed agricultural field includes large parcels that were in active cultivation but were not vegetated at the time of the 2011 field surveys. These areas could be transitioned to either fallow or cultivated conditions at other times. Disked/plowed agricultural field covers approximately 144.50 acres in the project area.

Fallow Agricultural Field

Fallow agricultural fields occur in large parcels throughout the project area where cultivation is inactive but could be reinitiated. Approximately 1,112.82 acres of fallow agricultural field occur in the project area. The dominant species in these fields are essentially the same as those described for nonnative annual grassland, but fallow fields cover larger areas than the noncultivated grasslands in the project area. Elderberry shrubs occur in several areas of fallow agricultural field.

Walnut Orchard

Three areas of walnut orchard occur in the southern half of the project area, comprising approximately 12.03 acres. Two of the orchards are in the River Park area and the third is on the west side of the Yolo Shortline Rail Corridor. Walnut orchards are distinguished from the walnut woodland in several respects—the trees are usually English walnut grafted onto a black walnut rootstock and planted in rows for cultivation and harvesting, and the orchard is generally managed intensively, with understory layers that are often unvegetated and sprayed with herbicides or disked.

Open Water Areas

Perennial Drainage

Perennial drainage occurs in the project area in the Sacramento River. The Sacramento River forms the eastern project area boundary and comprises approximately 63.65 acres in project area. The perennial drainage land cover type is unvegetated, but the river is bordered along much of its length in the project area by riparian woodland or scrub vegetation, as described above. The Sacramento River is a traditional navigable water, considered a water of the United States.

Ditch

Ditches occur throughout the project area and cover approximately 21.02 acres. Ditches in this category include unvegetated agricultural ditches used to irrigate fields and several roadside ditches used to drain runoff. The unvegetated ditches are more highly maintained than the ditches that support emergent wetland vegetation, which are discussed above. Some unvegetated ditches support riparian scrub or riparian woodland habitat along the banks.

The Main Drain in the project area is included as a blue-line feature on the U.S. Geological Survey quadrangle. This ditch averages 90 feet in width. The bank of the ditch is vegetated by an emergent wetland community dominated by cattails (*Typha* sp.), bulrush (*Schoenoplectus* sp.), and Himalayan blackberry, but the majority of the ditch is open water. RD 900 currently controls the flow, which is dependent on water pumped from the Sacramento River and is used for irrigation. At its end, water is pumped from the ditch into the DWSC.

Other irrigation ditches branch off the Main Drain to supply water to individual fields in the project area. These additional ditches are generally narrower (widths of approximately 15 feet and 40 feet) and convey water from the Main Drain to individual fields. Agricultural ditches in the Action Area are considered waters of the United States. Smaller agricultural ditches that are excavated in upland areas and are temporary features generally are not regulated by state or Federal agencies and were not included on the land cover mapping.

Developed/Landscaped

The developed/landscaped cover type was applied to residential parcels that include houses and other structures and where the vegetation is mostly landscaped, horticultural species and to roads and large paved areas, including RD 900's pumping plant on the landside of the DWSC levee. This cover type comprises approximately 113.56 acres and occurs throughout the project area.

Waters of the United States, Including Wetlands

The project area contains waters of the United States consisting of the Sacramento River, emergent wetland, pond, and ditches. A preliminary delineation was conducted and submitted to the Corps to determine their jurisdiction in the project area. A site visit was conducted to verify the Corps jurisdiction. Waters of the United States and any non-jurisdictional wetlands and ditches in the project area also may qualify as waters of the state.

4.3 Affected Species in the West Sacramento and Southport EIP Action Areas

4.3.1 Valley Elderberry Longhorn Beetle

West Sacramento Project

Documented occurrences of VELB are present along the Sacramento River north and south, Sacramento Bypass, Port south, DWSC east and west, and the South Cross levee reaches. Surveys were conducted in 2011-2013 and a shrub count for the West Sacramento project area was estimated from the detailed surveys conducted in the Southport EIP area. The survey area consisted of the construction footprints for the levee and borrow areas; where access was available. The surveys found the greatest numbers of shrubs on the Sacramento River levee and determined that shrubs are present in both basins. All shrubs are considered to be in a riparian zone. Based on surveys conducted, it is estimated that approximately 120 shrubs have the potential to be adversely impacted by the West Sacramento project. Compensation was estimated based on the average number of stems in each stem diameter range for the shrubs that could be surveyed. In addition, an assumption was made that there were exit holes in all. See Table 17 for a summary of stem counts for elderberry shrubs directly affected and proposed compensation.

Southport EIP

There are two CNDDB (2014) records of VELB occurrence in the Southport Action Area. Suitable habitat for VELB is located at numerous places in the Action Area along the levee and borrow construction footprints. A total of 106 shrubs/shrub clusters were identified during the 2011–2013 surveys in the Action Area. Forty-one of these shrubs are in the Action Area (Table 24). Stem counts and examination of shrubs for VELB exit holes could only be conducted for 14 of the 18 shrubs/shrub clusters directly affected in the Action Area because of property inaccessibility and the high density of California grape and Himalayan blackberry along portions of the Sacramento River riparian corridor.

Table 24. Summary of Elderberry Shrubs Potentially Affected by the Southport EIP.

Shrub	Presence of Exit Holes?	Riparian Habitat?	Number of Stems (by Diameter)			Effect on Shrub (Direct or Indirect)
			1-3 Inches	3-5 Inches	>5 Inches	
2	Y	Y	0	1	1	Indirect
3	Y	Y	13	5	5	Indirect
4	N	Y	19	2	2	Indirect
5	N	Y	18	0	1	Indirect
6	N	Y	60	5	9	Direct
7	N	Y	33	10	18	Direct
8	N	Y	8	5	2	Direct
9	N	Y	30	2	8	Direct
10	Y	Y	8	4	2	Direct
23	N	Y	3	3	1	Direct
31 [1]	Y	N	16	4	3	Indirect
32	N	N	3	1	1	Direct
33 [1]	Y	N	16	4	3	Direct
34	Y	N	12	6	10	Direct
37 [2]	N/A	Y	N/A	N/A	N/A	Indirect
38 [2]	N/A	Y	N/A	N/A	N/A	Indirect
39a	N	N	3	0	0	Direct
39b [2]	Y	N	16	4	3	Direct
41a [2]	Y	N	16	4	3	Direct
41b [2]	Y	N	16	4	3	Direct
41c	Y	N	5	7	2	Direct
45	N	Y	1	0	9	Indirect
47	Y	Y	42	8	2	Indirect
49	N	N	0	0	1	Indirect
50	Y	N	16	7	7	Indirect
51	Y	N	14	4	7	Indirect
52	Y	Y	6	1	1	Direct
53	Y	N	29	17	3	Direct
54	N	Y	17	1	0	Indirect
80 [2]	N/A	Y	N/A	N/A	N/A	Indirect
81 [2]	N/A	Y	N/A	N/A	N/A	Indirect
82 [2]	N/A	Y	N/A	N/A	N/A	Indirect
84 [2]	N/A	Y	N/A	N/A	N/A	Indirect
85 [2]	N/A	Y	N/A	N/A	N/A	Indirect
92	N	Y	10	15	8	Indirect
93 [2]	N/A	Y	N/A	N/A	N/A	Indirect
94 [2]	N/A	Y	N/A	N/A	N/A	Indirect
95 [2]	N/A	Y	N/A	N/A	N/A	Indirect
98	N	Y	4	0	0	Direct
100	Y	Y	8	2	0	Direct

N/A = Not Available
[1] Shrubs could not be surveyed because there was no property access
[2] Shrubs could not be surveyed because they were covered in grapevines or poison oak

As described under Conservation Measure 10: Compensate for Direct Effects on Valley Elderberry Longhorn Beetle Habitat, compensation for the removal of shrubs 33, 39b, 41a, and 41b was estimated based on the average number of stems in each stem diameter range for the shrubs that could be surveyed. In addition, an assumption was made that there were exit holes in the four shrubs that could not be surveyed. See Table 18 for a summary of stem counts for elderberry shrubs directly affected in the Action Area and Table 24 for shrubs potentially affected by the proposed action.

4.3.2 Chinook Salmon and Steelhead

Factors such as levee construction and bank armoring have altered habitat for Chinook salmon and steelhead and their critical habitat. These factors reduce floodplain habitat, change river bank substrate size, and decrease the amount of riparian and SRA habitat, which in turn, reduce habitat availability and quality (NMFS 2006a). These changes have affected primarily adult and juvenile migration as well as juvenile rearing.

Bank armoring projects that have been conducted recently by the Corps and DWR, some of which are on-going, have incorporated design elements to offset the loss of habitat that generally results from placement of river bank protection materials. The creation of setback levees, and the restoration of floodplain, riparian, and SRA habitat have been implemented to improve conditions for listed salmon and steelhead in the action area (Corps 2012).

During the intermittent years when the Yolo Bypass is flooded in the winter and spring all four runs of juvenile Chinook salmon and steelhead can potentially use the floodplain and toe drain for rearing and migration.

4.3.3 Green Sturgeon

Channelization of the action area has resulted in the removal of riparian and IWM, which simplify ecosystem functions. Simplification results in reduced food input and pollutant and nutrient processing (NMFS 2006a). These factors have degraded habitat quality for larvae and post-larvae and to a lesser extent, rearing and migrating juvenile and/or adult green sturgeon (NMFS 2006b).

As described for Chinook salmon and steelhead, incorporation of riparian plantings and SRA habitat into recent bank protection projects, and development of setback levees, have been implemented to improve conditions for green sturgeon in the action area (Corps 2012)

4.3.4 Delta Smelt

West Sacramento Project

As discussed for Chinook salmon and steelhead, levee construction has altered waterside bank habitat resulting in the destruction of spawning and refugia areas for delta smelt. Loss of riparian habitat and overall habitat simplification also reduces food input and pollutant and nutrient processing (NMFS 2006b), which may impair individuals. Revetment also fragments areas of high quality shallow water habitat and accelerates water velocity, which affects use of those areas by delta smelt and other native fishes (USFWS 2006b).

Incorporation of riparian plantings and SRA habitat into recent bank protection projects, as well as development of setback levees, has been implemented to improve conditions for delta smelt and their critical habitat in the action area (Corps 2012).

Southport EIP

Delta smelt adults, eggs, and larvae may occur in the Action Area from January through July. Critical habitat for Delta smelt includes the Action Area of the Southport EIP.

4.3.5 Giant Garter Snake

West Sacramento Project

Much, if not all, of the Sacramento River area is unlikely to provide giant garter snake aquatic habitat because it consists of larger rivers and flood control features, often surrounded by riparian vegetation and steep banks. Areas of the Yolo Bypass are currently being farmed as rice. Rice fields and their adjacent irrigation and drainage canals serve an important role as aquatic habitat for giant garter snake as is the case adjacent to and within the Sacramento Bypass, Yolo Bypass, and the South Cross toe drain.

In the South Basin, the Main Drain, some of the irrigation ditches, and emergent marshes also provide suitable aquatic habitat for giant garter snake. The water creating the habitats is from precipitation or the activities of RD 900. Water is pumped into the Main Canal from the Sacramento River and then flows into several adjoining irrigation ditches that are used to irrigate agricultural fields in the project area. The flow of water through these ditches is variable and depends on the need for irrigation water, but some of the canals in the South Basin are wet year round and were considered suitable for giant garter snake.

Upland basking and overwintering habitat is also present in the project area. Upland habitat consists of nonnative annual grasslands and fallow agricultural lands within 200 feet of suitable aquatic habitat. The upland areas adjacent to rice fields and canals associated with grasslands provide basking habitat for the snakes also.

Southport EIP

There are no CNDDB (2014) records for giant garter snakes in the Action Area, although there are 55 occurrences within 10 miles of the Action Area. No giant garter snakes were observed during the field surveys, but this does not eliminate the possibility that they inhabit the site. The Action Area is within the current range of giant garter snake (USFWS 1999b). The closest reported occurrence of giant garter snake is approximately 3 miles west of the Action Area in the Yolo Bypass (CDFW 2013).

In the Action Area, the Main Drain, some of the irrigation ditches, and emergent marshes provide suitable aquatic habitat for giant garter snake. Although Bees Lakes is outside of the Action Area, it creates suitable upland habitat for giant garter snake within the Action Area. The water creating the habitats is from precipitation or the activities of RD 900. Water is pumped into the Main Canal from the Sacramento River and then flows into several adjoining irrigation ditches that are used to irrigate agricultural fields in the Action Area. The flow of water through these ditches is variable and depends on the need for irrigation water. Most of the canals in the Action Area were wet at the time of the spring field surveys due to precipitation. However, most of the active fields in the Action Area are fallowed or planted in wheat, which does not require irrigation; therefore these ditches were not considered suitable for giant garter snake because they are dry during the snake's active season.

Upland basking and overwintering habitat is also present in the Action Area. Upland habitat consists of nonnative annual grasslands and fallow agricultural lands within 200 feet of suitable aquatic habitat. The aquatic habitat provided by Bees Lakes is not within the Action Area; however, suitable upland habitat associated with Bees Lakes is within the Action Area.

4.4 Effects from Changing Environmental Baseline

The environmental baseline for these two projects is further impacted by the potentially concurrent activities associated with the Corps' American River Common Features project and SRBPP. Concurrent construction of these four projects could contribute to adverse effects on the listed species analyzed in this BA. Due to the cumulative nature of these impacts, they are discussed below in Section 5.7.2, Federal Cumulative Effects Analysis.

4.5 Non-Discretionary and Discretionary Actions

NMFS' letter dated 9 September 2014 requested that the Corps clearly describe its scope of discretion over the proposed action and establish areas of non-discretion. The Corps agrees with the principle stated in the letter that ". . . impacts attributable the existence of the levees or to non-discretionary operations are subsumed within the impacts of the environmental baseline rather than the effects attributable to the proposed action."

4.5.1 Non-Discretionary Actions

The Corps has no discretion in regards to the continuing existence and operation of the flood control structures of the SRFCP. The responsibility to maintain Civil Works structures so that they continue to serve their congressionally authorized purposes is inherent in the authority to construct them and is therefore non-discretionary. Only Congressional actions to de-authorize the structures can alter or terminate this responsibility and thereby allow the maintenance of the structures to cease.

The Corps has a non-discretionary duty to maintain the SRFCP and the fact the Corps perpetuates the projects existence is not an action subject to consultation. The Federal government maintains oversight but has no ownership of or direct responsibilities for performing maintenance of the Federal levee system, except for few select features that continue to be owned and operated by the Corps. Considering these exceptions, the great majority of levees, channels, and related flood risk management structures are owned, operated, and maintained by the State of California and local levee and reclamation districts as governed by Corps O&M manuals. The May 1955 Standard O&M manual for the SRFCP is the primary O&M manual for the area. The levees of the West Sacramento and Common Features Projects are part of the SRFCP and therefore covered in the 1955 O&M manual.

4.5.2 Discretionary Actions

Postconstruction Maintenance

Following completion of construction of the West Sac and Common Features Projects, the Corps will prepare a supplement to the 1955 O&M manual which will specify maintenance requirements for these projects. Because the Corps does have discretion in how and when levee maintenance activities are performed (as opposed to the results of maintenance), maintenance is a discretionary activity that is part of the proposed action subject to consultation.

Typical maintenance activities would include vegetation control through mowing, herbicide application, and/or slope dragging; rodent control; patrol road maintenance; and erosion control and repair. Vegetation control typically would be performed twice a year. Herbicide and bait station application would be conducted under county permit by experts licensed by the state for pest control. Erosion control and slope repair activities would include re-sloping and compacting; fill and repair of damage from rodent burrows would be treated similarly. These activities are performed for approximately 20 days annually. Patrol road reconditioning activities would typically be performed once a year and would include placing, spreading, grading, and compacting aggregate base or substrate.

To meet Federal Flood Control Regulations (33 CFR 208.10) and state requirements (California Water Code Section 8370), the Federal Flood Risk Management facilities are inspected four times annually, at intervals not exceeding 90 days. DWR would inspect the system twice a year, and the local maintaining authorities would inspect it twice a year and immediately following major high water events. The findings of these inspections would be reported to the CVFPB's Chief Engineer through DWR's Flood Project Integrity and Inspection Branch (FPIIB).

5.0 Effects of the Proposed Actions

5.1 Valley Elderberry Longhorn Beetle

5.1.1 West Sacramento Project

Effects to VELB may occur if elderberry shrubs are incidentally damaged by construction personnel or equipment. Direct effects include removal or transplantation of VELB habitat for all shrubs within 20 feet of construction activities. Potential impacts due to damage or transplantation include direct mortality of beetles and/or disruption of their lifecycle.

Project actions have the potential to occur within one mile of critical habitat for VELB. Protocol-level surveys were conducted for a number of shrubs in November 2012 and January 2013. Information was recorded for each shrub that could be directly or indirectly affected by the proposed project, including number of stems between 1 and 3 inches, 3 and 5 inches, and greater than 5 inches in diameter; whether each stem 1 inch or more in diameter is located in a riparian or upland area; and presence of VELB exit holes. It was estimated that approximately 120 elderberry shrubs, including those identified in the Southport EIP Action Area, could be adversely affected due to construction activities such as removal of the shrub, heavy equipment vibration, and dust covering the elderberries.

Removal of habitat (elderberry shrubs) and potential injury or mortality of VELB associated with construction of the project would be considered direct effects on VELB. Trimming of elderberry branches that are 1 inch or greater in diameter could also result in injury or mortality of VELB. Because VELB larvae may feed on the roots of elderberries, disturbance of elderberry roots within the shrub dripline could also result in injury or mortality of individuals. Where root damage is expected to be extensive, elderberry shrubs would be removed. Where damage is limited (few roots affected) and roots are expected to grow back, impacts would be considered temporary. Removal of shrubs may also fragment remaining habitats, which may make dispersal more difficult. However, levee repairs may also have beneficial effects by protecting elderberry shrubs from being damaged or washed out due to slope failure.

Long-term effects of the project may include reduced viability of elderberry shrubs due to the placement of project area materials. Temporal loss of habitat may also occur due to transplantation of elderberry shrubs. Although compensation measures include restoration and creation of habitat, mitigation plantings will likely require five or more years to become large enough to provide supporting habitat. Furthermore, associated riparian habitats may take 25 years or longer to reach their full value.

The most likely impacts that may affect but not adversely affect VELB will be on the Sacramento River north and south levee reaches, involving bank erosion protection measures. Additional impacts could occur on the South Cross levee due to compliance with the Corps vegetation requirements. Currently, there are several elderberry shrubs found growing at the South Cross levee that would be adversely affected by fixing this levee in place. Measures to help with these impacts are detailed in Section 2.6.2 above.

5.1.2 Southport EIP

Direct Effects

Construction activities (e.g., excavation, grading, recreation trails) associated with the Proposed Action could result in the loss of VELB and removal or disturbance of a number of elderberry shrubs, the host plant for VELB. Direct effects include removal or transplantation of VELB habitat for all shrubs within 20 feet of construction activities. Up to 18 elderberry shrubs or groupings of shrubs could be directly affected during construction (Table 23).

Property inaccessibility and the high density of vegetation surrounding elderberry shrubs 33, 39b, 41a, and 41b in the Action Area limited the number of elderberry shrubs that could be surveyed to 14 of the 18 shrubs that would be directly affected. For this reason, compensation for the removal of the 4 shrubs that would be directly affected and were not counted was estimated based on the average number of stems in each stem diameter range for the 14 shrubs that could be surveyed (Appendix C). In addition, an assumption was made that there were exit holes in the 4 shrubs that could not be surveyed. Those averages are as follows.

- Number of stems ≥1 inch and ≤3 inches = 16.
- Number of stems >3 inches and <5 inches = 4.
- Number of stems ≥ 5 inches = 3.

Removal of habitat (elderberry) and potential injury or mortality of VELB associated with construction of the Proposed Action would be considered direct effects on VELB. Trimming of elderberry branches that are 1 inch or greater in diameter could also result in injury or mortality of VELB. Because VELB larvae may feed on the roots of elderberries, disturbance of elderberry roots within the shrub dripline could also result in injury or mortality of individuals. Where root damage is expected to be extensive, elderberry shrubs would be removed. Where damage is limited (few roots affected) and roots are expected to grow back, impacts would be considered temporary. Because incidental take of VELB would be difficult to detect or quantify, effects on elderberry shrubs will be used as a proxy for measuring take.

Elderberry shrubs within the construction area that cannot be protected will be removed in accordance with to USFWS-approved procedures outlined in the Conservation Guidelines (USFWS 1999a). Shrubs will be transplanted to the proposed Conservation Area, as described in Conservation Measure 10. Transplanted shrubs will be moved prior to construction when the shrubs are dormant, approximately November through the first 2 weeks in February, after they lose their leaves. Transplanting during the dormant period will reduce shock to the shrub and increase transplantation success. However, transplanted elderberry shrubs may experience stress, a decline in health, or death due to changes in soil, hydrology, microclimate, or associated vegetation.

Elderberry shrubs that can be avoided at the dripline of the shrub or greater distance will be protected with fencing and/or k-rail as described in Conservation Measure 7. Figure 6 (Appendix B) shows the approximate locations of elderberry shrubs.

As described in Conservation Measure 8, surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. The data collected during the surveys prior to transplantation will be used to determine if compensation requirements are being exceeded, or if additional plantings are necessary. Because the Proposed Action would be constructed over several years, elderberry survey data for each year will be used to rectify any discrepancies in compensation for the previous year, and ensure that impacts to VELB have been fully mitigated.

Indirect Effects

Loss of Connectivity to Adjacent Habitat

Loss of connectivity between elderberry shrubs may result when elderberries or associated vegetation is removed. Removal of such vegetation could result in gaps in vegetation that are too wide for VELB to travel across due to their fairly limited movement distances (Talley et al. 2006b), resulting in separation of individuals or reducing the possibility of colonization of adjacent areas. Removal of associated vegetation may result in an altered habitat structure or microclimate that could affect behaviors of VELB in response to these changes in unforeseen ways (USFWS 2003).

Although more research is needed, VELB has been observed to fly a mile or more in contiguous or fairly contiguous habitat, and exit holes have been observed on isolated shrubs that are a minimum of 0.25 mile from the next nearest elderberry (Arnold 2011). Within the American River Basin, evidence suggests that local beetle movements are farther within the riparian corridor (141±144 feet) than in the adjacent non-riparian scrub (82±52 feet) (average±1 standard deviation nearest neighbor distances between recent exit holes) illustrating that VELB population extents may also be habitat-specific (Talley et al. 2006b).

As described above, approximately 18 elderberry shrubs are expected to be removed as part of the Proposed Action, and 23 elderberry shrubs would remain in the Action Area and continue to provide habitat for VELB. Given the distance VELB has been observed to fly, and the amount of elderberry shrubs that will remain in the Action Area, VELB is not expected to be indirectly affected by a loss of connectivity to adjacent habitat.

Soil Disturbance Adjacent to Roots

Ground disturbance within 20 feet of an elderberry shrub's dripline could result in disturbance of roots. Root damage could result in stress or reduced vigor of elderberry shrubs. Because construction of the Proposed Action may result in disturbance within 20 feet of the dripline of elderberry shrubs, indirect effects on these shrubs may result. Elderberry shrubs will be fenced and/or protected with k-rail, as described in Conservation Measure 7, to minimize soil disturbance adjacent to roots. With this measure in place, and because elderberry shrubs are hearty and frequently resprout after damage, this indirect effect is not expected to substantially affect VELB.

Dust

Vehicle travel on roads adjacent to elderberry shrubs during construction of the Proposed Action could result in dust becoming airborne and settling on elderberries. Construction of the Proposed Action would increase the amount of dust in the Action Area as a result of ground-disturbing activities and an increase in the frequency of vehicles driving on roads. The amount of dust in the Action Area would be minimized through dust control measures, as described in Conservation Measure 9. Additionally, according to Talley et al. (2006a) in an experiment along the American River Parkway, conditions of elderberry shrubs related to dust from nearby trails and roads (paved and dirt) did not affect the presence of VELB. Additional work by Talley and Holyoak (2009) found no effect on elderberries from dust accumulations. Because dust has not been found to greatly affect elderberry shrubs and because dust control measures would be implemented during construction, this indirect effect is not expected to substantially affect VELB.

Altered Hydrology

Reduction of water to elderberry shrubs as a result of altered of hydrology from changes in topography or compaction of soil could result in reduced shrub vigor/vitality and an associated decrease in shoot, leaf, and flower production and ultimately reduce the suitability of the shrubs to provide habitat for VELB. In most portions of the Action Area, the levee will be degraded and rebuilt within the same footprint, and would not modify the hydrology of the surrounding area where elderberries may be present. There may be a few instances where the slope is modified or there are other changes that may affect the hydrology in the Action Area. These situations are expected to be rare. Therefore, altered hydrology as a result of the Proposed Action is not expected to substantially affect VELB.

Existing Elderberry Shrubs in the Conservation Area

As described in Conservation Measure 10, elderberry shrubs to be removed will be transplanted to the proposed Conservation Area, which contains existing elderberry shrubs. Although transplantation activities may occur within 100 feet of existing elderberry shrubs, it is unlikely that they would be indirectly affected by transplantation activities, as the transplantations would be conducted by qualified individuals who would be knowledgeable about elderberry shrubs and the existing conditions within the conservation area.

Temporal Loss of Habitat

It generally takes 5 or more years for newly planted elderberry cuttings/seedlings to become large enough to support beetles, and it generally takes 25 years or longer for riparian habitats to reach their full value (USFWS 1999a). Because elderberry shrubs within the Action Area will be transplanted to the proposed Conservation Area, which is immediately adjacent to the Action Area, no temporal loss of habitat for VELB is expected. Additional elderberry plantings in the conservation area will provide additional and/or replacement habitat for VELB in future years.

Effects of Operation and Maintenance Activities

Post-construction the setback levee, adjacent levees, strengthening in place (slope flattening), seepage berms, slurry cutoff walls, riprap bank stabilization, and relief wells would be subject to typical O&M. O&M activities in the project area are conducted per the approved Corps O&M manual applicable to this reach.

Effects on VELB and its habitat include hand and mechanical (mower) removing weeds, spraying of weeds with approved pesticides, minimal tree or shrub trimming all up to four times a year, and reconditioning of levee slope and road with a bull dozer as needed. These effects were determined to have no potential to affect VELB and its habitat as a result of the Proposed Action. Specifically, the following determinations were made.

- There would be no increased use of herbicides and/or pesticides from pre-project conditions as a result of the Proposed Action. Vegetation control would remain the same as existing conditions—typically twice per year. Herbicide use would also be at the same frequency as existing conditions.

The Proposed Action would not result in adverse effects on VELB and its habitat due to an increase in vehicles traveling to the project components to conduct maintenance activities. Inspections are infrequent (flood control facilities four times per year; relief wells once per year, plus inspections after high water events), and travel would be along the existing levee road and paved roads to the levee. Patrol road recondition activities would typically be performed once per year and would include placing, spreading, grading, and compacting aggregate base or substrate.

5.2 Fish Species

5.2.1 West Sacramento Project

The assessment of effects on fish considers the potential occurrence of protected species and life stages relative to the location, magnitude, timing, frequency, and duration of project actions. Species habitat attributes potentially affected by project implementation include spawning habitat area and quality, rearing habitat area and quality, migration habitat conditions, and water quality.

Short-term construction related effects on fish species include effects on individuals (e.g., displacement, disruption of essential behaviors, mortality) and immediate, short-term effects on habitat. These short-term effects are evaluated qualitatively and generally mitigated through the use of construction BMPs and limitations on construction windows.

Long-term effects typically last months or years, and generally involve physical alteration of the bank and riparian vegetation adjacent to the water's edge, with consequent impacts upon SRA cover, nearshore cover, and shallow water habitat (Fris and DeHaven 1993).

Sacramento River Winter-Run Chinook Salmon

Potential project effects from the actions are described below for each life stage and its habitat. Effects on designated critical habitat are addressed via description of habitat effects for each applicable species.

Construction-Related Effects

Adult Migration

Construction activities may affect but are not likely to adversely affect winter-run adults because construction will avoid the primary migration period (December through July), will be restricted to the channel edge, and will include implementation of the avoidance and minimization measures described in Section 2.6.4 and 2.6.5.

Spawning

Winter-run Chinook salmon do not spawn in the West Sacramento GRR area. Therefore, the project will have no effect on winter-run Chinook salmon spawning or spawning habitat.

Juvenile Rearing and Migration

Implementation of the bank erosion protection measures may result in adverse affects to juvenile and smolt winter-run Chinook salmon and their critical habitat. Construction activities that increase noise, turbidity, and suspended sediment may disrupt feeding or temporarily displace fish from preferred habitat. Rearing or outmigrating salmon may not be able to readily move away from nearshore areas that are directly affected by construction activities such as placement of rock revetment; these effects could result in stress, injury, or mortality. Take of juvenile or smolt winter-run Chinook salmon could therefore occur via mortality or injury during construction activity, or by the impairment of essential behaviors such as feeding or escape from predators. Substantial increases in suspended sediment could temporarily bury substrates that support benthic macroinvertebrates, an important food source for juvenile salmonids. However, due to the limited duration and spatial extent of project actions, effects on salmonid feeding are expected to be minimal. In addition, spills or leakage of gasoline, lubricants, or other petroleum products from construction equipment or storage containers could result in physiological impairment or mortality to rearing or outmigrating salmon in the vicinity of the project sites. With implementation of best management practices, the impacts due to spills should be minimal.

Restricting in-water activities to the August 1 through November 30 work window and implementing the avoidance and minimization measures described in Sections 2.4.4 and 2.4.5 will minimize, but may affect and is likely to adversely affect potential construction-related effects on juveniles and smolts.

Long-Term Effects

The West Sacramento GRR area does not support spawning habitat for winter-run Chinook salmon, therefore the projects long-term effects will have no effect to spawning habitat.

Winter-run Chinook salmon are expected to show a long term positive response to project actions in the Sacramento River SAM analysis reach (see Appendix G) over the lifetime of the project. Winter-run Chinook salmon should exhibit a positive response by year 8. Short term habitat deficits are expected within the recommended recovery period for winter-run Chinook salmon. The maximum habitat deficit identified is -1,207 feet for the juvenile migration life stage of Spring-run Chinook salmon in the summer of year 5. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions. For juvenile winter-run Chinook salmon, the bank protection measures will generally provide long-term increases in bank shading at project sites. The plantings of native grasses and willows are designed to benefit juvenile Chinook salmon by increasing the availability (habitat area) and quality (shallow water and instream cover) of nearshore aquatic habitat and SRA relative to current conditions. Figures 21 through 23 below show the long term scenario once bank protection measures are completed. Long term effects may affect but are not likely to adversely affect critical habitat for winter-run Chinook salmon juvenile rearing and migration.

Figure 21. Site 4R on the American River after Bank Protection in 2001.


Figure 22. Site 4R in 2005.


Figure 23. Site 4R in 2010.

Although a SAM analysis for the Yolo Bypass SAM analysis reach was conducted, the results were excluded from the final report. Through discussion with NMFS, it was determined that the unique environmental conditions in the Yolo Bypass SAM analysis reach exceed the applications of the SAM. The Yolo Bypass SAM analysis reach includes portions of the perennial tidal Toe Drain and portions of the Sacramento and Yolo Bypass that are only periodically inundated. During typical summer-fall conditions, SAM focus fish species are generally absent from the Toe Drain (Harrel, 2003). During winter-spring conditions, assuming inundation, the Yolo Bypass provides a large amount of floodplain habitat. Under the "worst case scenario" assumptions, project actions along the Yolo Bypass SAM analysis reach would result in the removal of all trees and vegetation; however, due to the abundance of floodplain habitat during inundation, it is highly unlikely that the loss of these shoreline habitat features would impact the life stages of listed species utilizing the Yolo Bypass during winter-spring conditions, therefore the projects long-term effects will have no effect to fry and juvenile rearing and migration.

<u>Central Valley Spring-Run Chinook Salmon</u>

Potential project effects for spring-run Chinook salmon are described below for each life stage and its habitat, including effects on designated critical habitat.

Construction-Related Effects

<u>Adult Migration</u>

Adult spring-run Chinook salmon migrate up the Sacramento River from March through September although most individuals have entered tributary streams by mid-June and will not be affected by construction activities. Therefore, potential for construction-related effects from the West Sacramento GRR will be similar to that described for winter-run Chinook salmon.

<u>Spawning</u>

Spring-run Chinook salmon do not spawn in the West Sacramento GRR area. Therefore, the project will have no effect on spring-run Chinook salmon spawning or spawning habitat.

<u>Juvenile Rearing and Migration</u>

Similar to winter-run Chinook salmon, spring-run Chinook salmon typically spend up to 1 year rearing in fresh water before migrating to sea. Therefore, potential for construction-related West Sacramento GRR project effects will be similar to that described for winter-run Chinook salmon above.

Restricting in-water activities to the August 1 through November 30 work window and implementing the avoidance and minimization measures described in Sections 2.4.4 and 2.4.5 will minimize, but may affect and is likely to adversely affect potential construction-related effects on juveniles and smolts.

Long-Term Effects

The West Sacramento GRR area does not support spawning habitat for spring-run Chinook salmon, therefore the projects long-term effects will have no effect to spawning habitat.

Spring-run Chinook salmon are expected to show a long term positive response to project actions in the Sacramento River SAM analysis reach (see Appendix G) over the lifetime of the project. Winter-run Chinook salmon should exhibit a positive response by year 8. Short term habitat deficits are expected within the recommended recovery period for spring-run Chinook salmon. The maximum habitat deficit identified is -1,207 feet for the juvenile migration life stage of spring-run Chinook salmon in the summer of year 5. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions. For juvenile spring-run Chinook salmon, the bank protection measures will generally provide long-term increases in bank shading at project sites. The plantings of native grasses and willows are designed to benefit juvenile Chinook salmon by increasing the availability (habitat area) and quality (shallow water and instream cover) of nearshore aquatic habitat and SRA relative to current conditions. Long term effects may affect but are not likely to adversely affect critical habitat for winter-run Chinook salmon juvenile rearing and migration.

Although a SAM analysis for the Yolo Bypass SAM analysis reach was conducted, the results were excluded from the final report. Through discussion with NMFS, it was determined that the unique environmental conditions in the Yolo Bypass SAM analysis reach exceed the applications of the SAM. The Yolo Bypass SAM analysis reach includes portions of the perennial tidal Toe Drain and portions of the Sacramento and Yolo Bypass that are only periodically inundated. During typical summer-fall conditions, SAM focus fish species are generally absent from the Toe Drain (Harrel, 2003). During winter-spring conditions, assuming inundation, the Yolo Bypass provides a large amount of floodplain habitat. Under the "worst case scenario" assumptions, project actions along the Yolo Bypass SAM analysis reach would result in the removal of all trees and vegetation; however, due to the abundance of floodplain habitat during inundation, it is highly unlikely that the loss of these shoreline habitat features would impact the life stages of listed species utilizing the Yolo Bypass during winter-spring conditions therefore the projects long-term effects will have no effect to fry and juvenile rearing and migration.

Central Valley Steelhead

Potential project effects for steelhead are described below for the relevant life stages and their habitat, including effects on designated critical habitat.

Construction-Related Effects

Adult Migration

In the Sacramento River, adult steelhead migrate upstream during most months of the year, beginning in July, peaking in September, and continuing through February or March. Adults use the river channel in the study area as a migration pathway to upstream spawning habitat, and may also use deep pools with instream cover as resting and holding habitat. The potential for construction-related effects on migrating adult steelhead would be similar to that described above for adult winter-run Chinook salmon with the determination being that the construction-related activities may affect but are not likely to adversely affect adult migration.

Spawning

Within theWest Sacramento GRR study area, there is minimal potential spawning habitat. Steelhead spawn in late winter and late spring outside of the August 1 through November 30 construction window; therefore, construction-related effects may affect but are not likely to adversely affect steelhead spawning or their spawning habitat.

Juvenile Rearing and Migration

Central Valley steelhead rear year-round in the cool upstream reaches of the mainstem Sacramento River and its major tributaries. Juveniles and smolts are most likely to be present in the study area during their downstream migration to the ocean, which may begin as early as December and peaks from January to May. The importance of main channel and floodplain habitats in the lower Sacramento River to rearing steelhead is becoming more understood. Steelhead are expected to show a long term positive response to project actions in the Sacramento River SAM analysis reach over the lifetime of the project (Appendix G). Steelhead should exhibit a positive response by year 8. Short term habitat deficits are expected within the recommended recovery period for Steelhead. The maximum habitat deficit identified is -777 feet for the juvenile migration life stage of Steelhead in the fall of year 7. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions.

Steelhead smolts have been found in the Yolo Bypass during the period of winter and spring inundation (Sommer 2002). Sommer et al. (2001) found that Juvenile Chinook salmon that reared within a large, engineered floodplain of the Sacramento River (the Yolo Bypass) had higher rates of growth and survival than fish that reared in the main-stem river channel during their migration. Due to similarities with Chinook salmon in juvenile feeding strategies and habitats utilized, steelhead would also benefit from inundated floodplains of the Yolo Bypass. For purposes of this analysis, rearing juvenile steelhead are assumed to use nearshore and off-channel habitat in the study area. The potential for construction-related effects on steelhead juveniles and smolts and their habitat will therefore be similar to that described for winter-run Chinook salmon with the determination being that the construction activities may affect but are not likely to adversely affect juvenile rearing and migration.

Long-Term Effects

The potential for long-term effects on adult migration habitat will be similar to that described for winter-run Chinook salmon. However, the potential spawning area is very small and it is expected that channel areas immediately adjacent to erosion sites do not support spawning riffles. The potential for long-term effects on steelhead juveniles and smolts and their critical habitat will be similar to that described for winter-run Chinook salmon, long-term effects will have no effect to fry and juvenile rearing and migration.

Delta Smelt

Delta smelt in the Sacramento River have been documented upstream as far as the city of Sacramento (RM 60) (Moyle 2002), and may be present throughout their life cycle. Potential project effects are described below for relevant life stages and their habitats, including effects on designated critical habitat. In determining which areas to designate as critical habitat, USFWS considers those physical and biological features that are essential to a species' conservation (50 CFR 424.12[b]). USFWS is required to list the known primary constituent elements together with a description of any critical habitat that is proposed. Such physical and biological features (i.e., primary constituent elements) include, but are not limited to, the following:

- Space for individual and population growth, and for normal behavior;
- Food, water, air, light, minerals, or other nutritional or physiological requirements;
- Cover or shelter;
- Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and
- Generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

The primary constituent elements essential to the conservation of the delta smelt 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 (NMFS 1994a). These elements are described in further detail below.

- Spawning Habitat. Delta smelt adults seek shallow, fresh or slightly brackish backwater sloughs and edgewaters for spawning. To ensure egg hatching and larval viability, spawning areas also must provide suitable water quality (i.e., low concentrations of pollutants) and substrates for egg attachment (e.g., submerged tree roots and branches and emergent vegetation). Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay. The spawning season varies from year to year and may start as early as December and extend until July (NMFS 1994a).
- Larval and Juvenile Transport. To ensure that delta smelt larvae are transported from the area where they are hatched to shallow, productive rearing or nursery habitat, the

Sacramento and San Joaquin Rivers and their tributary channels should be protected, when possible, from physical disturbance and flow disruption. Adequate river flow is necessary to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay. Additionally, river flow must be adequate to prevent interception of larval transport by the State and Federal water projects and smaller agricultural diversions in the Delta. To ensure that suitable rearing habitat is available in Suisun Bay, the 2 ppt isohaline must be located westward of the Sacramento-San Joaquin River confluence during the period when larvae or juveniles are being transported, according to the historical salinity conditions which vary according to water-year type. Reverse flows that maintain larvae upstream in deep-channel regions of low productivity and expose them to entrainment interfere with these transport requirements. Suitable water quality must be provided so that maturation is not impaired by pollutant concentrations. The specific geographic area important for larval transport is confined to waters contained within the legal boundary of the Delta, Suisun Bay, and Montezuma Slough and its tributaries. The specific season when habitat conditions identified above are important for successful larval transport varies from year to year, depending on when peak spawning occurs and on the water-year type. USFWS identified situations in the biological opinion for the delta smelt (1994) where additional flows might be required in the July-August period to protect delta smelt that were present in the south and central Delta from being entrained in the State and Federal project pumps, and to avoid jeopardy to the species. The long-term biological opinion on State and Federal water project operations will identify situations where additional flows may be required after the February through June period identified by EPA for its water quality standards to protect delta smelt in the south and central Delta (NMFS 1994a).

- Rearing Habitat. Maintenance of the 2 ppt isohaline according to the historical salinity conditions described above and suitable water quality (low concentrations of pollutants) within the Delta is necessary to provide delta smelt larvae and juveniles a shallow, protective, food-rich environment in which to mature to adulthood. This placement of the 2 ppt isohaline also serves to protect larval, juvenile, and adult delta smelt from entrainment in the State and Federal water projects. An area extending eastward from Carquinez Strait, including Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat. Three Mile Slough represents the approximate location of the most upstream extent of tidal excursion when the historical salinity conditions described above are implemented. Protection of rearing habitat conditions may be required from the beginning of February through the summer (NMFS 1994a).

- Adult Migration. Adult delta smelt must be provided unrestricted access to suitable spawning habitat in a period that may extend from December to July. Adequate flow and suitable water quality may need to be maintained to attract migrating adults in the Sacramento and San Joaquin River channels and their associated tributaries, including Cache and Montezuma sloughs and their tributaries. These areas also should be protected from physical disturbance and flow disruption during migratory periods (NMFS 1994a).

Construction-Related Effects

Adult Migration

Adult Delta smelt migrate upstream between December and January and spawn between January and July, with a peak in spawning activity between April and mid-May (Moyle 2002). Potential construction-related effects to physical habitat, water, river flow, and salinity concentrations for migrating adult Delta Smelt will be avoided or minimized by restricting in water construction activities on the Sacramento River to the August 1 through November 30 work window, which would allow for unrestricted access to suitable and important spawning habitat. If there is any change in effect due to construction constraints outside the work window, consultation will be initiated. Construction-related effects may affect but are not likely to adversely affect adult migration.

Spawning

Potential spawning habitat includes shallow channel edge waters in the Delta and Sacramento River. Specific areas that have been identified below the project area as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay. As a result, potential construction-related effects to Delta smelt physical habitat would include disruption of spawning activities, disturbance or mortality of eggs and newly hatched larvae, alteration of spawning and incubation habitat, and loss of shallow water habitat for spawning.

The erosion repair is likely to somewhat reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, from a system sediment prospective, the bank material we are protecting in the project reaches is not a major source of sediment compared to the upstream reaches of the Sacramento, Feather, and especially the Yuba River systems. The majority of the available sediment in the American River watershed is being contained behind Folsom Dam. The site specific designs will be constrained from allowing any velocity increases outside the erosion repair site (Schlunegger 2014).

In response to a USFWS request for more data on July 23, 2014, the Corps conducted an analysis of existing shallow water habitat in the West Sacramento project area, and the effect of the proposed project on that habitat. The results of this analysis are included as Appendix H to this report. The conclusion of the analysis was that approximately 13.35 acres of shallow water habitat would be lost as a result of implementation of the West Sacramento GRR. However, Alternative 5 of the West Sacramento GRR includes the Sacramento River South setback levee, which would create approximately 118 acres of new shallow water habitat during high water events. As a result, the 13.35 acres of impacts are offset by creation of the setback and there would be no significant effects associated with the loss of shallow water delta smelt habitat.

Construction-related effects on delta smelt spawning and incubation will be minimized by restricting in-water construction activities on the Sacramento River, Yolo Bypass, and the DWSC to the August 1 through November 30 work window, thereby avoiding the seasons when spawning is most likely to occur.. Construction activities may affect but are not likely to adversely affect Delta smelt spawning habitat, due to the creation of the Southport setback levee..

Juvenile Rearing and Migration

Juvenile Delta smelt may be subject to disturbance or displacement caused by construction activities that would alter physical habitat, water, and river flow in the form of increased noise, turbidity, and suspended sediment. Delta smelt may not be readily able to move away from channel or nearshore areas that are directly affected by construction activities (i.e., removal or placement of instream woody material, placement of rock revetment). Larvae may be disrupted during summer months as they migrate downstream to rear in the Delta. Incidental take of Delta smelt may occur from direct mortality or injury during a construction activity, or by the impairment of essential behavior patterns (i.e., feeding, escape from predators). Salinity concentrations would not be affected by the construction activities. Construction-related effects on Delta smelt rearing and migration will be minimized by restricting in-water construction activities on the Sacramento River, Yolo Bypass, and the DWSC to the August 1 through November 30 work window, thereby avoiding the seasons when these life stages are most likely to occur therefore construction-related activities may affect and is likely to adversely affect juvenile rearing and migration.

Long-Term Effects

Non-native species may exploit the warmer water temperature in the shallow bench habitat created as an on-site mitigation feature and prey on Delta smelt eggs and larvae; however, bench habitat would most likely not bring in more predatory fish that don't already exist in the project area. A 2013 draft report on the long-term aquatic monitoring program by FishBio for the SRBPP noted that Black bass (largemouth and smallmouth bass) have the highest probability of habitat occupancy at both sites with bench features and sites with no bench features. Unlike previous years, when highest bass abundance was typically associated with wetland trench designs (not included in the suite of monitored sites in 2013), the highest likelihood of encountering black bass was observed at no bench and bench sites, in particular those near river mile 70, well above the West Sacramento project area (Corps 2013b). Proposed planting of emergent vegetation will enhance habitat complexity by providing cover and incubation habitat, especially during high winter and spring flows.

<u>Green Sturgeon</u>

Potential project effects are described below for each life stage of green sturgeon and its habitat. An accurate assessment of potential project effects on green sturgeon and its habitat is difficult due to the limited information available on distribution, seasonal abundance, habitat preferences, and other life history requirements of this species.

Construction-Related Effects

<u>Adult Migration</u>

Adult green sturgeon are believed to move upstream through the West Sacramento GRR study area from February through late July (NMFS 2005c). Construction activities occurring outside of these time periods are not likely to affect migrating green sturgeon adults. Construction activities during July, however, may have adverse impacts on any adult green sturgeon that are still migrating upstream. Because construction activities will largely avoid the peak migration period, will be restricted to the channel edge, and will implement the avoidance and minimization measures described in Sections 2.6.4 and 2.6.5, construction-related activities may affect but are not likely to adversely affect adult migration.

<u>Spawning</u>

Spawning migrations of green sturgeon typically occur during the months of March through June (Thomas et al. 2013). The Sacramento River downstream of Knights Landing (RM 90) is not believed to have suitable spawning habitat for green sturgeon, primarily due to lack of suitable coarse bottom substrate such as large cobbles (Corps 2012). Therefore, the West Sacramento GRR project will have no affect on spawning green sturgeon or their habitat.

<u>Juvenile Rearing and Migration</u>

Based on general knowledge of green sturgeon life history, larvae may occur in the Sacramento River and Delta shortly after spawning, from February through late July (peak spawning from April through June) (Emmett et al. 1991 as cited in Moyle 2002). Restricting in-water construction activities to the August 1 through November 30 work window and implementing the avoidance and minimization measures described in Sections 2.6.4 and 2.6.5 will minimize potential impacts of in-water construction activities on green sturgeon larvae. However, if larvae or juveniles are present during construction, in-water activities could result in localized displacement and possible injury or mortality to individuals that do not readily move away from the channel or nearshore areas. Project actions associated with bank protection measures may increase sediment, silt, and pollutants, which may affect and is likely to adversely affect rearing habitat or reduce food production, such as aquatic invertebrates, for larval and juvenile green sturgeon.

Long-Term Effects

Project actions in the Sacramento River SAM analysis reach will mimic SRBPP repair site onsite mitigative features (Appendix G). SRBPP onsite mitigative features were designed to maximize habitat response for salmonid species; Green sturgeon will exhibit a negative response to these onsite mitigative features. Green sturgeon are expected to show long term negative response to project actions in the Sacramento River SAM analysis reach for several life stages at all seasonal habitat conditions over the lifetime of the project.

Impacts to Green sturgeon were analyzed for the Sacramento River SAM analysis reach only. Although the SAM analysis indicates long term habitat deficits, USACE does not expect significant impacts to the Green sturgeon. The SAM indicated a maximum deficit of -5,516 ft for the adult residence life stage in response to the creation of a shallow slope at winter/spring habitat conditions. This value is based on the maximum deficit observed for adult residence life stage of Green sturgeon at the winter of year 50. The SAM also indicated a maximum deficit of -2,139 ft for the spawning & egg incubation life stage in response to installation of fine substrate (natural) at winter/spring habitat conditions and to the installation of course substrate (10 inch rock revetment) at summer/fall habitat conditions. This value is based on the maximum deficit observed for larval & egg incubation life stage of Green sturgeon at summer conditions of year 50. A maximum deficit of -1,004 ft is expected for the larval, fry, & juvenile rearing and juvenile migration life stages in response to installation of fine substrate (natural) at winter/spring habitat conditions and to the installation of course substrate (10 inch rock revetment) at summer/fall habitat conditions as well as a loss of shoreline at the Stone Locks. This value is based on the maximum deficit observed for fry & juvenile rearing life stage of Green sturgeon at winter/spring conditions of year 3.

The habitat requirements of Green sturgeon are not well understood; assumptions built into the SAM on fish response to shoreline features were based on limited information. Habitat use of the West Sacramento project reach by Green sturgeon is likely limited to use as a migration corridor by adults and potential rearing area by juvenile life stages. Although the SAM indicates negative response to habitat by adult life stages, it is unlikely that shoreline repair activities would significantly impact the river for residence or as a migration corridor. SRBPP style repairs are designed to mimic naturally occurring habitat types and are not expected to significantly alter the width of the river. USACE does not expect any significant impacts to the adult residence or adult migration life stages and does not propose any additional mitigation.

Although the SAM indicates negative response to habitat by the spawning & egg incubation life stage, no suitable spawning habitat exists in the West Sacramento project reach. Green sturgeon spawning primarily takes place upriver of Colusa on the Sacramento River and in the lower Feather River. Because no suitable spawning habitat is present in the project reach under existing conditions, USACE does not expect any significant impacts to the spawning & egg incubation life stage of Green sturgeon and does not propose any additional mitigation.

Little is known about the fry & juvenile rearing and juvenile migration life stages of Green sturgeon. The SAM does not evaluate response to specific habitat attributes for the juvenile migration life stage. For the purpose of this analysis it is assumed that these life stages exhibit similar responses to analogous life stages of Chinook and Steelhead. This approach assumes that fry & juvenile rearing and juvenile migration life stages of Green sturgeon will exhibit a positive response to “good riparian habitat” (i.e. increased shoreline coverage of overhanging shade, aquatic vegetation, and IWM). Although the SAM indicates that that fry & juvenile rearing and juvenile migration life stages will exhibit a negative response to with-project conditions, short term deficits are expected to be offset by mitigation for Chinook and Steelhead. Long term deficits are expected to be lower than, and therefore offset by, long term habitat benefits expected for Chinook and Steelhead. USACE does not propose any additional mitigation.

5.2.2 Southport EIP

<u>Salmon, Steelhead, and Sturgeon</u>

The following assessment addresses potential direct and indirect effects of the Proposed Action on endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, threatened California Central Valley steelhead, threatened Southern DPS of North American green sturgeon, and their designated critical habitat. Potential project effects on listed species and critical habitat include both short-term and long-term effects. Short-term effects include temporary construction-related impacts on fish and aquatic habitat that may last from a few hours to days (e.g., suspended sediment and turbidity). Long-term effects typically last months or years, and are generally due to physical alteration of important habitat attributes of the channel, shoreline, and adjacent bank or floodplain. Short-term effects on listed fish species are evaluated qualitatively based on general knowledge of the impact mechanisms and species responses to construction actions. Long-term effects are measured in terms of the linear feet and area of riparian, SRA cover, and floodplain habitat affected by the Proposed Action and based on the responses of listed species to changes in habitat quantity and quality as measured by the SAM (Corps 2004).

Short-Term Effects

In-water construction activities, including the placement of rock slope protection, could result in localized, temporary disturbance of habitat that may alter natural behavior patterns of adult and juvenile fish and cause injury and death of individuals. These effects may include displacement, impaired feeding, and temporary disruption of migration and other essential behaviors. The extent of construction-related effects depends on the timing of these activities, the timing of fish presence in the Southport EIP Action Area, and the ability of the fish to successfully avoid the disturbance. Construction work on the waterside slope and shoreline, including in-water construction activities, are scheduled for July 1 through October 31 and, therefore, should avoid the primary migration periods of adult and juvenile winter-run Chinook salmon and spring-run Chinook salmon (November through June).

Steelhead adults occur in the Southport EIP Action Area primarily from September through March, while juveniles occur primarily from January through March. Adult green sturgeon are most likely to be present in the Southport EIP Action Area during the spring but may be present from March through September. Green sturgeon larvae and post-larvae may be present in the Southport EIP Action Area between June and October, and juveniles may be present year-round. Construction-related impacts are expected to occur seasonally over a four-year period, between Year 2 and Year 5 of construction.

Potential Effects of Noise, Turbidity, and Suspended Sediment

Construction noise resulting from operation of the barge and placement of rock below the water surface would cause physical disturbance of the bed and water column of the river that could displace juvenile and adult fish into adjacent habitats and possibly cause direct physical injury or death from falling rock. The resulting noise, turbidity, and suspended sediment may disorient and result in temporary displacement of fish from preferred habitats or alter normal feeding, sheltering, and migration behavior.

The effects of increased turbidity and suspended sediment on salmonids have been well studied. Depending on the level of exposure, suspended sediment can cause lethal, sublethal, and behavioral effects in fish (Newcombe and Jensen 1996). For salmonids, elevated suspended sediment has been linked to a number of behavioral and physiological responses indicative of stress (gill flaring, coughing, avoidance, and increase in blood sugar levels) (Bisson and Bilby 1982; Sigler et al. 1984; Berg and Northcote 1985; Servizi and Martens 1992). Migrating adults have been reported to avoid high silt loads or cease migration when avoidance is not possible (Cordone and Kelley 1961, as cited by Bjornn and Reiser 1991). Bell (1986) cited a study in which adult salmon did not move in streams where the sediment concentration exceeded 4,000 mg/L (as a result of a landslide). Juveniles tend to avoid streams that are chronically turbid (Bisson and Bilby 1982; Lloyd et al. 1987) or move laterally or downstream to avoid turbidity plumes (Sigler et al. 1984; Lloyd et. al. 1987; Servizi and Martens 1992). Juvenile coho salmon have been reported to avoid turbidities exceeding 70 NTU (Bisson and Bilby 1982) and cease territorial behavior when exposed to a pulse of turbidity of 60 NTU (Berg 1982). Such behavior could result in displacement of juveniles from preferred habitat or protective cover, which may reduce growth and survival by affecting foraging success or increasing their susceptibility to predation.

Laboratory studies have demonstrated that chronic or prolonged exposure to high turbidity and suspended sediment levels can lead to reduced growth rates. For example, Sigler et al. (1984) found that juvenile coho salmon and steelhead trout exhibited reduced growth rates and higher emigration rates in turbid water (25–50 NTU) compared to clear water. Reduced growth rates generally have been attributed to an inability of fish to effectively feed in turbid water (Waters 1995). Green sturgeon may be affected in similar ways although NMFS (2008) stated that short-term increases in suspended sediments or turbidity were unlikely to affect the foraging success of green sturgeon because this species uses olfactory cues as opposed to vision to locate prey. Chronic exposure to high turbidity and suspended sediment also may affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995).

NMFS (2008) reviewed observations of turbidity plumes during similar construction activities in the Sacramento River and concluded that visible plumes are expected to be limited to only a portion of the channel width, extend no more than 1,000 feet downstream, and dissipate within hours of cessation of in-water activities. In addition, in-water construction activities would be limited to daylight hours only. Based on these observations, NMFS expects turbidity levels to exceed 25–75 NTUs and potentially result in disruption of normal feeding and sheltering behavior (NMFS 2008). However, excessive turbidity levels will be avoided with adherence to the RWQCB Basin Plan turbidity objectives. Consequently, the effects of exposure of individual fish to turbid water generated by construction activities would likely be limited to avoidance, brief disruptions of normal activities, and potentially higher risk of predation.

Based on the extent, frequency, and duration of proposed in-water construction activities, potential adverse effects include direct injury from falling rock, temporary disruption of normal behavior, and increased risk of predation. The timing of construction activities is expected to minimize exposure of the most vulnerable life stages of Chinook salmon and steelhead juveniles (i.e., fry). Green sturgeon adults, larvae, and juveniles are more likely to be exposed to short-term disturbances, but their presence along the shoreline is expected to be uncommon based on their benthic nature. With adherence to the proposed in-water construction window, Central Valley RWQCB turbidity objectives, and erosion and sediment control BMPs (SWPPP), potential adverse effects of noise, turbidity, and suspended sediment would be limited to temporary displacement and potential injury or death of small numbers of fish within the affected shoreline areas.

Fish Entrapment in Cofferdams

Cofferdams may be required to install temporary culverts needed to maintain connectivity between the river and restored floodplain prior to construction of the final levee breaches. The potential exists for entrapment and mortality of fish following closure and dewatering of the cofferdam. As discussed above, the timing of cofferdam installation and other in-water activities (July 1 through October 31) will avoid the primary period of occurrence of winter-run and spring-run Chinook salmon fry, which are considered the most vulnerable species and life stage that may occur in the Southport EIP Action Area. Other species and life stages that may be present at the time of in-water construction are unlikely to be injured or killed because of their larger size, greater mobility, or preference for deeper, offshore areas. The potential for entrapment of fish will be further reduced by limiting the extent of the cofferdam footprint to the shallow edge of the river. Therefore, potential entrapment of listed fish species is unlikely to occur.

Potential Discharge of Contaminants

Contaminants used at construction sites, including gasoline, diesel fuel, lubricants, and hydraulic fluid could enter the Sacramento River as result of spills or leakage from machinery or storage containers and injure or kill listed salmon, steelhead, and sturgeon. These substances can kill aquatic organisms through exposure to lethal concentrations or exposure to non-lethal levels that cause physiological stress and increased susceptibility to other sources of mortality such as predation. Petroleum products also tend to form oily films on the water surface that can reduce DO levels available to aquatic organisms. There is also a slight risk of the release of bentonite into the Sacramento River during jet grouting or deep soil mixing used to construct slurry cut off walls. Bentonite is a naturally occurring, inert, nontoxic material that meets National Sanitation Foundation/American National Standards Institute Drinking Water Additives Standards 60 and 61. Therefore, any inadvertent release of drilling fluid containing only water and bentonite would not have toxicity effects on ESA-listed fish. However, bentonite released into streams could result in turbidity, and cause many of the same behavioral, physiological, and physical effects described above for turbidity and suspended sediment.

Implementation of a spill prevention, control, and countermeasure plan and bentonite slurry spill contingency plan as part of the environmental commitments of the project is anticipated to minimize the potential for toxic or hazardous spills or discharges into the Sacramento River. Adherence to all preventative, contingency, and reporting measures in the approved plans would reduce the risk of injury or mortality of listed fish species to negligible levels, and would avoid potential contamination of listed fish species prey.

Long-Term Effects

The Southport EIP is expected to result in long-term effects on riparian, SRA cover, and floodplain habitat, including modification of the designated critical habitat of winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon. Long-term effects on listed species and critical habitat may also occur as a result of local changes in hydraulic, geomorphic, and sediment transport conditions in the Sacramento River upstream and downstream of the Southport EIP project area. These modifications may affect behavior, growth, and survival of individuals and the primary constituent elements of critical habitat, including freshwater rearing sites, foraging areas, and migration corridors. The general effects of the Southport EIP on riparian, SRA cover, and floodplain habitat are described below, followed by a summary of long-term changes in habitat values and species responses based on the results of the SAM. This is followed by a general assessment of long-term effects on listed species and critical habitat related to potential fish stranding on the restored floodplain and predicted changes in local hydraulic, geomorphic, and sediment transport conditions in the main channel of the Sacramento River.

<u>SRA Cover and Riparian Habitat</u>

The loss of riparian vegetation and woody material and the replacement of natural substrate with rock revetment (riprap) generally reduces the quality of nearshore habitat for juvenile salmonids and other fishes by reducing habitat diversity and altering several important attributes of natural shorelines. These attributes, which characterize SRA cover, include natural substrates, riparian vegetation, woody material, and variable water depths and velocities, including shallow, low-velocity areas used by juveniles as refuge from fast currents and predators. Simple riprapped banks generally create more uniform physical and hydraulic conditions characterized by deeper, faster water, and lack of cover. These conditions reduce utilization by juvenile fishes and also inhibit the establishment of shoreline vegetation and retention of sediment, organic material, and large woody material, which provide important sources of cover and food for juvenile fishes and other aquatic organisms. In addition to cover and shelter for fish, riparian vegetation provides other important stream ecosystem functions, including channel and streambank stability; inputs of food (e.g., terrestrial insects), organic matter, and nutrients; and temperature-moderating shade (Murphy and Meehan 1991).

The Southport EIP would affect approximately 7,419 linear feet of the existing Sacramento River levee as a result of levee degradation and installation of rock slope and biotechnical bank protection at the proposed erosion repair and levee breach sites. The total area of bank within the construction limits between the submerged toe of the bank (-10 to -45 feet NAVD88) and the ordinary high water mark (OHWM) (+20 feet NAVD88) is approximately 10 acres. Where the remnant levee is breached, all existing SRA cover and riparian vegetation on the levee slope would be lost due to degradation of the levee and the addition of biotechnical and rock slope protection needed to create and protect the breaches. Within the erosion sites, the removal of SRA cover and riparian vegetation would be limited to the lower portion of the bank below elevation +12 feet NAVD 88.

Vegetation mapping of the project site in April–May 2011 indicates that the proposed erosion repairs, rock slope protection, and levee breaches for the Southport EIP would affect 5.44 acres of cottonwood riparian woodland and 1.46 acres of riparian scrub. The impacts to critical habitat include the loss of 2.01 acres of cottonwood riparian woodland and 0.51 acre of riparian scrub below the OHWM on the waterside slope of the existing levee, and the loss of 2,790 linear feet of moderate- to high-quality SRA cover (Figure 24). It is assumed that the portions of the existing levee outside the affected levee sites (totaling approximately 24,198 feet), including all existing SRA cover and riparian habitat, would remain intact and no longer be subject to levee maintenance activities. In addition, portions of the remnant levee that are currently devoid of vegetation or sparsely vegetated would be planted with woody riparian species to enhance SRA cover and riparian habitat values and meet any remaining onsite compensation requirements. Habitat removal below the OHWM on the waterside slope of the existing levee would begin in Year 2 with construction of the erosion repair sites, followed by construction of breaches N1 and S3 in Year 3, and construction of breaches N2, S1, and S2 in Year 5.

Onsite compensation and enhancement of SRA cover and riparian habitat will be achieved through the planting of native riparian species on the floodplain offset areas, levee breaches, remnant levees, and erosion repair sites. A detailed description of the SRA cover and riparian habitat compensation and enhancement objectives is being developed as part of the draft MMP for the Southport EIP (see Conservation Measure 6).

Erosion Repair Sites. Erosion repair and bank stabilization would be conducted in the second year of construction at three sites (C1, C2, and G3, comprising approximately 1,013 linear feet of bank) to treat several over-steepened or eroding levee areas in Segment C, D, and G (Appendix B, Figures 2 and 3a–3c). To minimize long-term impacts on SRA cover and riparian habitat, these sites have been designed to retain existing vegetation and woody material to the extent possible and promote onsite replacement of SRA cover and riparian vegetation. This would be accomplished by retaining existing woody vegetation (Sites C1 and C2) or planting woody vegetation (Site G3) above elevation 12 feet NAVD88, incorporating a 10:1 bench and soil fill within the average annual low and high water inundation zone of the river (between 7 to 12 feet NAVD88) to provide a surface for planting riparian vegetation, anchoring woody material, and creating shallow water habitat (Appendix B, Figures 3a–3c. The low benches will provide shallow water habitat for fish during typical winter and spring flows and woody instream and overhanging cover that will increase in extent over time as the planted vegetation becomes established. To address reductions in SRA cover values associated with the placement of rock and loss of shade along the summer/fall shoreline, onsite and imported IWM will be anchored between elevations 4 and 6 feet to achieve a minimum of 40% cover (approximately 400 linear feet) within the average summer/fall inundation zone. The proposed design is similar to other erosion control designs that have been employed on the lower Sacramento and American Rivers to minimize impacts on existing habitat values and restore some of the key attributes and functions of natural SRA cover and riparian habitat that would otherwise be lost as a result of standard revetment practices or continued erosion. In addition to increasing the amount of structural cover available to fish along the shoreline, the installation of IWM is also expected to promote sediment deposition on the rock bench as observed at locations where similar designs have been used to address the compensation needs of listed fish species (e.g., Sand Cove, RM 62.2).

Levee Breaches. Approximately 6,406 linear feet of the existing levee would be degraded to create the five levee breaches and associated shoulder rock (Figure 15), resulting in permanent losses of existing SRA cover and riparian vegetation on the affected banks. Based on the current design, individual breaches range in width (bank length) from approximately 645 to 1,345 feet, while the adjacent rock shoulders range from 90 to 228 feet long. Two of the breaches (N1 and S3) would be constructed in Year 3, and the remaining three breaches (N2, S1, and S2) would be constructed in Year 5. During Year 3 of construction, the existing levee within each of the proposed footprints of the deferred breaches (N2, S1, and S2) would be degraded (approximately 200 linear feet) to install one to two temporary culverts. The culverts will extend through the existing levee (bottom elevation of +7 feet) to maintain connectivity between the river and restored floodplain during the interim period.

A combination of rock slope protection and biotechnical methods would be used to control erosion and maximize the amount of vegetated surfaces within the levee breaches. The riverbank and apron zones will be planted with emergent marsh and woody riparian species (extending along the Sacramento River and laterally into the swales and restored floodplain) to restore SRA and riparian habitat to the extent possible. However, species selection within the riverbank and apron zones may be limited to those suitable for coppicing, which may be necessary to maintain uniform hydraulic conditions and minimize the risk of scour within the levee breaches (Figure 6). Existing rock slope protection within the riverbank zone between elevations +7 and +10 feet would be retained. In areas that lack revetment or where the revetment is found to be in poor condition (coverage), vegetated coir fabric will be installed between elevations +7 and +10 feet. No vegetation or other habitat features will be incorporated into the rock shoulders.

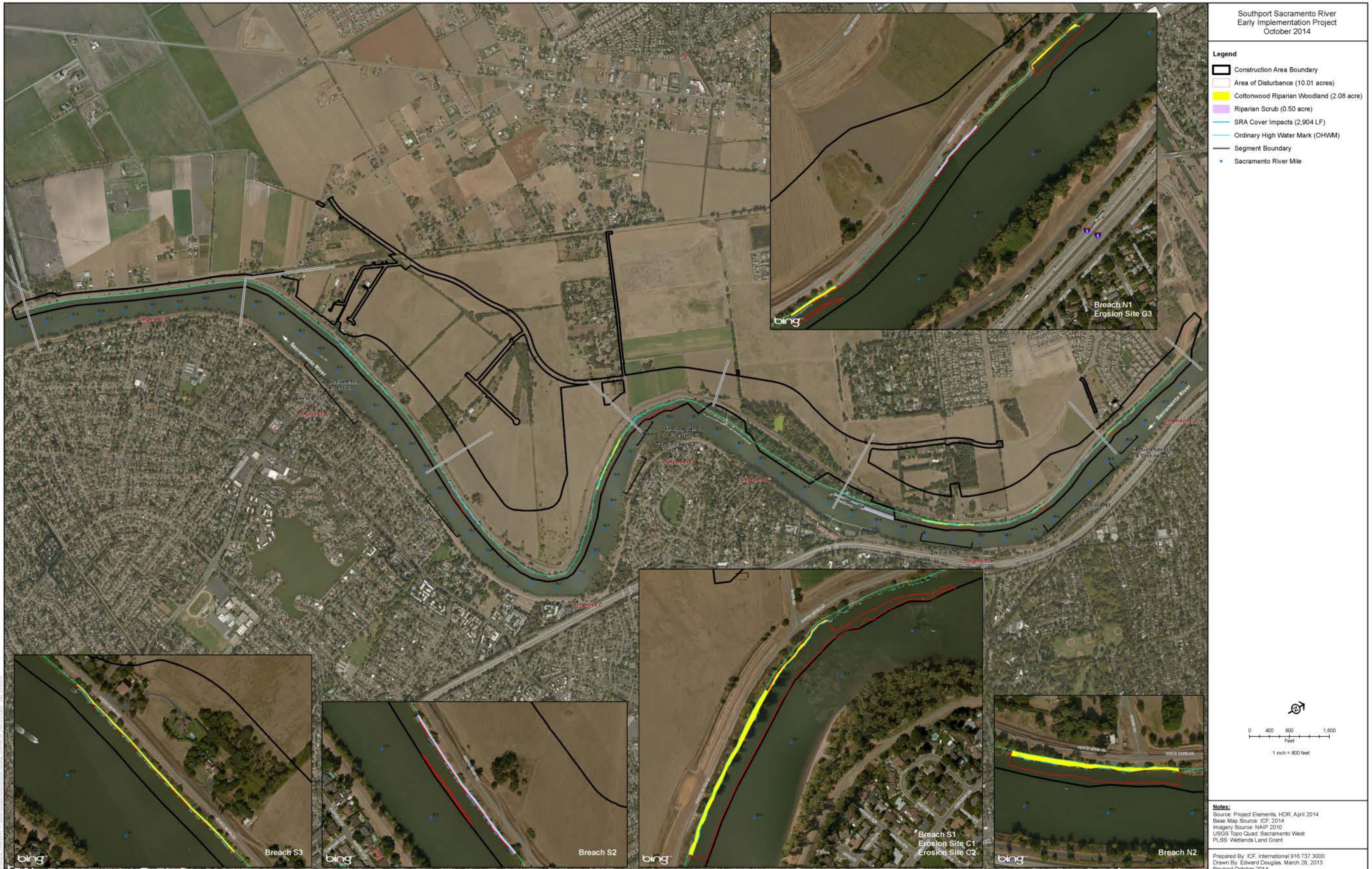

Figure 24. Southport EIP Critical Habitat Impacts.

Floodplain Habitat

The levee setback component of the project would result in the restoration of approximately 120 acres of historical Sacramento River floodplain with a diverse mosaic of seasonal floodplain, wetland, riparian, and upland habitat. The goals of the offset area restoration design are to increase river-floodplain connectivity, restore ecologically functional floodplain habitat, and meet the flood risk–reduction objectives of the project.

Restoring floodplain habitat and connectivity of large rivers to their floodplains have been identified as important objectives of ecosystem restoration and species recovery efforts for listed and other special-status fish species in the Central Valley (NMFS 2009). Floodplains are recognized as major contributors to aquatic production and species diversity in large river systems where native fish species have evolved specific adaptations to exploit these variable but highly productive habitats (Welcomme 1979; Junk et al. 1989; Gutreuter et al. 1999). Historically, the Sacramento River Valley contained extensive areas of seasonal floodplains and wetlands that flooded nearly every winter and spring. These habitats supported significant production of native fish species and contributed substantially to overall biological productivity of the river and estuary (Ahearn et al. 2006). As demonstrated in the Yolo Bypass, floodplain habitat can greatly expand the quantity and quality of habitat available to juvenile salmon and other native fishes during seasonal inundation periods (Sommer et al. 2001, 2005). After young salmon have dispersed from spawning areas, the distribution and abundance of young salmon is determined largely by their preferences for shallow water and low water velocities, which in large rivers are found mostly along channel margins, floodplains, and other off-channel habitats (Beechie et al. 2005; Lestelle et al. 2005).

Floodplain restoration through the creation of setback levees is considered a key conservation action for addressing historical and ongoing impacts of levee construction and maintenance activities on listed fish species and their habitats, especially in the highly constrained portions of the lower Sacramento River. It is generally assumed that the number or biomass of fish that can be supported by aquatic ecosystems is directly proportional to the area of suitable habitat. In addition to increased living space, floodplains may further enhance the growth and survival of young fish by increasing the production and availability of food, increasing growth capacity (i.e., food conversion efficiency), reducing competition for food, and reducing potential encounters with predators. Floodplains also enhance the productivity of river-floodplain systems by increasing hydraulic residence time, water temperature, and inputs of organic matter, plankton, and macro-invertebrates from the floodplain into river channels (Ahearn et al. 2006).

The levee setback design was developed through a collaborative process among project engineers, biologists, and restoration ecologists to achieve the flood-risk reduction and habitat restoration objectives of the project. A principle step in this process has been the linkage of key hydrologic and hydraulic parameters (inundation timing, frequency, duration, depth, velocity) with habitat suitability criteria of the target species through the application of the the Corps' Ecosystem Functions Model and 2D hydrodynamic modeling (MIKE 21C) (cbec, inc. and ICF International 2013).

Native Sacramento splittail and Chinook salmon (including winter-, spring-, and fall-run Chinook salmon) were selected as the target species for the offset area design. These species were selected because they are considered key indicator species of functional floodplain habitat in the Central Valley. A flood frequency analysis was performed using the long-term flow record from the Freeport gauge to evaluate the recurrence probability of flows and water surface elevations that correlate with the occurrence of suitable habitat for the target species. The ecological criteria for each of the target species and corresponding flows, recurrence intervals, and water surface elevations are summarized in Appendix B. In general, the offset areas have been designed to flood every 1–2 years for at least 2–3 weeks during December through May based on the minimum floodplain inundation requirements for successful spawning, incubation, and larval development of Sacramento splittail, and rearing and enhanced growth of juvenile Chinook salmon.

The levee offset areas were also designed to achieve the desired flooding regime (depth, duration, and extent of flooding), drainage patterns, and soil conditions to support riparian, wetland, and upland vegetation on the restored floodplain. Based on current design, much of the offset areas will be excavated down to an elevation of approximately 10 feet NAVD88 to achieve frequent inundation of the new floodplain and expand the amount of riparian habitat, SRA cover, and floodplain habitat available to fish over a broad range of flows. The floodplain design includes one or more interconnected swales or low-flow channels that would form the primary aquatic and riparian corridors connecting the river and floodplain (Appendix B, Figure 7). These channels are designed to maintain suitable soil moisture conditions for wetland and riparian vegetation, facilitate river-floodplain connectivity and drainage of the floodplain over a broad range of flows, and minimize the extent of suitable habitat (isolated ponds) for bass and other undesirable fish species that spawn and rear during the drier late spring and summer months. In addition, topographic heterogeneity has been incorporated into the project design grading plans to create a mosaic of wetland, riparian, and upland habitats supporting emergent wetland, willow-scrub, cottonwood forest, oak woodland plantings and native grasses. A draft MMP for the offset areas is being developed on behalf of WSAFCA and will be approved by NMFS, USFWS, and CDFW before implementation of the project. The MMP will include a detailed discussion of the design process; an updated review of the hydrologic, hydraulic, geomorphic, and ecological modeling results; representative plans and cross sections of the Southport EIP elements; fish stranding and vegetation monitoring methods; habitat compensation and restoration success criteria; and a protocol for implementing remedial actions should any success criteria not be met. Monitoring will be conducted over a period of 10 years. Annual monitoring reports that describe each year's monitoring activities and progress toward the success criteria will be submitted to the resource agencies during the course of the monitoring period. Monitoring will be conducted until the projected benefits of the compensation and restoration actions have been substantially achieved.

SAM Assessment. The SAM was developed by the Corps and Stillwater Sciences, in consultation with NMFS, USFWS, CDFW, and DWR, to address specific habitat assessment and regulatory needs for ongoing and future bank protection actions in the Sacramento River Bank Protection Project (SRBPP) Action Area. The SAM was designed to systematically evaluate the impacts and compensation requirements of bank protection and levee improvement projects on Chinook salmon, steelhead, green sturgeon, and delta smelt, and their critical habitat. The SAM has been used previously in both programmatic (Corps 2007a) and project-level (e.g., Jones & Stokes 2007) bank protection effect analyses.

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 response index 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. For example, the difference in WRIs between with- and without-project conditions in a given year provides a measure of the impacts (negative species response) or benefits (positive species response) of the project relative to baseline conditions. More detail on the SAM is provided by the Corps (2004, 2007a).

The SAM employs six habitat attributes to characterize nearshore, SRA cover, and floodplain habitats of listed fish species.

- *Bank slope*—This is the average bank slope along the average annual summer, fall, winter, and spring water surface elevation. This variable is used as an indicator of shallow-water habitat availability, which is important to juveniles for feeding, rearing, and refuge from high flows and predators.
- *Floodplain availability*—This is the ratio of wetted area for the 2-year flood flow to the wetted area for the average annual winter-spring flow. This variable is used as an indicator of the amount seasonally flooded shallow-water habitat, which is important to juveniles for feeding, rearing, and refuge from high flows and predators.
- *Bank substrate size*—This is median particle diameter of the bank (i.e., D_{50}) along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge and food availability for juveniles and adults.
- *Instream structure*—This is the percent of shoreline coverage of IWM along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge, food availability, and cover and resting habitat for juveniles and adults.

- *Aquatic and riparian vegetation*—This is the percent of shoreline coverage of aquatic or riparian vegetation along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge, food availability, and cover.
- *Overhanging shade*—This is the percent of the shoreline coverage of shade along each average seasonal water surface elevation. This variable is used as an indicator of juvenile and adult predator refuge.

The SAM was used to quantify the responses of the target fish species and life stages to with-project conditions over a 50-year project period relative to the species and life stage responses under without-project (existing) conditions. The assessment followed the general steps outlined in the SAM User's Manual (Corps 2004). A detailed description of the data sources, methods, and assumptions used to characterize existing and with-project habitat conditions is presented in Appendix C.

The results of the SAM for each species, life stage, season of occurrence, and target year, as applied to the Southport EIP, are described below and presented graphically in Appendix F. The SAM results focus on the following life stages and primary seasons of occurrence based on the sensitivity of these life stages to project effects.

- Chinook salmon juvenile rearing and smolt migration in fall, winter, and spring (applies to winter-run and spring-run Chinook salmon).
- Steelhead juvenile rearing and smolt migration in fall, winter, and spring.
- Green sturgeon juvenile rearing (all seasons).

Appendix F also includes summary tables of the projected changes in habitat conditions between year 0 (existing conditions) and year 5 in terms of linear feet of specific habitat classes as defined by the SAM.

Chinook Salmon Juvenile Rearing. The SAM results indicate that the Southport EIP would result in slight initial habitat deficits (<5% reduction relative to baseline values) for juvenile winter-run and spring-run Chinook salmon rearing during the fall, followed by a gradual recovery in future years (Appendix F, Figure F-1). Nearly complete compensation of impacts resulting from the installation of rock and loss of existing IWM is achieved in Year 2 with the installation of IWM at the erosion repair sites. Subsequent growth of planted vegetation and associated increases in shade at the erosion control sites and on the remnant levee is expected to contribute to full recovery of fall habitat values in future years.

The Southport EIP would result in substantial long-term gains in winter and spring habitat values for juvenile winter-run and spring-run Chinook salmon (Appendix F, Figure F-1). Winter and spring WRIs for juvenile rearing are projected to increase rapidly in years 2–5 and continue to increase over the 50-

year assessment period. Between years 5 and 50, WRI values are predicted to increase 35 to 65% over baseline values. These results reflect the positive responses of juvenile salmon to the large and immediate gains in habitat values resulting from increases in floodplain area, shallow water habitat, and natural substrate associated with the levee setback, increases in shallow water habitat on the constructed benches of the erosion repair sites, and gradual increases in shoreline cover resulting from the growth of planted vegetation on the levee breaches, erosion protection sites, and remnant levee.

Chinook Salmon Smolt Migration. The SAM results indicate that the responses of winter-run and spring-run Chinook salmon smolts to changes in SRA cover, riparian, and floodplain habitat associated with the Southport EIP would be similar to those predicted for juvenile rearing (Appendix F, Figure F-2). The slight initial deficit in fall WRIs is expected to recover completely by year 15. Like juvenile rearing, winter-spring WRIs for smolt migration are projected to increase rapidly in years 2–5 and continue to increase over the 50-year period. Between years 5 and 50, WRI values are predicted to increase 6 to 12% over baseline values.

Steelhead Juvenile Rearing. Similar to Chinook salmon, the SAM results indicate that the Southport EIP would result in slight initial habitat deficits (<5% reduction relative to baseline values) for steelhead rearing during the fall, followed by a gradual recovery in future years, and substantial habitat gains in winter-spring values (27 to 47% increase between years 5 and 50) beginning in the second year of construction and increasing throughout the 50-year assessment period (Appendix F, Figure F-3).

Steelhead Smolt Migration. The SAM results for steelhead smolt migration (Appendix F, Figure F-4) are similar to those for Chinook salmon smolt migration, as described above.

Green Sturgeon Juvenile Rearing. The SAM results indicate that the Southport EIP Proposed Action would result in small net gains in habitat values for juvenile green sturgeon in all seasons and project years (Appendix F, Figure F-5). Summer, fall, winter, and spring WRIs are predicted to exceed baseline values by 1 to 2% in years 5 through 50. These results reflect the positive responses of juvenile green sturgeon to increases in shallow water habitat and instream structure associated with the constructed bench and installed IWM at the erosion repair sites. The Southport project would have negligible effects on substrate potentially used by green sturgeon for holding, foraging, and migration in deeper portions of the channel.

<u>Fish Stranding</u>

Following periods of floodplain inundation, receding floodwaters may collect in existing ponds, ditches, borrow areas, and other depressions on the restored floodplain, resulting in fish stranding and high mortality rates due to lethal water temperatures, low dissolved oxygen, predation, and desiccation. WSAFCA will minimize fish stranding by developing and implementing a drainage and grading plan that minimizes the extent of ponding and facilitates complete drainage of the active floodplain to the main river. The final offset area design will include substantial grading and re-contouring of the restored floodplain as necessary to facilitate complete drainage and unimpeded fish passage to the main river as floodwaters recede from the levee offset area. Features with substantial stranding risk will be filled and/or graded to minimize this risk. Bees Lakes would remain hydraulically isolated from the main river. As described above, the restoration and monitoring plan will evaluate the effectiveness of the grading and drainage features in preventing fish stranding and will include provisions for remediation should the design fail to meet established performance or success criteria.

Long-Term Hydraulic, Geomorphic, and Sediment Transport Conditions

The Southport EIP may adversely affect listed species and designated critical habitat as a result of local changes in hydraulic, geomorphic, and sediment transport conditions that may modify channel morphology, water depths and velocities, and suspended sediment and turbidity levels in the Sacramento River. As described in Appendix C-1 and C-2 of the Southport EIP Draft EIS/EIR (ICF International 2013), hydraulic modeling performed by MBK for Alternatives 2 and 5 (setback levee alternatives) indicate that the Southport EIP would not significantly affect water surface elevations or cause negative hydraulic effects in the Sacramento River under 100-year, 200-year, and 500-year flood events. In general, the risk of channel scour, bank erosion, and levee failure would be reduced relative to existing conditions because of proposed levee strengthening, increased bank stability, and reductions in shear stress associated with the widened floodplain. Although local shear stresses would be reduced, these reductions are not expected to significantly alter erosion, deposition, and sediment transport rates in the main channel of the Sacramento River. Therefore, the Southport EIP is not likely to adversely affect listed species or critical habitat through long-term effects on hydraulic, geomorphic, and sediment transport conditions in the Sacramento River.

Operations and Maintenance

O&M activities that require in-water work are expected to occur between July 1 and October 31 for the life of the project to maintain flood control and habitat features in the Southport EIP Action Area. Anticipated O&M activities include vegetation maintenance up to four times a year (mowing or applying herbicide); control of burrowing rodent activity (baiting with pesticide); site-specific slope repair, as needed (resloping and compacting); patrol road reconditioning up to once a year (placing, spreading, grading, and compacting aggregate base or substrate); regular visual inspections of the levee; and relief well monitoring. In addition, periodic rock placement may be needed to prevent or repair localized scouring on the levee slopes and in the offset areas. Potential impacts from slope repairs would be similar to those described for construction activities but would be infrequent, localized, and shorter in duration. Consequently, the potential for adverse effects on listed fish species or critical habitat would be lower and further minimized by application of the BMPs and other minimization and avoidance measures that are proposed during construction.

Delta Smelt

The following assessment addresses potential direct and indirect effects of the Southport EIP on delta smelt and its designated critical habitat. Potential effects include both short-term and long-term effects. Short-term effects include temporary construction-related impacts on fish and aquatic habitat that may last from a few hours to days (e.g., suspended sediment and turbidity). Long-term effects typically last months or years, and are generally due to physical alteration of important habitat attributes of the channel, shoreline, and adjacent bank or floodplain, Short-term project effects on delta smelt are evaluated qualitatively based on general knowledge of the impact mechanisms and species responses to construction actions. Long-term project effects are measured in terms of the linear feet and area of riparian, SRA cover, and floodplain habitat affected by the Southport EIP, and the responses of listed species to changes in habitat quantity and quality as measured by the SAM (Corps 2004).

Direct Effects

Short-Term Effects of Noise, Turbidity, and Suspended Sediment

In-water construction activities, including operation of the barge and placement of rock below the water surface, would cause physical disturbance of the bed and water column of the Sacramento River. The resulting noise, turbidity, and suspended sediment may result in temporary avoidance or displacement of delta smelt from preferred habitat, disruption of migration and spawning activities, disturbance or mortality of eggs and newly hatched larvae, and alteration of spawning and incubation habitat. Eggs and newly hatched larvae are most vulnerable to these effects because of their inability to move away from areas that are directly affected by in-water construction activities. Potential effects include injury or mortality from falling rock and burial of eggs or larvae by suspended sediment.

The extent of construction-related effects depends on the timing of these activities, the timing of fish presence in the Southport EIP Action Area, and their ability to successfully avoid the disturbance. In-water construction activities are scheduled for July 1 through October 31, and therefore should avoid the primary migration, spawning, and larval dispersal periods of delta smelt. Adult delta smelt migrate upstream between December and January and spawn between late February and June, with peak spawning activity between mid-April and May (Bennett 2005). Because larvae move downstream shortly after hatching, restriction of in-water activities to the July 1–October 31 window should avoid adverse construction-related effects on incubation and early larval stages originating in the Southport EIP Action Area. However, the potential exists for delta smelt larvae or juveniles to be present in the Southport EIP Action Area in the early summer as they disperse downstream from potential spawning areas upstream of the Southport EIP Action Area. Based on the potential upstream extent of spawning in the Sacramento River, small numbers of larvae or juveniles could be adversely affected by in-water construction activities that occur in the Sacramento River after July 1. Potential turbidity and sedimentation effects on these life stages will be minimized by adhering to the proposed in-water construction window, RWQCB turbidity objectives, and erosion and sediment control BMPs (SWPPP).

Potential Discharge of Contaminants

Contaminants used at construction sites, including gasoline, diesel fuel, lubricants, and hydraulic fluid, could enter the Sacramento River as result of spills or leakage from machinery or storage containers and injure or kill delta smelt and other listed fish species. These substances can kill aquatic organisms through exposure to lethal concentrations or exposure to non-lethal levels that cause physiological stress and increased susceptibility to other sources of mortality such as predation. Petroleum products also tend to form oily films on the water surface that can reduce dissolved oxygen levels available to aquatic organisms. There is also a slight risk of the release of bentonite into the Sacramento River during jet grouting or deep soil mixing used to construct slurry cut off walls. Bentonite is a naturally occurring, inert, nontoxic material that meets National Sanitation Foundation/American National Standards Institute Drinking Water Additives Standards 60 and 61. Therefore, any inadvertent release of drilling fluid containing only water and bentonite would not have toxicity effects on ESA-listed fish. However, bentonite released into streams could result in turbidity and cause many of the same behavioral, physiological, and physical effects described above for turbidity and suspended sediment.

Implementation of a spill prevention, control, and countermeasure plan and bentonite slurry spill contingency plan as part of the environmental commitments of the project is anticipated to minimize the potential for toxic or hazardous spills or discharges into the Sacramento River. Adherence to all preventative, contingency, and reporting measures in the approved plans would reduce the risk of injury or mortality of listed fish species to negligible levels.

Fish Entrapment in Cofferdams

Cofferdams may be required to install temporary culverts needed to maintain connectivity between the river and restored floodplain prior to construction of the final levee breaches. The potential exists for entrapment and mortality of delta smelt adults, eggs, and larvae following closure and dewatering of the cofferdam. As discussed above, the timing of cofferdam installation and other in-water activities (July 1 through October 31) would avoid the primary delta smelt spawning, incubation, and larval dispersal period in the Southport EIP Action Area. However, because spawning may extend into July, small numbers of adult, eggs, or larvae may be present. The potential for entrapment of delta smelt would be minimized by constructing the cofferdam during summer low water conditions and limiting the extent of the cofferdam footprint to the shallow edge of the river.

Long-Term Effects on Critical Habitat

The project is expected to result in long-term modification of SRA cover, riparian, and floodplain habitat, including modification of the designated critical habitat of delta smelt. Long-term effects on delta smelt and critical habitat may also occur as a result of local changes in hydraulic, geomorphic, and sediment transport conditions in the Sacramento River upstream and downstream of the Southport EIP project area. These modifications may affect behavior, growth, and survival of individuals and the primary constituent elements of critical habitat. General effects of the project on riparian, SRA cover, and floodplain habitat are described below, followed by a summary of long-term changes in habitat values and species responses based on the results of the SAM. This is followed by a general assessment of long-term effects on delta smelt and critical habitat related to potential fish stranding on the restored floodplain and predicted changes in local hydraulic, geomorphic, and sediment transport conditions in the main channel of the Sacramento River.

SRA Cover and Riparian Habitat. The loss of riparian vegetation and the replacement of natural substrate with riprap generally reduces the quality of nearshore habitat for fish by reducing habitat diversity and altering several important attributes of natural shorelines. These attributes, which characterize SRA cover, include natural substrates, riparian vegetation, woody material, and variable water depths and velocities, including shallow, low-velocity areas used by native fishes for spawning, foraging, and refuge from fast currents, deep water, and predators. Simple riprapped banks generally create more uniform physical and hydraulic conditions characterized by deeper, faster water, and lack of cover. These conditions reduce utilization by native fishes and also inhibit the establishment of shoreline vegetation and retention of sediment, organic material, and large woody material, which provide important sources of cover and food for juvenile fish and other aquatic organisms. In addition to cover and shelter for fish, riparian vegetation provides other important stream ecosystem functions, including channel and streambank stability; inputs of food (e.g., terrestrial insects), organic matter, and nutrients; and temperature-moderating shade (Murphy and Meehan 1991).

The Southport EIP would affect approximately 7,419 linear feet of the existing Sacramento River levee as a result of levee degradation and installation of rock slope and biotechnical bank protection at the proposed erosion repair and levee breach sites (Appendix B, Figures 3a–c , 5a–c, and 6). The total area of bank within the construction limits between the submerged toe of the bank (-10 to -45 feet NAVD88) and the OHWM (+20 feet NAVD88) is approximately 8.49 acres. Where the remnant levee is breached, all existing SRA cover and riparian vegetation on the levee slope would be lost due to degradation of the levee and the addition of biotechnical and rock slope protection needed to create and protect the breaches (Appendix B, Figures 5a–5c and 6). Within the erosion sites, the removal of SRA cover and riparian vegetation would be limited to the lower portion of the bank below elevation +12 feet NAVD 88 (Appendix B, Figures 3a–3c).

Vegetation mapping of the project site in April–May 2011 indicates that the proposed erosion repairs, rock slope protection, and levee breaches for the Southport EIP would affect approximately 5.44 acres of cottonwood riparian woodland and 1.46 acres of riparian scrub. This includes the loss of approximately 2.01 acres of cottonwood riparian woodland and 0.51 acre of riparian scrub below the OHWM on the waterside slope of the existing levee. It is assumed that the portions of the existing levee outside the affected levee sites (totaling approximately 24,198 feet), including all existing SRA cover and riparian habitat, would remain intact and no longer be subject to levee maintenance activities. In addition, portions of the remnant levee that are currently devoid of vegetation or sparsely vegetated would be planted with woody riparian species to enhance SRA cover and riparian habitat values and meet any remaining onsite compensation requirements.

Onsite compensation and enhancement of SRA cover and riparian habitat would be achieved through the planting of native riparian species on the floodplain setback area, levee breaches, remnant levees, and erosion repair sites. A detailed description of the SRA cover and riparian habitat compensation and enhancement objectives is being developed as part of the MMP for the Southport EIP (see Conservation Measure 6 on page 2-30).

Erosion Repair Sites. Erosion repair and bank stabilization would be conducted in the second year of construction at three sites (C1, C2, and G3, comprising approximately 1,013 linear feet of bank) to treat several over-steepened or eroding levee areas in Segment C, D, and G (Appendix B, Figures 2 and 3a-3c). To minimize long-term impacts on SRA cover and riparian habitat, these sites have been designed to retain existing vegetation and woody material to the extent possible and promote onsite replacement of SRA cover and riparian vegetation. This would be accomplished by incorporating a 10:1 bench and soil fill within the average annual low and high water inundation zone of the river (between +7 to +12 feet NAVD88) to provide a surface for planting riparian vegetation, anchoring woody material, and creating shallow water habitat (Appendix B, Figures 3a-3c). The low benches would provide shallow water habitat for fish during typical winter and spring flows and woody instream and overhanging cover that would increase in extent over time as the planted vegetation becomes established. To address reductions in SRA cover values associated with the placement of rock and loss of shade along the summer-fall shoreline, onsite and imported IWM would be anchored between elevations 4 and 6 feet to achieve a minimum of 40% cover (approximately 400 linear feet) within the average summer-fall inundation zone. The proposed design is similar to other erosion control designs that have been employed on the lower Sacramento and American Rivers to minimize impacts on existing habitat values and restore some of the key attributes and functions of natural SRA cover and riparian habitat that would otherwise be lost as a result of standard revetment practices or continued erosion. In addition to increasing the amount of structural cover available to fish along the shoreline, the installation of IWM is also expected to promote sediment deposition on the rock bench as observed at locations where similar designs have been used to address the compensation needs of listed fish species (e.g., Sand Cove, RM 62.2).

Levee Breaches. Approximately 6,406 linear feet of the existing levee would be degraded to create the five levee breaches (Appendix B, Figure 2), resulting in permanent losses of existing SRA cover and riparian vegetation within the proposed beach locations. Based on the current design, individual breaches range in width (bank length) from approximately 645 to 1,345 feet. Two of the breaches (N1 and S3) would be constructed in Year 3, and the remaining three breaches (N2, S1, and S2) would be constructed in Year 5. During Year 3 of construction, the existing levee within each of the proposed footprints of the deferred breaches (N2, S1, and S2) would be degraded (approximately 200 linear feet) to install one to two temporary culverts. The culverts would extend through the existing levee (bottom elevation of +7 feet) to maintain connectivity between the river and restored floodplain during the interim period.

A combination of rock slope protection and biotechnical methods would be used to control erosion and maximize the amount of vegetated surfaces within the levee breaches. The riverbank and apron zones would be planted with emergent marsh and woody riparian species (extending along the Sacramento River and laterally into the swales and restored floodplain) to restore SRA and riparian habitat to the extent possible. However, species selection within the riverbank and apron zones may be limited to those suitable for coppicing which may be necessary to maintain uniform hydraulic conditions and minimize the risk of scour within the levee breaches (Appendix B, Figure 8). Existing rock slope protection within the riverbank zone between elevations +7 and +10 feet would be retained. In areas that lack revetment or where the revetment is found to provide insufficient protection, vegetated coir fabric would be installed between elevations +7 and +10 feet. The existing levee bordering the levee breaches (shoulders) would be armored with standard rock revetment to serve as scour protection. Individual segments of shoulder rock would range in length from 90 to 228 feet long and total 1,780 linear feet. No vegetation or other habitat features would be incorporated into the rock shoulders.

Remnant Levee. Portions of the existing levee outside the erosion repair sites and levee breaches (totaling approximately 24,198 feet), including existing SRA cover and riparian habitat, would remain intact and no longer be subject to levee maintenance activities. However, portions of the remnant levee that are currently devoid of vegetation or sparsely vegetated would be planted with woody riparian to enhance SRA cover and riparian habitat values and meet any remaining onsite compensation requirements.

Floodplain Habitat. The levee setback component of the project would result in the restoration of approximately 120 acres of historical Sacramento River floodplain supporting seasonal floodplain, wetland, riparian, and upland habitat. The goals of the offset area restoration design are to increase river-floodplain connectivity, restore ecologically functional floodplain habitat, and meet the flood risk reduction objectives of the project.

Restoring floodplain habitat and connectivity of large rivers to their floodplains have been identified as important objectives of ecosystem restoration and species recovery efforts for listed and other special-status fish species in the Central Valley (NMFS 2009). Floodplains are recognized as major contributors to aquatic production and species diversity in large river systems where native fish species have evolved specific adaptations to exploit these variable but highly productive habitats (Welcomme 1979, Junk et al. 1989, Gutreuter et al. 1999). Historically, the Sacramento River Valley contained extensive areas of seasonal floodplains and wetlands that flooded nearly every winter and spring. These habitats supported significant production of native fish species and contributed substantially to overall biological productivity of the river and estuary (Ahearn et al. 2006). As demonstrated in the Yolo Bypass, floodplain habitat can greatly expand the quantity and quality of habitat available to juvenile salmon and other native fishes during seasonal inundation periods (Sommer et al. 2001, 2005). After young salmon have dispersed from spawning areas, the distribution and abundance of young salmon is determined largely by their preferences for shallow water and low water velocities, which in large rivers are found mostly along channel margins, floodplains, and other off-channel habitats (Beechie et al. 2005, Lestelle et al. 2005).

Floodplain restoration through the creation of setback levees is considered a key conservation action for addressing historical and ongoing impacts of levee construction and maintenance activities on listed fish species and their habitat, especially in the highly constrained portions of the lower Sacramento River. It is generally assumed that the number or biomass of fish that can be supported by aquatic ecosystems is directly proportional to the area of suitable habitat. In addition to increased living space, floodplains may further enhance the growth and survival of young fish by increasing the production and availability of food, increasing growth capacity (i.e., food conversion efficiency), reducing competition for food, and reducing potential encounters with predators. Floodplains also enhance the productivity of river-floodplain systems by increasing hydraulic residence time, water temperature, and inputs of organic matter, plankton, and macro-invertebrates from the floodplain into river channels (Ahearn et al. 2006).

The levee setback design was developed through a collaborative process among project engineers, biologists, and restoration ecologists to achieve the flood-risk reduction and habitat restoration objectives of the project. A principle step in this process has been the linkage of key hydrologic and hydraulic parameters (inundation timing, frequency, duration, depth, velocity) with habitat suitability criteria of the target species through the application of the Corps' Ecosystem Functions Model and 2D hydrodynamic modeling (MIKE 21C) (cbec, inc. and ICF International 2013).

Native Sacramento splittail and Chinook salmon (including winter-, spring-, and fall-run Chinook salmon) were selected as the target species for the offset area design. These species were selected because they are considered key indicator species of functional floodplain habitat in the Central Valley. A flood frequency analysis was performed using the long-term flow record from the Freeport gauge to evaluate the recurrence probability of flows and water surface elevations that correlate with the occurrence of suitable habitat for the target species. The ecological criteria for each of the target species and corresponding flows, recurrence intervals, and water surface elevations are summarized in Appendix D. In general, the offset areas have been designed to flood every 1-2 years for at least 2-3 weeks during December through May based on the minimum floodplain inundation requirements for successful spawning, incubation, and larval development of Sacramento splittail, and rearing and enhanced growth of juvenile Chinook salmon.

The offset areas were also designed to achieve the desired flooding regime (depth, duration, and extent of flooding), drainage patterns, and soil conditions to support riparian, wetland, and upland vegetation on the restored floodplain. Based on current design, much of the offset areas would be excavated down to an elevation of approximately 10 feet NAVD88 to achieve frequent inundation of the new floodplain and expand the amount of riparian habitat, SRA cover, and floodplain habitat available to fish over a broad range of flows. The floodplain design includes one or more interconnected swales or low-flow channels that would form the primary aquatic and riparian corridors connecting the river and floodplain (Appendix B, Figure 9). These channels are designed to maintain suitable soil moisture conditions for wetland and riparian vegetation, facilitate river-floodplain connectivity and drainage of the floodplain over a broad range of flows, and minimize fish stranding and the extent of suitable habitat (isolated ponds) for bass and other undesirable fish species during the drier late spring and summer months. In addition, topographic heterogeneity has been incorporated into the project design grading plans to create a mosaic of wetland, riparian, and upland habitats supporting emergent wetland, willow-scrub, cottonwood forest, oak woodland plantings and native grasses.

An MMP for the offset areas is being developed on behalf of WSAFCA and will be approved by the Corps, NMFS, USFWS, and CDFW before implementation of the Southport EIP. The MMP will include representative plans and cross sections of the Southport EIP elements; fish stranding and vegetation monitoring methods; habitat compensation and restoration success criteria; and a protocol for implementing remedial actions should any success criteria not be met. Annual monitoring reports that describe each year's monitoring activities and progress toward the success criteria would be submitted to the resource agencies during the course of the monitoring period. Monitoring would be conducted until the projected benefits of the compensation and restoration actions have been substantially achieved.

SAM Assessment. The SAM was developed by the Corps and Stillwater Sciences, in consultation with NMFS, USFWS, CDFW, and CDWR, to address specific habitat assessment and regulatory needs for ongoing and future bank protection actions in the Sacramento River Bank Protection Project (SRBPP) Action Area. The SAM was designed to systematically evaluate the impacts and compensation requirements of bank protection and levee improvement projects on Chinook salmon, steelhead, green sturgeon, and delta smelt, and their critical habitat. The SAM has been used previously in both programmatic (Corps 2007a) and project-level (e.g., Jones & Stokes 2007) bank protection effect analyses.

The SAM quantifies habitat values in terms of a 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 as feet or square feet. The species response index 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. For example, the difference in WRIs between with- and without-project conditions in a given year provides a measure of the impacts (negative species response) or benefits (positive species response) of the project relative to baseline conditions. More detail on the SAM is provided by the Corps (2004 and 2007a).

The SAM employs six habitat attributes to characterize nearshore, SRA cover, and floodplain habitats of listed fish species:

- Bank slope – This is the average bank slope along the average annual summer, fall, winter, and spring water surface elevation. This variable is used as an indicator of shallow-water habitat availability, which is important to juveniles for feeding, rearing, and refuge from high flows and predators.
- Floodplain availability – This is the ratio of wetted area for the 2-year flood flow to the wetted area for the average annual winter-spring flow. This variable is used as an indicator of the amount seasonally flooded shallow-water habitat, which is important to juveniles for feeding, rearing, and refuge from high flows and predators.
- Bank substrate size – This is median particle diameter of the bank (i.e., D_{50}) along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge and food availability for juveniles and adults.
- Instream structure – This is the percent of shoreline coverage of IWM along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge, food availability, and cover and resting habitat for juveniles and adults.
- Aquatic and riparian vegetation – This is the percent of shoreline coverage of aquatic or riparian vegetation along each average seasonal water surface elevation. This variable is used as an indicator of juvenile predator refuge, food availability, and cover.
- Overhanging shade – This is the percent of the shoreline coverage of shade along each average seasonal water surface elevation. This variable is used as an indicator of juvenile and adult predator refuge.

The SAM was used to quantify the responses of delta smelt to with-project conditions over a 50-year project period relative to the species and life stage responses under without-project (existing) conditions. The assessment followed the general steps outlined in the SAM User's Manual (Corps 2004). A detailed description of the data sources, methods, and assumptions used to characterize existing and with-project habitat conditions is presented in Appendix E.

The results of the SAM, as applied to the Southport EIP, for the spawning/incubation and larval/juvenile rearing life stages of delta smelt are described below and presented graphically in Appendix F. The SAM focuses on these life stages because of their potential presence in the Southport EIP Action Area and sensitivity to project effects.

Delta Smelt Spawning and Incubation. The Southport EIP would result in long-term gains in winter and spring habitat values (i.e., positive species responses) for delta smelt during the primary winter and spring spawning and incubation period (February–May). Winter and spring WRIs are projected to increase rapidly in years 2–5 and continue to increase over the 50-year with-project period. Between years 5 and 50, WRI values are predicted to increase by 1,509 to 2,336 linear feet, representing an 8% to 12% increase over baseline (existing) habitat values. These results reflect the positive responses of delta smelt to the large and rapid gains in habitat values resulting from increases in floodplain area and shallow water habitat associated with the levee setback and constructed benches, and gradual increases in shoreline cover (aquatic and riparian vegetation) resulting from the growth of planted vegetation on the levee breaches, erosion protection sites, and remnant levee.

Delta Smelt Larval and Juvenile Rearing. The SAM results indicate that the responses of larval and juvenile delta smelt to changes in SRA cover, riparian, and floodplain habitat associated with the Southport EIP would be similar to those predicted for spawning and incubation (Appendix F, Figure F-2). Between years 5 and 50, winter and spring WRIs are projected to increase by 1,388 to 2,049 linear feet, representing a 9% to 13% increase over baseline (existing) habitat values in response to increases in floodplain area and shallow water habitat under with-project conditions. Virtually no change in WRIs under average summer flow conditions is predicted to occur under with-project conditions (Appendix F, Figure F-2). Based on the SAM response relationships, these results reflect the insensitivity of larval and juvenile delta smelt to changes in average substrate size and IWM levels along the average summer-flow shoreline under with-project conditions (see Appendix E, Table E-4).

Fish Stranding

Following periods of floodplain inundation, receding floodwaters may collect in existing ponds, ditches, borrow areas, and other depressions on the restored floodplain, resulting in fish stranding and high mortality rates due to lethal water temperatures, low dissolved oxygen, predation, and desiccation. WSAFCA will minimize fish stranding by developing and implementing a drainage and grading plan that minimizes the extent of ponding and facilitates complete drainage of the active floodplain to the main river. The final levee offset area design will include substantial grading and re-contouring of the restored floodplain as necessary to facilitate complete drainage and unimpeded fish passage to the main river as floodwaters recede from the levee offset area. Features with substantial stranding risk will be filled and/or graded to minimize this risk. Bees Lakes would remain hydraulically isolated from the main river. As described above, the mitigation and monitoring plan will evaluate the effectiveness of the grading and drainage features in preventing fish stranding and will include provisions for remediation should the design fail to meet established performance or success criteria.

Long-Term Hydraulic, Geomorphic, and Sediment Transport Conditions

The Southport EIP may adversely affect delta smelt and designated critical habitat as a result of local changes in hydraulic, geomorphic, and sediment transport conditions that may modify channel morphology, water depths and velocities, and suspended sediment and turbidity levels in the Sacramento River. As described in Appendix C-1 and C-2 of the Southport EIP Draft EIS/EIR (ICF International 2013), hydraulic modeling performed by MBK for Alternatives 2 and 5 (setback levee alternatives) indicate that the Southport EIP would not significantly affect water surface elevations or cause negative hydraulic effects in the Sacramento River under 100-year, 200-year, and 500-year flood events. In general, the risk of channel scour, bank erosion, and levee failure would be reduced relative to existing conditions because of proposed levee strengthening, increased bank stability, and reductions in shear stress associated with the widened floodplain. Although local shear stresses would be reduced, these reductions are not expected to significantly alter erosion, deposition, and sediment transport rates in the main channel of the Sacramento River. Therefore, the Southport EIP is not likely to adversely affect delta smelt or critical habitat through long-term effects on hydraulic, geomorphic, and sediment transport conditions in the Sacramento River.

Indirect Effects

Operations and Maintenance

O&M activities are not part of the Federal action. Because O&M activities are conducted by DWR and local flood protection districts, the effects of these activities are not part of the Southport EIP. However, they are discussed in this BA because they are interrelated and interdependent to the Southport EIP.

O&M activities that require in-water work are expected to occur between July 1 and October 31 for the life of the project to maintain flood control and habitat features in the Southport EIP Action A`rea, Anticipated O&M actions include vegetation maintenance up to four times a year (mowing or applying herbicide), control of burrowing rodent activity (baiting with pesticide), site-specific slope repair, as needed (resloping and compacting), patrol road reconditioning up to once a year (placing, spreading, grading, and compacting aggregate base or substrate), regular visual inspections of the levee, and relief well monitoring. In addition, periodic rock placement may be needed to prevent or repair localized scouring on the levee slopes and in the offset areas. Potential impacts from slope repairs would be similar to those described for construction activities but would be infrequent, localized, and shorter in duration. Consequently, the potential for adverse effects on listed fish species or critical habitat would be lower and further minimized by application of the BMPs and other minimization and avoidance measures that are proposed during construction.

5.3 Giant Garter Snake

5.3.1 West Sacramento GRR

Potential effects to the giant garter snake and its habitat could occur during repairs to the Yolo Bypass levee, DWSC east and west levees, Sacramento River south levee and the South Cross levee. Giant garter snakes could be injured or crushed by construction equipment working in suitable aquatic and upland habitat or if soil or other materials are side-cast or fall into suitable aquatic habitat. Snakes could also be killed by construction vehicles traveling though the construction area. Fuel or oil spills from construction equipment into aquatic habitat could also cause illness or mortality of giant garter snakes. Trenches left open overnight could trap snakes moving through the construction area during the early morning hours. Noise and vibrations from construction equipment, and presence of human activity during construction activities may also disturb giant garter snakes within the project area. Most construction activities will be limited to the snake's active period (May 1–October 1) when the potential for direct mortality is reduced because snakes can actively move and avoid danger. However, if work requires construction during the snakes dormant period (October 2-April 30) giant garter snakes, if present in the upland agricultural and grassland adjacent to the work area, could be injured or killed. Conservation measures discussed above would be implemented to reduce the potential for mortality during this time period.

The study area contains numerous aquatic or irrigation features that are or have the potential to be waters of the United States, including wetlands. These habitat features include, but are not limited to, emergent wetlands (approximately 86 acres), irrigated rice and grain crops (approximately 20 acres), open water (approximately 413 acres), and seasonal wetlands (0.3 acre). This includes open waters that are protected under Federal law from removal, filling, hydrological interruption, or other construction activities.

Direct effects including construction activities associated with this alternative would result in the loss of waters of the United States, including wetlands, as well as upland habitat and disruption of wildlife movement corridor. Except for the proposed levee work on the water side of the Sacramento River levees where high flows exclude this snake, this effect would be considered significant because fixing the levee in place would remove nearshore wetlands and upland habitat that provide suitable habitat ranging between marginal to optimal with low to moderate to high food, cover, and water values for the giant garter snake depending on the quantity and quality of the habitat. It also disturbs the aquatic environment as rock revetment is placed in the water.

In the short term, there are adverse effects due to temporary habitat disturbance to waterways providing habitat for the snake from construction activities to fix the levee in place (Table 25). Construction would result in the temporary disturbance up to 200 acres of suitable upland habitat in the project area, including the Southport EIP Action Area. Temporary loss of up to 200 acres of suitable upland habitat would occur adjacent to water featuers in fallow agricultural fields and grasslands in the borrow areas. The actual temporary impacts from borrow activities will be substantially less pending an analysis on the suitability of materials. Temporarily affected upland habitat would be restored to preproject conditions. It is estimated that 11 acres of temproary construction impacts to seasonal and permanent wetland habitat that provides foraging, breeding, and rearing habitat for the giant garter snake would also occur.

In the long term, it is estimated that a total of 20 acres of seasonal and permanent wetland habitat that provides foraging, breeding, and rearing habitat for the giant garter snake and up to 10 acres of non-native grassland (associated with the oak woodland habitat lost) habitat would be adversely affected by the construction activities to fix the levees in place (Table 25).

Table 25. Effects on Giant Garter Snake Habitat in the West Sacramento Project Area.

Habitat	Temporary	Permanent
Aquatic Habitat	11	20
Upland Habitat[1]	200[2]	10

[1] Upland habitat consists of fallow agricultural fields and nonnative grasslands from borrow sites within 200 feet of aquatic habitat.
[2] The actual temporary impacts from borrow activities will be substantially less pending an analysis on the suitability of materials.

During post construction levee maintenance activities and maintenance of mitigation plantings, there are potential significant indirect effects to the giant garter snake. If driving on dirt roads in close proximity to the existing wetlands or other water body types and newly created mitigation plantings is necessary, it could disturb the giant garter snake due to vibration, noise, and dust covering the aquatic environment and wetlands. However, these effects are considered short term and it is not significant because the use of vehicles is reduced to one or two vehicles/trucks needed or there is a restricted limited use of heavy equipment needed later for levee repair.

Potential adverse indirect effects to the giant garter snake could occur as a result of the following post construction activities:

- O&M activities, including removal of weeds, tree and shrub trimming up to four times per year, and reconditioning of levee slopes and road with a bull dozer, as needed;
- Permanent altering of light and noise levels;
- Temporary alteration of flows if dewatering a portion of the water body and riparian floodplain/zone for levee repairs or installation of closure structures in the DWSC is necessary;
- Damage caused through toxicity associated with herbicides, insecticides, and rodenticides;
- Introduction of pet and human disturbance (including trash dumping);
- Increases or changes in habitat to attract non- native competitors or predators; and
- Introduction of invasive nonnative plant species onto disturbed and nearby degraded areas.

All project areas would be surveyed prior to final designs to determine the extent to which the species may be impacted. To minimize potential impacts to the species, work will occur between May 1 and October 1 when snakes are active and can move out of the construction area.

5.3.2 Southport EIP

As discussed in Chapter 3, suitable aquatic habitat for giant garter snake in the Southport EIP Action Area consists of irrigation and drainage ditches and emergent wetland, as shown in Appendix B, Figure 7. Figure 7 shows Bees Lakes as Adjacent Aquatic Habitat; although Bees Lakes is outside of the Southport EIP Action Area, it creates suitable upland habitat for giant garter snake within the Action Area. Most of the active fields in the Southport EIP Action Area are fallowed or planted in wheat, which does not require irrigation; therefore these ditches were not considered suitable for giant garter snake because they are dry during the snake's active season.

Suitable upland habitat consists of fallow agricultural fields and nonnative grassland in the Southport EIP Action Area. For the effects discussion below, impacts on suitable upland areas were calculated if they occur within 200 feet of suitable aquatic habitat.

<u>**Direct Effects**</u>

Construction of the Southport EIP would result in the temporary disturbance of 155 acres and the permanent loss 2.24 acres of suitable upland habitat in the Southport EIP Action Area (Table 26). Temporary loss of up to 155 acres of suitable upland habitat in the Southport EIP Action Area would occur in fallow agricultural fields and grasslands in the borrow areas. The actual temporary impacts from borrow activities will be substantially less pending an analysis on the suitability of materials. Temporarily affected upland habitat would be restored to preproject conditions within a maximum of two seasons (a season is defined as the calendar year between May 1 and October 1 [U.S. Fish and Wildlife Service 1997]), as described in Conservation Measure 16.

The permanent loss of 2.24 acres of suitable upland habitat would result from work in fallow agricultural fields and nonnative grasslands. Compensation would be required for permanent impacts on giant garter snake as described in Conservation Measure 18.

Table 26. Effects on Giant Garter Snake Habitat in the Southport EIP Action Area.

Habitat	Temporary	Permanent
Aquatic Habitat	0	0
Upland Habitat[1]	155[2]	2.24

[1] Upland habitat consists of fallow agricultural fields and nonnative grasslands from borrow sites within 200 feet of aquatic habitat.
[2] The actual temporary impacts from borrow activities will be substantially less pending an analysis on the suitability of materials.

While there would be no temporary or permanent effects of suitable aquatic habitat for giant garter snake in the Southport EIP Action Area, disturbance or degradation of aquatic habitat could occur if soil or other materials are sidecast or fall into the habitat. Fuel or oil leaks or spills adjacent to aquatic habitat could also cause degradation of habitat. These potential effects would be avoided by installing sediment and construction barrier fencing (Conservation Measure 12), locating staging areas away from aquatic habitat (Conservation Measure 13), implementing sediment and contaminant BMPs as required by the NPDES permit (SWPPP) (Conservation Measure 2), and preparing a frac-out plan and SPCCP (Conservation Measures 3 and 4).

Construction activities in suitable habitat could result in the injury, mortality, or disturbance of giant garter snakes. Giant garter snakes could be injured or crushed by construction equipment working in suitable aquatic and upland habitat or if soil or other materials are side-cast or fall into suitable aquatic habitat. Snakes could also be killed by construction vehicles traveling though the Southport EIP Action Area. Fuel or oil spills from construction equipment into aquatic habitat could also cause illness or mortality of giant garter snakes. Trenches left open overnight could trap snakes moving through the construction area during the early morning hours. Noise and vibrations from construction equipment, and presence of human activity during construction activities may also disturb giant garter snakes within the Southport EIP Action Area. Most construction activities will be limited to the snake's active period (May 1–October 1) when the potential for direct mortality is reduced because snakes can actively move and avoid danger. However, if work requires construction during the snakes dormant period (October 2-April 30) giant garter snakes, if present in the upland agricultural and grassland adjacent to the work area, could be injured or killed. Conservation Measure 16 would be implemented to reduce the potential for mortality during this time period.

Potential effects on giant garter snake would be minimized or avoided by conducting biological resources awareness training, conducting work during the active period (May 1–October 1) (Conservation Measure 1), installing exclusion fencing around suitable habitat (Conservation Measure 12), conducting preconstruction surveys and monitoring (Conservation Measure 14), and providing escape routes or covering open trenches (Conservation Measure 15). If work continued past October 1, additional preconstruction surveys and monitoring would be required (Conservation Measure 14).

Indirect Effects

Construction of the Southport EIP is not expected to have any indirect effects on giant garter snake. Several indirect effects on giant garter snake and its habitat were considered but were determined to have no potential to occur as a result of the Southport EIP. Specifically, the following determinations were made.

There would be no increase of trash, hazardous waste, or off-road vehicle use due to increased human presence. The Southport EIP would not result in development or increased access to giant garter snake habitat.

The Southport EIP would not result in indirect effects on habitat suitability through changes in the length of inundation or other habitat modifications that would make the habitat less suitable for giant garter snake.

Effects from Operation and Maintenance

Post-construction setback levees, adjacent levees, strengthening in place (slope flattening), seepage berms, slurry cutoff walls, riprap bank stabilization, and relief wells would be subject to typical O&M. O&M activities in the Southport EIP project area are conducted per the approved Corps O&M manual applicable to this reach. Such activities include hand and mechanical (mower) removal of weeds, spraying of weeds with approved pesticides, minimal tree or shrub trimming all up to four times a year, monthly control of burrowing rodent activity by baiting with pesticide, and reconditioning of levee slope and road with a bull dozer as needed.

Effects on giant garter snake and its habitat were considered but were determined to have no potential to occur as a result of the Southport EIP. Specifically, the following determinations were made.

- There would be no increased use of herbicides and/or pesticides from pre-project conditions as a result of the Southport EIP. Vegetation control would remain the same as existing conditions—typically twice per year. Herbicide and bait station use would also be at the same frequency as existing conditions.
- The Southport EIP would not result in an increase in potential mortality of giant garter snake due to an increase in vehicles traveling to the project components to conduct maintenance activities. Inspections are infrequent (flood control facilities four times per year; relief wells once per year, plus inspections after high water events), and travel would be along the existing levee road and paved roads to the levee. Patrol road recondition activities would typically be performed once per year and would include placing, spreading, grading, and compacting aggregate base or substrate. Erosion control and slope repair activities would include resloping and compacting; fill and repair of damage from rodent burrows would be treated similarly.

5.4 Ongoing Project Actions

As described in Section 2.0, in-water construction work will be completed during established work windows for salmonids and Delta smelt. Maintenance activities may occur year-round in the dry areas. Such activities include hand and mechanical (mower) removal of weeds, spraying of weeds with approved pesticides, minimal tree or shrub trimming all up to four times a year, monthly control of burrowing rodent activity by baiting with pesticide, and reconditioning of levee slope and road with a bull dozer as needed.

5.5 Effects on the Environmental Baseline

Effects of the proposed action include reductions in nearshore aquatic and riparian habitat that is used by aquatic and terrestrial species. Placement of revetment on earthen banks alters natural fluvial processes that sustain high-value nearshore and floodplain habitats in alluvial river systems. Effects are expected to be similar to effects described in Sections 5.1 through 5.3. Cumulative effects from these two projects, combined with the American River Common Features project and the SRBPP, on the environmental baseline are discussed in Section 5.7.2 below.

5.6 Effects on Essential Elements of Critical Habitat

The project actions may affect designated critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, Delta smelt and green sturgeon. Potential impacts of the project actions on critical habitat for listed species are discussed separately for each species in Section 5.2.

5.7 Cumulative Effects

5.7.1 ESA Cumulative Effects Analysis

The ESA requires NMFS and USFWS to evaluate the cumulative effects of the proposed actions on listed species and designated critical habitat, and to consider cumulative effects in formulating Biological Opinions (USFWS and NMFS 2002a). The ESA defines cumulative effects as "those effects of future State or private actions, not involving Federal activities that are reasonably certain to occur within the action area" of the proposed action subject to consultation (USFWS and NMFS 2002b). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Federal ESA. Federal actions, including hatcheries, fisheries, and land management activities are, therefore, not included. For the purposes of this BA, the area of cumulative effects analysis is defined as the Sacramento River watershed.

A number of other commercial and private activities, including hatchery operations, timber harvest, recreation, as well as urban and rural development, could potentially affect listed species in the Sacramento River basin. Levee maintenance activities by state agencies and local reclamation districts are likely to continue, although any effects on listed species will be addressed through Section 10 of the ESA. Ongoing non-federal activities that affect listed salmonids, Green Sturgeon, Delta Smelt, valley elderberry longhorn beetle, giant garter snake and their habitat, will likely continue in the short-term, at intensities similar to those of recent years. However, some activities associated with the State's proposed Central Valley Flood Protection Plan or state or local efforts to implement the ETL could result in increased effects on listed species. The extent and pace of those activities are not yet known.

Cumulative effects may also include non-federal rock revetment projects. Some non-federal rock revetment projects carried out by State or local agencies (e.g., reclamation districts) that do not fill wetlands or occur below the ordinary high water line will not need Section 404 (Clean Water Act) permits from the Corps and resulting Section 7 (ESA) consultation, but any effects on listed species should be addressed through Section 10 of the ESA. These types of actions are possible at many locations throughout the West Sacramento GRR study area, but are not included as part of the current project.

Potential cumulative effects on fish may include any continuing or future non-federal diversions of water that may entrain adult or larval fish or that may incrementally decrease outflows, thus changing the position of habitat for these species. Water diversions through intakes serving numerous small, private agricultural lands and duck clubs in the Delta, upstream of the Delta, and in Suisun Bay contribute to these cumulative effects. These diversions also include municipal and industrial uses and power production. Several new diversions are in various stages of action. The introduction of exotic species may also occur under numerous circumstances. Exotic species can displace native species that provide food for larval fish.

Potential cumulative effects on all species addressed in this BA could include: wave action in the water channel caused by boats that may degrade riparian and wetland habitat and erode banks; dumping of domestic and industrial garbage; land uses that result in increased discharges of pesticides, herbicides, oil, and other contaminants; and conversion of riparian areas for urban development. In addition, routine vegetation clearing and mowing associated with agricultural practices may affect or remove habitat for the valley elderberry longhorn beetle and giant garter snake.

5.7.2 Federal Cumulative Effects Analysis

While cumulative effects analyses in ESA consultations are specifically to address non-federal actions as explained above, the following cumulative analysis of Federal actions is being provided to inform the agencies of federal actions affecting listed species in the general local area. The Corps has initiated consultation with USFWS and NMFS on four different Federal actions which could create a cumulative effect on listed species in the Sacramento area. These four projects include the West Sacramento Project, the Southport EIP, the American River Common Features Project, and the Sacramento River Bank Protection Project (SRBPP).

The purpose of the American River Common Features Project is to determine whether there is a Federal interest in modifying the authorized project for flood risk reduction in the Greater Sacramento Area at the confluence of the Sacramento and American Rivers. The proposed alternatives for this project include improving levees along the American River, NEMDC, Arcade, Dry/Robla, and Magpie Creeks to address identified seepage, stability, erosion, and height concerns. The levees along the

Sacramento River would be improved to address identified seepage, stability, and erosion concerns. Approximately one mile of levee raising would still be required on the Sacramento River. Due to environmental, real estate, and hydraulic constraints within the study area, the majority of the levees would be fixed in place. In addition, the project proposes to widen the Sacramento Weir and Bypass to divert more flows into the Yolo Bypass.

The SRBPP was authorized to protect the existing levees and flood control facilities of the SRFCP. The SRBPP is a long-range program of bank protection authorized by the Flood Control Act of 1960. The SRBPP directs the Corps to provide bank protection along the Sacramento River and its tributaries, including that portion of the lower American River bordered by Federal flood control project levees. Beginning in 1996, erosion control projects at five sites covering almost two miles of the south and north banks of the lower American River have been implemented. Additional sites at RM 149 and 56.7 on the Sacramento River totaling one-half mile have been constructed since 2001. During 2005 through 2007, 29 critical sites totaling approximately 16,000 linear feet were constructed under the Declaration of Flood Emergency by Governor Schwarzenegger. This is an ongoing project, and additional sites requiring maintenance will continue to be identified indefinitely until the remaining authority of approximately 24,000 linear feet is exhausted over the next 3 years. WRDA 2007 authorized an additional 80,000 linear feet of bank. For implementation of the 80,000 additional linear feet of bank protection, the Corps has submitted a biological assessment and initiated formal consultation with NMFS and USFWS.

Potential cumulative impacts from the combination of these projects to each of the listed species included in this consultation are below. During preconstruction engineering and design, the Corps designs will avoid impacts to special status species, where possible, or otherwise minimize effects to each of these species.

Valley Elderberry Longhorn Beetle

Concurrent construction of multiple projects over the next 10 to 15 years within the Sacramento Metropolitan area would likely cause mortality to beetles due to construction operations. Construction activities for the multiple projects would occur each year during the flight season of beetles. Since construction activities would be adjacent to known VELB locations it is likely that some mortality may occur. The exact number injured or killed is unknown but would likely be minimal due to the exceptional flight ability of the beetle to avoid construction vehicles. No designated critical habitat would be affected with the construction of any of the projects.

Shrubs within the each project footprint would be transplanted to areas in close proximately to the current locations. Additionally, compensation would be located within the vicinity of impacted shrubs. Transplanting of shrubs and planting of seedlings and natives within the project vicinity would provide connectivity for the beetle. Connectivity is a primary cause of the beetle decline and an important element in the recovery and sustainability for the beetle. The transplanting of shrubs and compensation within the same area as the potential impacts would result in effects to the beetle but not result in jeopardy to the Valley Elderberry Longhorn Beetle.

Salmon, Steelhead, and Sturgeon

The proposed projects could adversely modify critical habitat or contribute to the loss or degradation of sensitive habitats for listed species such as the Sacramento River winter-run Chinook salmon, Central Valley steelhead, Central Valley spring-run Chinook salmon, and green sturgeon in the greater project vicinity. However, with site specific erosion repair designs, retention of SRA through vegetation variances, and the installation of riparian plantings and instream large woody material, the proposed projects are expected to increase habitat values over time by increasing the amount of riparian habitat, SRA cover, and floodplain habitat available to listed fish over a broad range of flows.

The erosion repair activities of these combined projects would likely reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, from a system sediment perspective, the bank material we are protecting in the project reaches is not a major source of sediment compared to the upstream reaches of the Sacramento, Feather, and especially the Yuba River systems. All of the available sediment in the American River watershed is being contained behind Folsom Dam. The site specific designs will be constrained from allowing any velocity increases outside the erosion repair site (Schlunegger 2014).

Site specific designs such as setback levees, IWM, and shallow bank slopes within the SRBPP, Common Features, West Sacramento, and Southport EIP projects would be incorporated to address erosion repair while including features for increasing habitat for listed fish. The levee setback component of the Southport EIP and West Sacramento projects would result in the restoration of historical Sacramento River floodplain in the project areas, with a diverse mosaic of seasonal floodplain, wetland, riparian, and upland habitat. The goals of the offset area restoration designs are to increase river-floodplain connectivity, restore ecologically functional floodplain habitat, and meet the flood risk–reduction objectives of the projects. Based on the SAM, establishing connectivity of the floodplain to the river will result in large and rapid gains in habitat quantity and quality that will fully compensate for initial habitat deficits on the existing levee and result in significant long-term species benefits (improved growth and survival) relative to existing conditions. Although not addressed by the SAM, these benefits will be enhanced over time by revegetation of the floodplain and development of a diverse mosaic of wetland, riparian and upland plant communities that will further improve the habitat and ecosystem functions of the restored floodplain. In addition to increasing the amount of structural cover available to fish along the shoreline, the installation of IWM is also expected to promote sediment deposition on the rock bench as observed at locations where similar designs have been used to address the compensation needs of listed fish species. Project actions are unlikely to result in long-term habitat losses to Sacramento River winter-run Chinook salmon, Central Valley steelhead, Central Valley spring-run Chinook salmon, and green sturgeon.

The American River Common Features and West Sacramento Projects would have initial cover losses due to project actions but will be partially offset by installing riparian plantings and native grasses along the lower slopes. These features will increase the availability of high quality shallow water habitat for juvenile Chinook salmon and steelhead, and possibly juvenile green sturgeon during the annual high-flow period (late fall, winter, and spring). Because of the vegetation variance that the Corps will be seeking, tree removal would be limited to no more than the upper one-half of the waterside of the levees therefore leaving the lower one-half or more of the trees in place on the Sacramento River within the study area. SRA would not be compromised, thus maximizing existing SRA values in the study area. The establishment and growth of planted riparian vegetation is expected to increase habitat values over time by increasing the extent of overhead cover available to listed fish species.

Delta Smelt

The proposed projects, with the implementation of site specific designs, would provide long-term net benefits to delta smelt as explained above in for the other fish species. However, there are four specific significant threats to the delta smelt that have been identified by the USFWS: direct entrainments by State and Federal water export facilities, summer and fall increases in salinity, summer and fall increases in water clarity, or effects from introduced species.

Implementation of the various projects would not affect direct entrainments by State and Federal water export facilities. The only potential affect could be with the American River Common Features Project and the release of more water down the Sacramento Bypass into the Yolo Bypass during high water events. The excess water that would normally be moving downriver through the Sacramento area would enter the system farther down in the Delta area. Since adult delta smelt are moving up the system to spawn at this time this would not affect entrainment in the water export facilities. Summer and fall increases in salinity is driven more by low flow drought years and water releases in the Sacramento tributaries then site specific designs for erosion protection in the project areas. Summer and fall increases in water clarity are associated with, among other factors, invasive non-native clam species and non-native plant species, which are generally located down in the Delta below the project areas, that are filtering out vital chlorophyll and plankton that would normally increase turbidity which helps the delta smelt avoid predators. However, as mentioned above the erosion repair activities of these combined projects would likely reduce the sediment supply for riverine reaches directly downstream because the erosion repair is holding the bank or levee in place. However, as explained above, from a system sediment perspective, the bank material we are protecting in the project reaches is not a major source of sediment compared to the upstream reaches of the Sacramento, Feather, and especially the Yuba River systems.

Giant Garter Snake

The giant garter snake could be affected by multiple projects being constructed within the Sacramento Metropolitan area over the next 10 to 15 years. Primarily habitat loss would occur on the West Sacramento side of the Sacramento River adjacent to the Sacramento Bypass and the West

Sacramento and Southport construction areas. Short term impacts would occur for a single construction season along haul routes and within borrow sites. To minimize potential impacts to snakes work within giant garter snake habitat would be conducted between May 1 and October 1 when snakes are active and can move out of the construction area. Snake mortality could occur during construction along haul routes, however, the snakes are mobile and would likely move out of the way from construction equipment. There would be a permanent loss a few irrigation canals and existing wetlands adjacent to the levees.

5.8 Conclusion and Effects Determination for Listed Species

5.8.1 Conclusions and Determinations for the West Sacramento Project

<u>Valley Elderberry Longhorn Beetle</u>

Because of the potential direct effects discussed in detail above, including the removal of up to 120 elderberry shrubs and the potential for injury or mortality of VELB during removal and transplantation, the West Sacramento project is likely to adversely affect VELB. In cases where work occurs within 20 feet of elderberry shrubs, the contractor will be instructed to avoid impacts to shrubs as much as possible. Any impacts to shrubs will be mitigated according to the guidelines outlined in Section 2.8.2.

The project will also result in long-term benefits to VELB as approximately 120 acres of floodplain habitat will be restored or enhanced as part of project implementation. In consideration of this information, the project actions are unlikely to result in long-term habitat losses to valley elderberry longhorn beetle, as long as the applicable mitigation and compensation measures are implemented.

<u>Fish Species</u>

Project effects on listed fish species include alteration of the designated critical habitat of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, Delta smelt, and green sturgeon. Project effects may include localized incidental take due to disturbance, displacement, or impairment of feeding or other essential behaviors of adult and juvenile salmon, steelhead, and green sturgeon during construction and O&M activities. Injury or mortality of juvenile salmonids, green sturgeon, and Delta smelt could occur if individuals are unable to readily move away from channel or nearshore areas directly affected by construction activities. Accidental discharge of toxic substances during construction could cause physiological impairment or mortality of listed fish and other aquatic species at or immediately downstream of project sites. Other potential stressors include noise, suspended sediment, turbidity, and sediment deposition generated during in-water construction activities. These effects could also occur in areas downstream of project sites, because noise and sediment may be propagated downstream. Restricting in-water activities to the August 1 through November 30 work window, and implementing BMPs, will minimize the potential for adverse effects.

Long-term project effects on the habitat of listed fish species include alteration of river hydraulics, removal of instream and overhead cover, and alteration of substrate conditions along the seasonal low- and high-flow shorelines of the Sacramento River erosion sites. Implementation of the project will result in temporary losses of instream structure and riparian vegetation along the summer-fall and winter-spring shorelines and will also limit long-term fluvial functioning necessary for the development and renewal of SRA habitat in the future.

Initial cover losses due to project actions discussed above will be partially offset by installing riparian plantings and native grasses along the lower slopes. The remaining losses will be compensated for by purchasing mitigation credits from local mitigation banks. These features will increase the availability of high quality shallow water habitat for juvenile Chinook salmon and steelhead, spawning and incubating Delta smelt, and possibly juvenile green sturgeon during the annual high-flow period (late fall, winter, and spring). Because we will not be removing any trees on the lower one-third of the waterside of the levees in the Sacramento River area, SRA will not be compromised thus maximizing existing SRA values in the study area. The establishment and growth of planted riparian vegetation is expected to increase habitat values over time by increasing the extent of overhead cover available to listed fish species.

In consideration of the above information, the project actions are not likely to result in long-term habitat losses to Sacramento River winter-run Chinook salmon, Central Valley steelhead, Central Valley spring-run Chinook salmon, Delta smelt, and green sturgeon as long as the applicable mitigation and compensation measures are implemented. This conclusion is based on the Corps' commitment to: (1) minimize temporary habitat losses through the incorporation of on-site mitigation features (e.g., vegetated riparian and wetland benches, riparian plantings, and no planned tree removal) in the project area measures; and (2) implementation of off-site habitat compensation measures (e.g., riparian planting, rock removal) prior to or concurrent with project construction. However, project actions may affect and are likely to adversely affect these focus species due to: (1) incidental take during construction and O&M activities; (2) fragmentation of existing natural bank habitats due to the placement of revetment; and (3) the potential loss of long-term fluvial functioning necessary for the development and renewal of shaded riverine aquatic habitat.

Section 7 of the Endangered Species Act requires that Federal agencies ensure, in consultation with the U.S. Fish and Wildlife Service, that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of critical habitat. Effects to critical habitat are discussed for each species in section 5.2.1. Based on those assessments, project actions:

- May adversely affect designated critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and Green sturgeon;

- May adversely affect designated critical habitat for delta smelt within the West Sacramento GRR project area which includes the Sacramento River upstream to approximately RM 60 (U.S. Fish and Wildlife Service 2003a).

Giant Garter Snake

To minimize the potential for adverse effects, giant garter snake habitat will be designated as an environmentally sensitive area delineated with signs or fencing, and if possible, avoided by all construction personnel. Additional measures and habitat compensation as outlined in Section 2.8.3 will also be implemented.

In consideration of the above information, the project actions are unlikely to result in long-term habitat losses to the giant garter snake, with implementation of the applicable mitigation and compensation measures. However, even with on-site mitigation and off-site compensation, the project actions may adversely affect giant garter snakes and their critical habitat due to: (1) take during construction and O&M activities; and (2) habitat fragmentation.

5.8.2 Determinations, Summary, and Conclusions for the Southport EIP

Valley Elderberry Longhorn Beetle

Because of the potential direct effects discussed in detail above, including the removal of 18 elderberry shrubs and the potential for injury or mortality of VELB during removal and transplantation, the Southport EIP is likely to adversely affect VELB. However, the project will result in substantial long-term benefits to VELB as approximately 120 acres of floodplain habitat will be restored or enhanced as part of project implementation.

Salmonids

Summary and Conclusions

The Southport EIP is expected to result in adverse short-term, construction- and O&M-related effects on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, southern DPS North American green sturgeon, and their designated critical habitat. Potential effects may include physical injury or death and temporary modification of feeding, migration, or other essential activities. During in-water construction activities, injury or mortality of juvenile salmonids and green sturgeon could occur because of their proximity to in-water work areas (nearshore areas), limited ability to avoid direct contact with construction equipment and materials, and sensitivity to noise, turbidity, and suspended sediment. Barge operation and placement of rock (riprap) and temporary cofferdams in the river will cause underwater noise and physical disturbance of the bed and water column of the river that could cause physical injury, death, entrapment, and displacement of individuals from preferred habitat. Temporary increases in suspended sediment and turbidity are expected to reach levels known to cause avoidance behavior in juvenile salmonids, potentially causing displacement of juveniles from cover and increased exposure to predators. Accidental discharge of toxic substances during construction could cause physiological impairment or mortality of individuals at or immediately downstream of construction sites.

Potential short-term effects on listed fish species may include injury or mortality of fish from rock placement; entrapment of fish within temporary cofferdams or turbidity barriers; temporary disruption of feeding, migration, and sheltering behavior, and displacement of fish from preferred habitat in response to noise, turbidity, and suspended sediment; and associated increases in predation risk. The timing of in-water construction activities is expected to minimize exposure of the most sensitive Chinook salmon and steelhead life stages (i.e., fry) which occur in the Southport EIP Action Area primarily in winter and spring following the onset of high flows (November through May). Adults and most juvenile winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon that may be present during the proposed construction window (July 1 through October 31) utilize deeper water and are expected to detect and move away from affected nearshore areas. Most construction activities potentially affecting these species will occur in Year 2 of the proposed construction period, thus avoiding or minimizing the potential for adverse effects on multiple year classes. Based on these considerations and the implementation of proposed conservation measures and BMPs, adverse effects resulting from construction and O&M activities will be limited to temporary harassment and potential injury or death of small numbers of juvenile winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon during in-water activities.

Long-term project effects on listed fish species include modification of the designated critical habitat of winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon. Habitat modification may affect behavior, growth, and survival, and the primary constituent elements of critical habitat, including freshwater rearing sites, foraging areas, and migration corridors. These modifications include substantial long-term increases in the quantity and quality of riparian, SRA cover, and floodplain habitat available to fish on the restored floodplain. Major objectives of the levee offset areas include restoring ecologically functional floodplain habitat based on the hydrological, hydraulic, and geomorphic characteristics and habitat functions of natural floodplains. Based on the SAM, establishing connectivity of the floodplain to the river will result in large and rapid gains in habitat quantity and quality that will fully compensate for initial habitat deficits on the existing levee and result in significant long-term species benefits (improved growth and survival) relative to existing conditions. Although not addressed by the SAM, these benefits will be enhanced over time by revegetation of the floodplain and development of a diverse mosaic of wetland, riparian, and upland plant communities that will further improve the habitat and ecosystem functions of the restored floodplain.

Initial habitat deficits associated with the loss of natural substrate and removal of existing riparian vegetation and IWM on the existing levee slope will be addressed onsite through the integration of engineered benches, IWM, biotechnical materials, and revegetation of the erosion repair sites, levee breaches, and remnant levee. Based on the SAM, initial deficits in winter-spring habitat values will be fully offset in the first year of levee breach construction and repairs (Year 2) by increases in floodplain area and shallow water habitat on the restored floodplain and constructed benches, followed by long-term increases in habitat values associated with the growth of planted vegetation on the levee breaches, erosion protection sites, and remnant levee. The installation of IWM along the summer-fall shorelines of the erosion repair sites is sufficient to compensate or nearly compensate for initial deficits in fall habitat values although complete recovery may take 15 years or more depending on the success of shoreline plantings in creating shade and IWM along the summer-fall shoreline in future years. However, these deficits are not expected to significantly affect species survival and growth because of their small magnitude and the substantial increases in winter-spring habitat values discussed above. Additionally, planting the remnant levee is expected to effectively restore and potentially enhancing summer-fall habitat values along the existing levee slope.

An MMP for the offset areas is being developed on behalf of WSAFCA and will be approved by the Corps, NMFS, USFWS, and CDFW before implementation of the project. The MMP will include representative plans and cross sections of the Southport EIP elements; fish stranding and vegetation monitoring methods; habitat compensation and restoration success criteria; and a protocol for implementing remedial actions should any success criteria not be met. The existing O&M requirements and practices will also be incorporated into the plan. Annual monitoring reports that describe each year's monitoring activities and progress toward the success criteria would be submitted to the resource agencies during the course of the monitoring period. Monitoring would be conducted until the projected benefits of the compensation and restoration actions have been substantially achieved.

In summary, the Southport EIP will result in adverse, short-term construction- and O&M-related effects on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, southern DPS North American green sturgeon, and the freshwater and migration primary constituent elements of critical habitat. These effects will be minimized by the proposed frequency, timing, and duration of in-water activities, and successful implementation of the proposed conservation measures and other BMPs described in the project description. Based on the SAM, the Southport EIP is expected to largely compensate for initial impacts on SRA cover and riparian habitat values on the existing waterside levee of the Sacramento River through the integration of engineered benches, IWM, biotechnical materials, and revegetation of the erosion repair sites, levee breaches, and remnant levee. The proposed levee offset and floodplain restoration plan is expected to substantially improve habitat values for listed fish species in the Southport EIP Action Area by restoring ecologically functional floodplain habitat based on the hydrological, hydraulic, and geomorphic characteristics and habitat functions of natural floodplains. With successful implementation of the MMP, the reconnection and restoration of floodplain habitat will result in significant long-term improvement in rearing and migration primary constituent elements and species responses (improved growth and survival), contributing to overall increases in the conservation value of critical habitat in the Southport EIP Action Area.

Effects Determination

The Southport EIP is likely to adversely affect Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, and southern DPS North American green sturgeon and their designated critical habitat. Adverse effects would result from construction, operations, and maintenance activities, and initial losses of SRA cover and riparian habitat associated with erosion repairs, rock slope protection, and levee breach creation on the existing Sacramento River levee. Overall, the Southport EIP, including successful implementation of the MMP, will result in substantial long-term benefits to listed fish species and overall increases in the conservation value of critical habitat in the Southport EIP Action Area through restoration and enhancement of historic Sacramento River floodplain in the levee offset areas.

Delta Smelt

The Southport EIP is likely to adversely affect delta smelt and its designated critical habitat. Adverse effects would result from construction, operations, and maintenance activities, and initial losses of SRA cover and riparian habitat associated with erosion repairs, rock slope protection, and levee breach creation on the existing Sacramento River levee. Overall, the Southport EIP, including successful implementation of the MMP, would result in substantial long-term benefits to delta smelt and overall increases in the conservation value of critical habitat in the Southport EIP Action Area through restoration and enhancement of historic Sacramento River floodplain in the offset areas.

Giant Garter Snake

Because of the potential direct effects discussed in detail above, including the permanent loss of 2.24 acres of upland habitat and the potential for injury or mortality during construction, the Southport EIP is likely to adversely affect giant garter snake.

5.9 Effects on Essential Fish Habitat

5.9.1 West Sacramento GRR

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended (U.S.C. 180 et seq.), requires that Essential Fish Habitat (EFH) be identified and described in Federal fishery management plans. Federal action agencies must consult with NMFS on any activity that they fund, permit, or carry out that may adversely affect EFH. NMFS is required to provide EFH conservation and enhancement recommendations to the Federal action agencies.

EFH of Pacific salmon, pursuant to section 305 (b) (2) of the MSA, require appropriate determinations for EFH as either: (1) will not adversely effect, or (2) may adversely affect. Important components of EFH for Chinook salmon spawning, rearing, and migration include:

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
- Freshwater rearing sites with:
  - Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
  - Water quality and forage supporting juvenile development; and
  - Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
- Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
- Estuarine areas free of obstruction and excessive predation with:
  - Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater;
  - Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and
  - Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

The West Sacramento GRR includes habitats on the Sacramento River, Yolo Bypass, and the Sacramento Deep Water Ship Channel that have been designated as EFH for Chinook salmon, a major contributor to Pacific Coast salmon fisheries. The Pacific Coast salmon fishery EFH extends along the Pacific Coast from Washington to Point Conception in California. Freshwater EFH includes all habitats currently and historically accessible to salmon and is based on descriptions of habitat used by coho and Chinook salmon. The EFH excludes areas above naturally occurring barriers such as waterfalls, which have been present for several hundred years, and impassible dams identified on large rivers (NMFS 1997). The following analysis of EFH does not include effects to the fish species, just the species habitat as defined in the MSA. Results for the effects of EFH for winter-run, spring-run, and fall/lt-fall-run Chinook salmon in the West Sacramento GRR study area were based on the SAM analysis detailed in Appendix G.

Effects of the Proposed Action on EFH

Site specific project designs were unavailable for the West Sacramento project reach at the time of this SAM analysis. In an effort to fairly assess the impacts of the project action, a "worst case scenario" approach was taken in applying the SAM analysis. The following data sources were used to characterize SAM habitat conditions (as defined by bank slope, floodplain availability, substrate size, instream structure, aquatic vegetation, and overhanging shade) within the West Sacramento project area under existing or pre-project conditions:

- USACE's Sacramento River revetment database – This database was used to stratify the project reach into subreaches that encompass relatively uniform bank conditions based on their general physical characteristics (USACE 2007). This database was used to characterize existing habitat conditions within individual subreaches where more recent data were unavailable.
- Aerial images of the West Sacramento project reach (Google™ Earth), provided current and historical images of bank conditions that were used to address gaps or uncertainties related to existing cover characteristics within individual subreaches.

The SAM employs six habitat variables to characterize near-shore and floodplain habitats of the winter-run, spring-run, and fall/lt-fall-run Chinook species:

- Bank slope—average bank slope of each average seasonal water surface elevation;
- Floodplain availability—ratio of wetted channel and floodplain area during the 2-year flood, to the wetted channel area during average winter and spring flows;
- Bank substrate size—the median particle diameter of the bank (i.e., D50) along each average seasonal water surface elevation;
- Instream structure—percent of shoreline coverage of instream woody material along each average seasonal water surface elevation;
- Aquatic vegetation—percent of shoreline coverage of aquatic or riparian vegetation along each average seasonal water surface elevation; and
- Overhanging shade—percent of the shoreline coverage of shade along each average seasonal water surface elevation.

Sacramento River SAM EFH Analysis

The Sacramento River SAM analysis reach includes the entire right bank (west side) of the Sacramento River from the Sacramento Bypass to the confluence of the Sacramento River and the old Stone Locks near the Port of Sacramento. This reach also includes the short cut-off levee described as part of the Port South phase of the project.

Short Term

Short term construction activities may adversely affect Chinook EFH. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions most positively associated with fry and juvenile rearing and migration.

Long Term

Long term construction actions will not adversely affect EFH on the Sacramento River portion of the West Sacramento GRR study area. EFH is expected to show a long term positive response to project actions in the Sacramento River SAM analysis reach over the lifetime of the project. Positive EFH response would be most likely associated with long term growth of SRA (overhanging shade) and aquatic vegetation.

Yolo Bypass SAM EFH Analysis

Although a SAM analysis for the Yolo Bypass SAM analysis reach was conducted, the results were excluded from the final report. Through discussion with NMFS, it was determined that the unique environmental conditions in the Yolo Bypass SAM analysis reach, exceed the applications of the SAM. The Yolo Bypass SAM analysis reach includes portions of the perennial tidal Toe Drain and portions of the Sacramento and Yolo Bypass levees that are only periodically inundated. During typical summer-fall conditions, SAM focus fish species which include Chinook salmon are generally absent from the Toe Drain (Harrel, 2003). During winter-spring conditions, assuming inundation, the Yolo Bypass provides a large amount of floodplain habitat. Under the "worst case scenario" assumptions, project actions along the Yolo Bypass SAM analysis reach would result in the removal of all trees and vegetation which would result in a determination of may adversely affect EFH; due to the abundance of floodplain habitat during inundation, it is highly unlikely that the loss of these shoreline habitat features would impact overall EFH that would be available and most likely utilized by Chinook salmon in the Yolo Bypass during winter-spring conditions. With this taken into consideration, the project effects will not adversely affect EFH in the Yolo Bypass.

Deep Water Ship Channel/Port SAM Analysis

Short Term

Short term construction activities may adversely affect Chinook EFH. Short term habitat deficits will result from the initial loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions most positively associated with fry and juvenile rearing and migration..

Long Term

Long term construction effects may adversely affect EFH in the DWSC. Habitat deficits displayed a general trend toward increasing beyond the lifetime of the project. Long term habitat deficits will result from the permanent loss of aquatic vegetation and over hanging shade at fall/summer habitat conditions due to compliance with the Corps ETL.

5.9.2 Southport EIP

The MSA, as amended (U.S.C. 180 et seq.), requires that EFH be identified and described in Federal fishery management plans. Federal action agencies must consult with NMFS on any activity that they fund, permit, or carry out that may adversely affect EFH. NMFS is required to provide EFH conservation and enhancement recommendations to the Federal action agencies.

EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. NMFS defines these terms as follows.

- “Waters” includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate.
- “Substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities.
- “Necessary” means habitat required to support a sustainable fishery and a healthy ecosystem.
- “Spawning, breeding, feeding, or growth to maturity” covers all habitat types used by a species throughout its life cycle.

Freshwater EFH for salmon consists of four major components: spawning and incubation habitat, juvenile rearing habitat, juvenile migration corridors, and adult migration corridors and adult holding habitat. Important attributes of EFH for spawning, rearing, and migration include suitable substrate composition; water quality (e.g., dissolved oxygen, nutrients, temperature); water quantity, depth and velocity; channel gradient and stability; food; cover and habitat complexity (e.g., large woody material, pools, channel complexity, aquatic vegetation); space; access and passage; and floodplain and habitat connectivity (Pacific Fishery Management Council 2003).

The Action Area of the Southport EIP is within the region identified as EFH for Pacific salmon in Amendment 14 of the Pacific Salmon FMPs. EFH in the Action Area consists of adult migration habitat and juvenile rearing and migration habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley fall-/late fall-run Chinook salmon, all of which are managed under the Pacific Coast Salmon FMP. Descriptions of these species are described in Chapter 3.

Effects of the Proposed Action on EFH

The effects of the Southport EIP on Pacific Coast salmon EFH would be similar to the effects of the Southport EIP on the designated critical habitat of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and California Central Valley steelhead, as discussed in the preceding BA. A summary of these effects and conclusions are presented below and applied to EFH.

The Southport EIP would result in short-term and long-term effects on Pacific coast salmon EFH. Short-term effects include construction-related increases in turbidity and suspended sediment in the Sacramento River. As discussed in the preceding BA, these effects would be temporary and localized and would be further minimized by the restriction of in-water construction activities to the low-flow period (July 1 and October 31) and compliance with Central Valley RWQCB turbidity objectives and other proposed erosion and sediment control BMPs (see Conservation Measures). The risk of spills or discharges of contaminants in the Sacramento River would be effectively minimized by implementation of a spill prevention and control plan.

Long-term effects on Pacific coast salmon EFH include modification of SRA cover, riparian, and floodplain habitat. Adverse effects resulting from the removal of riparian vegetation and installation of riprap on the waterside slope of the Sacramento River levee would be addressed through onsite integration of engineered benches, IWM, biotechnical materials, and re-vegetation at the erosion repair sites, levee breaches, and remnant levee. Based on the SAM, initial deficits in winter-spring habitat values would be fully offset in the first year of levee breach construction (year 3) by increases in floodplain area and shallow water habitat on the restored floodplain, followed by long-term increases in habitat values associated with the growth of planted vegetation on the erosion repair sites, levee breaches, and remnant levee. The installation of IWM along the summer-fall shorelines of the erosion repair sites is sufficient to compensate or nearly compensate for initial deficits in fall habitat values although complete recovery may take 15 years or more depending on the success of plantings in creating shade and IWM along the summer-fall shoreline. Planting the remnant levee is expected to effectively restore and potentially enhance summer-fall habitat values along the existing levee slope. Overall, the Southport EIP, including successful implementation of the MMP, would compensate for adverse effects on EFH and result in substantial long-term increases in the quantity and quality of EFH for Chinook salmon through the restoration and enhancement of historic Sacramento River floodplain in the levee setback area.

6.0 References

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Appendix J.2

USFWS Initiation Letter for the West Sacramento General Reevaluation Study and the Southport Sacramento River Early Implementation Project

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA, 95814-2922

REPLY TO
ATTENTION OF

Environmental Resources Branch

NOV 21 2014

Ms. Jennifer M. Norris, Field Supervisor
U.S. Fish and Wildlife Service
2800 Cottage Way, Suite W2605
Sacramento, California 95825-1846

Dear Ms. Norris:

We are requesting to initiate formal consultation under Section 7(a) of the Endangered Species Act for the West Sacramento Project, General Reevaluation Report (West Sacramento Project) and the Southport Early Implementation Project (Southport EIP). Both projects are located in Yolo County, California. The West Sacramento Project includes the geographic area and project features that are also being considered in the Southport EIP. Either or both of these actions may be approved and constructed. The U.S. Army Corps of Engineers (Corps) initiated consultation for the Southport EIP in a letter dated June 4, 2013. The Southport EIP consultation was then combined with the West Sacramento GRR consultation in a letter dated June 10, 2014, and the original consultation request was withdrawn in a letter dated October 27, 2014. On July 23, 2014, the Corps received a letter from the U.S. Fish and Wildlife Service requesting additional information on the project. Therefore, this letter transmits an updated BA containing the additional information requested in the July letter.

Under the West Sacramento Project, the Corps and the non-Federal project partners, the Central Valley Flood Protection Board (CVFPB) and West Sacramento Area Flood Control Agency (WSAFCA), are proposing to improve 50 miles of levees surrounding the city of West Sacramento to reduce flood risk to the city. The study authority for the West Sacramento area was provided through Section 209 of the Flood Control Act of 1962, Public Law 87-874. In a separate but related action, WSAFCA is proposing to implement the Southport EIP to provide 200-year protection consistent with the goal for urbanized areas, as well as to provide opportunities for ecosystem restoration and public recreation. To implement this project, WSAFCA is requesting permission from the Corps pursuant to Section 14 of the Rivers and Harbors At of 1899. (Title 33 of the United States Code [USC], Section 408 [33 USC 408]), referred to as Section 408, for the alteration of the Federal flood management project. WSAFCA is also seeking a permit under Section 404 of the Clean Water Act (CWA) for regulation of dredged or fill material in jurisdictional waters of the United States, and under Section 10 of the Rivers and Harbors Act of 1899 for regulation of navigable waters. CVFPB and WSAFCA propose to begin construction on the Southport EIP in the summer of 2015.

Levees in the project area require improvements to address seepage, slope stability, overtopping, and erosion concerns. The measures proposed to improve the levees are described in the attached Biological Assessment (BA) and consist of seepage cutoff walls, seepage berms, stability berms, levee raises, flood walls, relief wells, sheet pile walls, jet grouting, and bank protection. The above measures would be implemented by fixing levees in place, constructing adjacent levees, or constructing a setback levee.

Three listed species (and their critical habitats) have the potential to occur in the action area and may be affected by the proposed action. Accordingly, these species, as displayed in the following table, are the subject of the attached BA.

Common Name	**Scientific Name**	**Critical Habitat in the Action Area**
Threatened and Endangered Species		
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Yes
Delta Smelt	*Hypomesus transpacificus*	Yes
Giant garter snake	*Thamnophis gigas*	No

Valley elderberry longhorn beetle (VELB) habitat and elderberry shrubs occur throughout the project area. The levee slopes and landside footprint contain largely non-native ruderal grasses, with some thistle, while the waterside of the levees have riparian vegetation with riprap on some of the levee slopes. There is the potential that approximately 120 elderberry shrubs could be directly impacted by construction of the West Sacramento Project. Because of the potential direct effects, including the removal of elderberry shrubs and the potential for injury or mortality of VELB during removal and transplantation, the Proposed Action is likely to adversely affect VELB. However, the Corps would implement measures to minimize and compensate for these impacts, as detailed in the enclosed BA.

Delta smelt and their critical habitat have the potential to be adversely affected from in water work in the form of the placement of riprap along the Sacramento River levees. Adverse effects would result from construction, operations, and maintenance activities, and initial losses of SRA cover and riparian habitat associated with erosion repairs, rock slope protection, and levee breach creation on the existing Sacramento River levee. However, construction would be completed within the applicable work windows to minimize impacts to fish. Additional measures to reduce impacts to Delta smelt are described in the enclosed BA, including the restoration and enhancement of historic Sacramento River floodplain in the levee setback area. Overall, with successful mitigation, the project is expected to result in long-term benefits to Delta smelt and overall increases in the conservation value of critical habitat in the Action Area.

Giant garter snake habitat does occur along the Sacramento River Deep Water Ship Channel east and west levees, along the Yolo Bypass levees, and along the Port of West Sacramento north and south levees. The project is likely to adversely impact approximately 31 acres of aquatic giant garter snake habitat and a maximum of 211 acres of upland giant garter snake habitat, of which 200 acres would be only temporarily impacted. The Corps would implement measures to minimize and compensate for these impacts, as detailed in the enclosed BA.

Based on the information provided in this letter and the attached BA, the West Sacramento Project and the Southport EIP are likely to adversely affect the valley elderberry longhorn beetle, Delta smelt, and giant garter snake, and their critical habitat. Therefore, we request a Biological Opinion with incidental take statements for the West Sacramento Project and the Southport EIP. If you have questions regarding this action, please contact Ms. Sarah Ross Arrouzet for the West Sacramento Project, at (916) 557-5256 or by e-mail: Sarah.R.RossArrouzet@usace.army.mil. For questions on the Southport EIP, please contact Ms. Tanis Toland, at (916) 557-6717 or by e-mail: Tanis.J.Toland@usace.army.mil. Please provide questions or comments via e-mail within 30 days of the receipt of this letter. Thank you for your attention to this matter.

Sincerely,

Alicia E. Kirchner
Chief, Planning Division

Enclosure

cc:
Mr. Harry Kahler, U.S. Fish and Wildlife Service, 2800 Cottage Way, Room W-2605, Sacramento, California 95825-1846
Mr. Michael Hendrick, National Marine Fisheries Service, 650 Capitol Mall, Suite 5-100 Sacramento, CA 95819

DATE 20-NOV-14

cc:
CESPK-PD
CESPK-PD-RA (Ross Arrouzet)

ROBERTSON
CESPK-PD-R

BAKER
CESPK-PD-RA

ROSS ARROUZET
CESPK-PD-RA

TOLAND
CESPK-PD-R

GARCIA
CESPK-PD-RA

ORELLANA
CESPK-CO-OR

FUGLER
CESPK-RD-S

LAKE
CESPK-PM-C

STACHER
CESPK-PD

RUSSI
CESPK-PD

KIRCHNER
CESPK-PD

Appendix J.3

NMFS Initiation Letter for the West Sacramento General Reevaluation Study and the Southport Sacramento River Early Implementation Project

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA, 95814-2922

REPLY TO
ATTENTION OF

Environmental Resources Branch

NOV 2 1 2014

Ms. Maria Rae
Assistant Regional Administrator
Central Valley Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, CA 95819

Dear Ms. Rae:

We are requesting to initiate formal consultation under Section 7(a) of the Endangered Species Act for the West Sacramento Project, General Reevaluation Report (West Sacramento Project) and the Southport Early Implementation Project (Southport EIP). Both projects are located in Yolo County, California. The West Sacramento Project includes the geographic area and project features that are also being considered in the Southport EIP. Either or both of these actions may be approved and constructed. The U.S. Army Corps of Engineers (Corps) requested to initiate consultation for the Southport EIP in a letter dated June 4, 2013. The Southport EIP consultation was then combined with the West Sacramento GRR consultation in a letter dated June 10, 2014, and the original consultation request was withdrawn in a letter dated October 10, 2014. On September 9, 2014, the Corps received a letter from the National Marine Fisheries Service with the determination that the BA lacked sufficient information to initiate consultation at that time. Therefore, this letter transmits an updated BA containing the additional information requested in the September letter.

Under the West Sacramento Project, the Corps, and the non-Federal project partners, the Central Valley Flood Protection Board (CVFPB) and West Sacramento Area Flood Control Agency (WSAFCA), are proposing to improve 50 miles of levees surrounding the city of West Sacramento to reduce flood risk to the city. The study authority for the West Sacramento area was provided through Section 209 of the Flood Control Act of 1962, Public Law 87-874. In a separate but related action, WSAFCA is proposing to implement the Southport EIP to provide 200-year protection consistent with the goal for urbanized areas, as well as to provide opportunities for ecosystem restoration and public recreation. To implement this project, WSAFCA is requesting permission from the Corps pursuant to Section 14 of the Rivers and Harbors At of 1899 (Title 33 of the United States Code [USC], Section 408 [33 USC 408]), referred to as

Section 408, for the alteration of the Federal flood management project. WSAFCA is also seeking a permit under Section 404 of the Clean Water Act (CWA) for regulation of dredged or fill material in jurisdictional waters of the United States, and under Section 10 of the Rivers and Harbors Act of 1899 for regulation of navigable waters. CVFPB and WSAFCA propose to begin construction on the Southport EIP in the summer of 2015.

Levees in the project area require improvements to address seepage, slope stability, overtopping, and erosion concerns. The measures proposed to improve the levees are described in the attached Biological Assessment (BA) and consist of seepage cutoff walls, seepage berms, stability berms, levee raises, flood walls, relief wells, sheet pile walls, jet grouting, and bank protection. The above measures would be implemented by fixing levees in place, constructing adjacent levees, or constructing a setback levee.

Four listed species (and their critical habitats) have the potential to occur in the action area and may be affected by the proposed action. Accordingly, these species, as displayed in the following table, are the subject of the attached BA.

Common Name	Scientific Name	Critical Habitat in the Action Area
Threatened and Endangered Species		
Sacramento River winter-run Chinook Salmon ESU	*Oncorhynchus tshawytscha*	Yes
Central Valley spring-run Chinook Salmon ESU	*Oncorhynchus tshawytscha*	Yes
Central Valley steelhead DPS	*Oncorhynchus mykiss*	Yes
Green Sturgeon southern DPS	*Acipenser medirostris*	Yes

The above-listed fish species and their critical habitat have the potential to be adversely affected from in water work in the form of the placement of riprap along the Sacramento River levees. Adverse effects would result from construction, operations, and maintenance activities, and initial losses of Shaded Riverine Aquatic habitat cover and riparian habitat associated with erosion repairs, rock slope protection, and levee breach creation on the existing Sacramento River levee. However, construction would be completed within the applicable work windows to minimize impacts to fish. Additional measures to reduce impacts to fish species are described in the enclosed BA, including the restoration and enhancement of historic Sacramento River floodplain in the levee setback areas. Overall, with successful mitigation, the West Sacramento project is expected to result in long-term benefits to listed fish species and overall increases in the conservation value of critical habitat in the Action Area.

Based on the information provided in this letter and the attached BA, we have determined that the West Sacramento Project and the Southport EIP are likely to adversely affect the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and green sturgeon, and their critical habitat. Therefore, we request a Biological Opinion with incidental take statements for the West Sacramento Project and the Southport EIP.

We have also determined that the West Sacramento project and the Southport EIP may benefit the long-term quality of Essential Fish Habitat (EFH) pursuant to the Magnuson-Stevens Fishery Management Act. However, EFH may be adversely affected during construction due to habitat disturbance from the initial loss of aquatic vegetation. Conservation measures are proposed for both projects to minimize potential adverse effects on EFH.

If you need any additional information or have questions regarding this action, please contact Ms. Sarah Ross Arrouzet for the West Sacramento Project, at (916) 557-5256 or by e-mail: Sarah.R.RossArrouzet@usace.army.mil. For questions on the Southport EIP, please contact Ms. Tanis Toland, at (916) 557-6717 or by e-mail: Tanis.J.Toland@usace.army.mil. Please provide questions or comments via e-mail within 30 days of the receipt of this letter. Thank you for your attention to this matter.

Sincerely,

Alicia E. Kirchner
Chief, Planning Division

Enclosure

cc:
Mr. Michael Hendrick, National Marine Fisheries Service, 650 Capitol Mall, Suite 5-100 Sacramento, CA 95819
Mr. Harry Kahler, U.S. Fish and Wildlife Service, 2800 Cottage Way, Room W-2605, Sacramento, California 95825-1846

cc:
CESPK-PD
CESPK-PD-RA (Ross Arrouzet)

ROBERTSON
CESPK-PD-R

BAKER
CESPK-PD-RA

ROSS ARROUZET
CESPK-PD-RA

TOLAND
CESPK-PD-R

GARCIA
CESPK-PD-RA

ORELLANA
CESPK-CO-OR

FUGLER
CESPK-RD-S

LAKE
CESPK-PM-C

STACHER
CESPK-PD

RUSSI
CESPK-PD

KIRCHNER
CESPK-PD

Appendix J.4

USFWS Biological Opinion for the West Sacramento General Reevaluation Study and the Southport Sacramento River Early Implementation Project

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W-2605
Sacramento, California 95825-1846

In Reply Refer to:
FF08ESMF00-
2014-F-0434-2

JAN 06 2015

Ms. Alicia E. Kirchner
Chief, Planning Division
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814

Subject: Formal Consultation on the West Sacramento Project General Reevaluation Report, Yolo County, California

Dear Ms. Kirchner:

This letter is in response to the U.S. Army Corps of Engineers (Corps) November 21, 2014, request for initiation of formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed West Sacramento Project General Reevaluation Report (West Sacramento GRR Project or project) in Yolo County, California. Your request, which included the November 2014 Biological Assessment, West Sacramento, California General Reevaluation Study and Section 408 Permission (biological assessment), was received by mail from the Corps by the Service on November 24, 2014. The biological assessment presents an evaluation of the West Sacramento GRR Project effects on species federally-listed under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). This response is provided under the authority of the Act, and in accordance with the implementing regulations pertaining to interagency cooperation (50 CFR 402).

The purpose of the West Sacramento GRR Project is to evaluate flood risk and provide improvements to flood management for the City of West Sacramento. It includes the Southport Project, which is to be completed as an early implementation project by the West Sacramento Area Flood Control Agency (WSAFCA) upon permission from the Corps, pursuant to Section 14 of the River and Harbors Act of 1899 (33 U.S.C. 408). Pursuant to 50 CFR 402.12(j), you submitted the 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 federally-threatened giant garter snake (*Thamnophis gigas*) (snake), federally-threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (beetle), and federally-threatened delta smelt (*Hypomesus transpacificus*) (smelt), as well as delta smelt critical habitat.

In considering your request, we based our evaluation of the biological assessment's findings on the following: (1) your consultation request and biological assessment received November 24, 2014; (2) site visits with Service, Corps, WSFACA, ICF International (ICF) representatives, and others; (3) numerous meetings with the Service, Corps, National Marine Fisheries Service (NMFS), WSAFCA, ICF, and others; (4) e-mail correspondence and other communication between the Service and the Corps; and (5) other information available to the Service. A complete administrative record is on file at the Sacramento Fish and Wildlife Office.

Consultation History

May 26, 2011	The Service attended a stakeholders meeting outlining preliminary plans for the Southport Early Implementation Project (Southport Project). The Southport Project was planned to proceed in advance of the other portions of the West Sacramento GRR Project.
August 15, 2011	WSAFCA held a stakeholder meeting and field visit for the Southport Early Implementation Project of the West Sacramento GRR Project, which the Service and the Corps attended.
February 12, 2013	The Corps provided the Service a draft biological assessment prepared by ICF for the Southport Project.
February 21, 2013	The Service provided comments on the draft biological assessment for the Southport Project. The comments centered on the need to include the delta smelt in the biological assessment.
June 3, 2013	The Service attended a meeting and site visit along with representatives from WSAFCA, ICF, NMFS, the California Department of Fish and Wildlife (CDFW), and others to review the proposed plans for the Southport Project.
June 5, 2013	The Service received a formal consultation request for the Southport Project from the Corps, dated June 4, 2013, along with a biological assessment.
August 27, 2013	The Corps hosted a meeting with the Service, NMFS, WSAFCA, and ICF. Mike Hendrick (NMFS) noted that NMFS would be preparing an insufficiency letter based on the project design noted in the Southport Project biological assessment.
September 4, 2013	Harry Kahler (Service) e-mailed Tanis Toland (Corps) noting that in lieu of impending changes to the Southport Project description, work on the consultation would be suspended until the project description was updated.
December 18, 2013	The Service attended a meeting at ICF discussing design modifications to the Southport Project that addressed concerns raised in NMFS insufficiency letter and previous meetings.

January 23, 2014	The Service received from the Corps a draft biological assessment for the West Sacramento GRR Project. The biological assessment did not contain information regarding the Southport Project.
March 20, 2014	The Corps hosted a meeting attended by the Service and NMFS to discuss the inter-relatedness of concurrent projects – the Southport Project, the West Sacramento West Sacramento GRR Project, the Sacramento River Bank Protection Project, and the American River Watershed Investigation, Common Features, General Reevaluation Report Project.
April 21, 2014	The Corps hosted a meeting attended by the Service and NMFS. The Service recommended that the Southport Project and the West Sacramento GRR Project be included in one biological opinion.
June 9, 2014	The Service received a request from the Corps to initiate formal consultation on the West Sacramento GRR Project. The initiation letter and biological assessment included the Southport Project.
June 19, 2014	The Service conveyed to the Corps via telephone and e-mail that effects to smelt and smelt critical habitat are quantified in terms of acreage, rather than in linear feet of river, as is the case for salmonids. The Service requested the Corps provide the acreage of smelt shallow water habitat that is to be affected by the West Sacramento GRR Project.
July 23, 2014	The Service sent a letter to the Corps detailing the need for more information regarding the amount of smelt habitat that will be impacted by the project and the amount of smelt habitat that will be created.
September 24, 2014	The Service received a response from the Corps, dated September 23, 2014, describing the amount of smelt shallow water habitat that will impacted by the West Sacramento GRR Project and the amount that will be created by the Southport Project.
October 16, 2014	The Corps held a meeting with the Service and NMFS, stating that they would be seeking incidental take coverage from Section 9 of the Act for the West Sacramento GRR Project as a whole, rather than taking a programmatic approach.
October 20, 2014	The Service downloaded an updated biological assessment from the Corps' FTP site.
October 27, 2014	The Corps sent via electronic mail a copy of a letter to the Service that officially withdrew the June 4, 2013, request for consultation for the Southport Project based on updated information regarding the West Sacramento GRR Project Plans.

November 21, 2014 The Corps sent via electronic mail a new request to initiate formal consultation for the West Sacramento GRR Project. An electronic link was included that provided access to the November 2014 final biological assessment.

November 24, 2014 The Service received by mail the signed request to initiate formal consultation for the West Sacramento GRR Project along with the biological assessment that addressed concerns raised by the Service and NMFS following the initiation request received June 9, 2014.

November 25, 2014 The Service requested and received, via electronic mail and telephone conversations, clarification regarding the identification and selection of potential sites for construction borrow material. The Corps explained that although potential borrow sites are identified for the West Sacramento GRR Project, the sites are subject to field verification for suitability.

BIOLOGICAL OPINION

Description of the Action

In 2006, a comprehensive evaluation of West Sacramento levees was completed by WSAFCA, in conjunction with the California Department of Water Resources, to determine the current level of flood protection provided by the levee system, to identify the magnitude and severity of levee deficiencies, and to propose flood risk reduction measures (HDR 2008). Results of the comprehensive evaluation revealed multiple levee deficiencies that would require substantial improvements to meet flood protection standards as implemented federally by the Corps. Furthermore, Senate Bill 5 signed in 2007 by Governor Arnold Schwarzenegger requires that urban areas such as West Sacramento achieve 200-year level flood protection by 2025.

The West Sacramento GRR Project is a Corps feasibility study of the improvements needed to provide West Sacramento with 200-year level flood protection. Its primary purpose is to assess and address the levee deficiencies on the nearly 50 miles of levees surrounding West Sacramento. Improvements to levees will be made incrementally, rather than altogether as one large project. In fact, three levee reaches with severe deficiencies have already been constructed by WSAFCA as Early Implementation Projects at the I Street Bridge, the CHP Academy, and The Rivers sites, all progressing in advance of the West Sacramento GRR Project. A fourth Early Implementation Project, known as the Southport Project, is included herein as part of the West Sacramento GRR Project.

West Sacramento is divided into two basins by levees, a north basin of about 6,100 acres and a south basin of about 6,900 acres. Deficiencies identified among different levee reaches of each basin generally include seepage, slope stability, erosion, and height insufficiencies (Figure 1). Construction will occur sequentially through each levee reach over a 19-year period, beginning with the Sacramento River South Levee. As a proposed Early Implementation Project, the Southport Project design along the Sacramento River South levee reach is more refined and detailed than the rest of the West Sacramento GRR Project. The proposed levee remediation measures vary among the nine levee reaches of the two basins and are summarized in Table 1.

Figure 1. West Sacramento General Reevaluation Report Project levee deficiencies, City of West Sacramento, Yolo County, California (Corps 2014b).

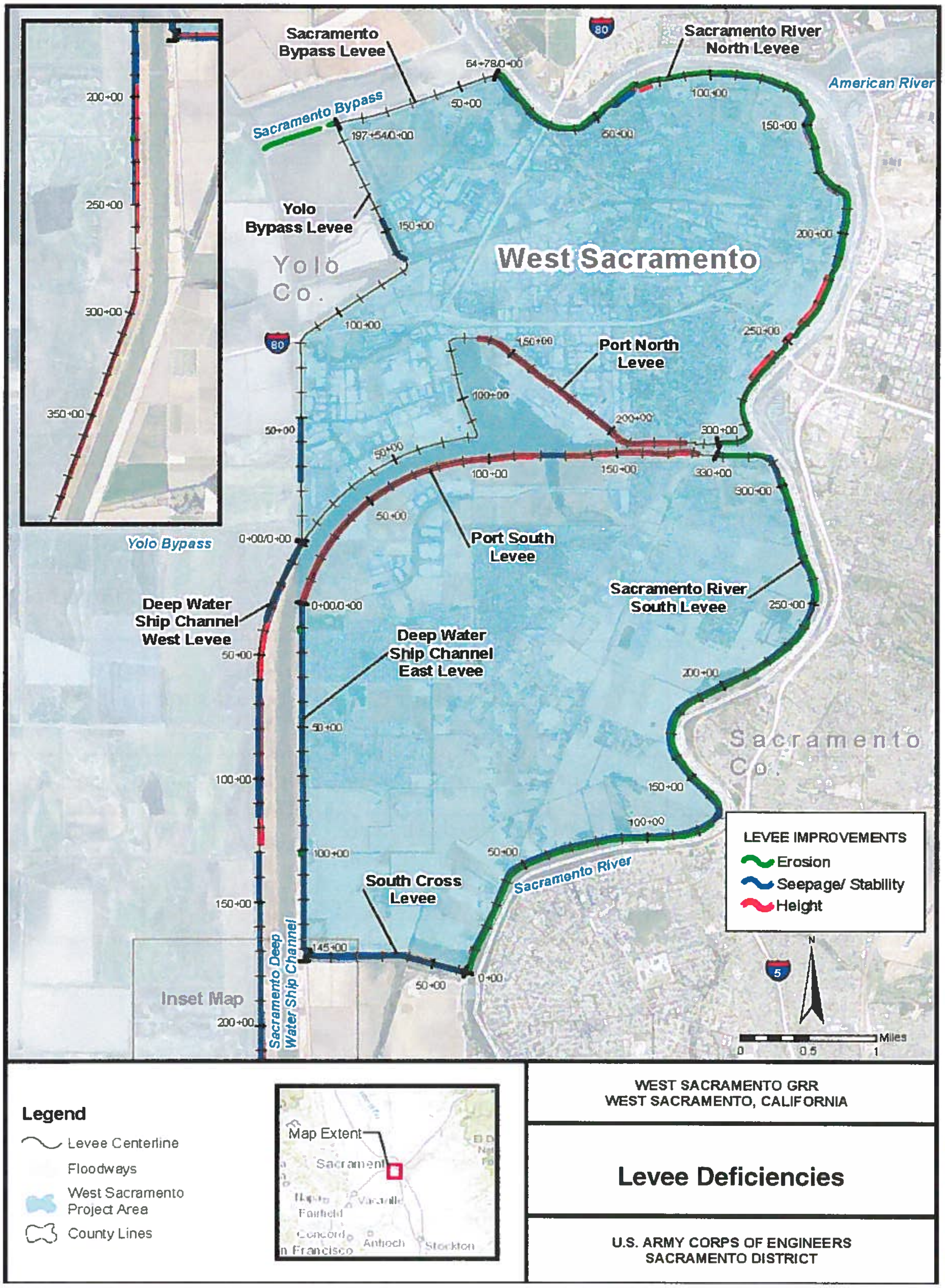


Table 1. Proposed remediation by levee reach, West Sacramento General Reevaluation Report, City of West Sacramento, Yolo County, California (Corps 2014b).

Levee Reach	Construction Sequence and Duration*	Seepage Remediation	Stability Remediation	Overtopping Remediation	Erosion Protection
	NORTH BASIN				
Sacramento River North	3 (2 years)	Cutoff Wall	Cutoff Wall	Levee Raise	Bank Protection
Port North	9 (2 years)	---	---	Floodwall	---
Yolo Bypass	4 (1 year)	Cutoff Wall	Cutoff Wall	---	---
Sacramento Bypass Training Levee	2 (1 year)	---	---	---	Bank Protection
	SOUTH BASIN				
South Cross	8 (2 years)	Stability Berm, Relief Wells	---	Levee Raise	---
Deep Water Ship Channel East	7 (3 years)	Cutoff Wall	Cutoff Wall	Levee Raise	Bank Protection
Deep Water Ship Channel West	5 (3 years)	Cutoff Wall	Cutoff Wall	Levee Raise	---
Port South	6 (1 year)	Cutoff Wall	Cutoff Wall	Levee Raise	---
Sacramento River South	1 (3 years)**	Setback Levee, Cutoff Wall, Seepage Berm	Setback Levee, Cutoff Wall, Seepage Berm	---	Setback Levee, Bank Protection

* Construction throughout all levee reaches is scheduled to occur sequentially over a 19-year period.

** Construction of flood-risk reduction measures will require 3 years; contouring and restoration of the associated offset floodplain area will require an additional 3 years.

Operation and Maintenance

As construction along levee reaches throughout the West Sacramento GRR Project area is completed, re-sloping and compacting will occur as needed. After construction, piezometers will be installed at various locations along the levees to monitor groundwater levels. Monthly visual inspections by driving along access roads on the crown will monitor levee conditions. Access roads will be maintained yearly with new aggregate base or substrate if necessary. Upon completion of construction, levees will be maintained per the approved operations and maintenance (O&M) manual applicable to each levee reach throughout the West Sacramento GRR Project area. Levees are expected to be mowed up to four times a year to control vegetation. Herbicide applications will be used as needed. Burrowing mammal activity will be controlled monthly by baiting with pesticides.

Details of each specific construction measures are described below, followed by descriptions of the deficiencies and corrective construction measures for each levee reach of the West Sacramento GRR Project.

Construction Methods

Several construction methods will be used to alleviate seepage, slope stabilization concerns, overtopping, and erosion. In addition, some general construction measures will be implemented throughout the West Sacramento GRR Project, regardless of the specific corrective measures that will be applied. Flood risk reduction measure construction activities will primarily occur during the typical construction season for flood control projects, April 15 to October 31.

General Construction Measures

Standard Levee Footprint
On all levees that are out of compliance with Corps policies, a standard levee footprint will be established during construction. The standard levee footprint consists of a 20-foot crown with 3 horizontal:1 vertical (3H:1V) levee slopes. If a 3H:1V landside slope is not possible given the site-specific conditions, then a minimum slope of 2H:1V will be established. Also, a 20-foot-wide maintenance access buffer will be established on both the landside and waterside levee toes. If 20 feet is not possible, given site-specific conditions, then a minimum of 10 feet will be designed as a buffer. All encroachments into the levee footprint will be brought into compliance with Corps policy or removed. Encroachments include buildings, certain vegetation, utility poles, and pump stations, as well as underground pipes, conduits, and cables. Bringing into compliance generally means relocation, reconstruction, or retrofitting. Any utility lines found within the levee footprint will either be relocated above the new levee prism, or equipped with positive closure devices for through-lines. Private encroachments will be removed by the non-Federal sponsor (WSAFCA) or property owner prior to construction.

Vegetation Policy Compliance
The Corps has established and plans to follow guidelines for landscape planting and vegetation management at levees, floodwalls, embankment dams, and appurtenant structures, as described in Engineering Technical Letter (ETL) 1110-2-583 (Corps 2014a). The primary purpose of the vegetation-free zone is to provide a reliable corridor of access to, and along, flood control structures. A three-dimensional vegetation-free zone will surround all levees, floodwalls, embankment dams, and critical appurtenant structures in all flood damage reduction systems. The vegetation-free zone applies to all vegetation except perennial grass species, which are permitted for the purpose of erosion control. The vegetation free zone extends 15 feet from both landside and waterside levee toes, and 8 feet vertically.

A variance from the vegetation policy is being sought for work along the Sacramento River North and Sacramento River South levee reaches. Along much of the Sacramento River within the project area, the distance between the levee toe and the river waterline is sufficient to allow vegetation to remain along the riverbank without a variance. However; in some places, trees will be thinned along the Sacramento River North Reach to allow placement of rock slope protection, and therefore would require a variance.

Borrow Materials
A maximum estimate of 9 million cubic yards of borrow material will be needed to construct the West Sacramento GRR Project. Because most of the project is in the preliminary stages of design, detailed studies of each levee reach borrow needs have not been completed. A worst case scenario was evaluated for the volume of borrow material needed. Actual volumes exported from any single borrow site may 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 West Sacramento GRR Project area (Figure 2). The criteria used to determine potential locations were based on current land use patterns, soil types from U.S. Soil Conservation Service (SCS), and the Corps' criteria for material specifications. The data from the land use maps and the SCS will be field verified. To reduce impacts, the closest identified potential borrow sites will be evaluated for suitability first, with additional sites being evaluated as needed. Any identified potential borrow sites outside of the City of West Sacramento that may affect federally-listed species, or may adversely modify designated federally-listed species critical habitat, will not be used for borrow material. Borrow sites will only be obtained from willing sellers.

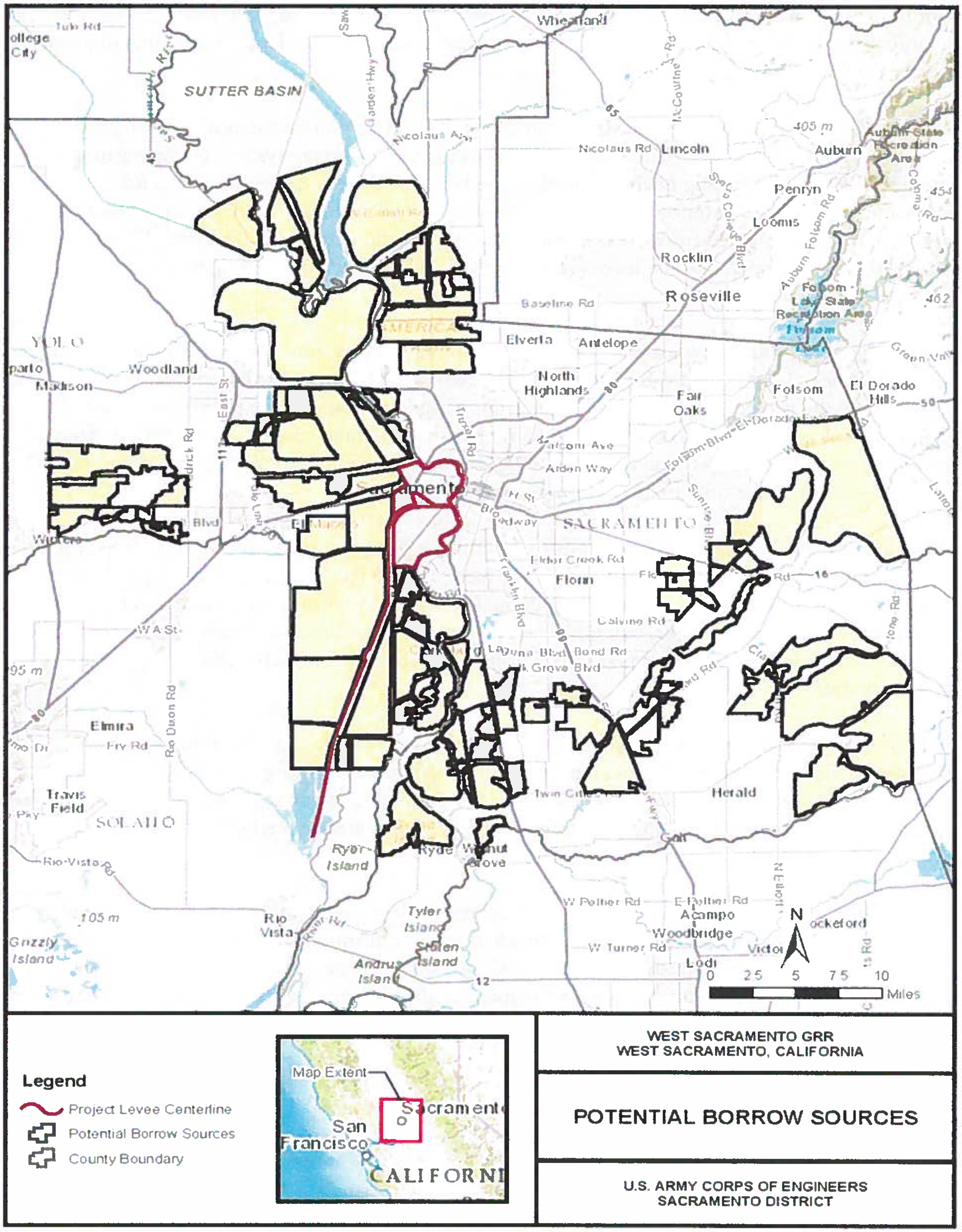
The excavation limits on the borrow sites will provide a minimum buffer of 50 feet from the edge of the site boundary. From this setback, the slope from the existing grade down to the bottom of the excavation will be no steeper than 3H:1V. Excavation depths from the borrow sites will be determined based on available suitable material and local groundwater conditions. The borrow sites will be stripped of top material and excavated to appropriate depths. Once material is extracted, borrow sites will be returned to their existing use whenever possible, or these lands could be used to mitigate for project effects, if appropriate.

Seepage Remediation and Slope Stabilization

Slurry Cutoff Walls
Conventional Open Trench Cutoff Wall: A 3-foot-wide trench is dug from the top of the levee centerline up to 85 feet deep into the substrate materials. As the trench is excavated, it is filled with a temporary bentonite slurry to prevent cave-ins. To form the wall, the soil from the excavation is mixed with hydrated bentonite or cement and backfilled into the trench, displacing the temporary slurry. Once the permanent soil-slurry mix is hardened, the levee embankment is reconstructed and capped with an impervious or semi-impervious soil. Heavy equipment to be used for cutoff walls includes bulldozers, haulers, excavators, scrapers, rollers, and water trucks.

Clamshell Method Cutoff Wall: The clamshell method is similar to the conventional open trench method, yet also employs a dragline crane with a clamshell bucket. The initial trench is excavated and backfilled as described for the conventional open trench method, yet the dragline crane and clamshell bucket is used when the trench becomes too deep to complete conventionally. The bentonite grout is mixed with the native soil and poured in the trench as the clamshell is removed. Cement is added to the mix at times to add strength and decrease curing time.

Figure 2. Potential Locations for Borrow Material within a 20-mile Radius of the West Sacramento General Reevaluation Report Project action area, California, 2014.



Deep Soil Mixing Cutoff Wall: At the wall site a crane with two to four augers will drill through the levee crown to a depth of up to 140 feet. High-pressure hoses will carry the grout from the batching plant to the wall site, where the grout is injected through the augers and mixed with native soils. As the drilling apparatus progresses along the levee crown, a series of overlapping columns of grout mixture are left to form the wall.

Because large quantities of a cement-bentonite grout are used, a contractor-provided onsite batch plant is necessary. The batch plant will consist of an aggregate storage system, an aggregate rescreen system if needed, a rewashing facility if needed, the batching system, cement storage, ice manufacturing, and the grout mixing and loading system. All aggregate used within the batch plant operations will be obtained from local commercial sources and delivered to the site. When the wall has hardened it is capped and the levee embankment is reconstructed with impervious or semi-impervious materials.

Jet Grouting: Jet grouting typically is used in constructing a slurry cutoff wall to access areas other methods cannot. Jet grouting will be used around existing utilities not proposed for removal, and at bridges along the project levees. It involves injecting fluids or binders into the soil at very high pressure to a maximum depth of about 130 feet. The injected fluid can be grout; grout and air; or grout, air, and water. Jet grouting breaks up soil and, with the aid of a binder, forms a homogenous mass that solidifies over time to create a mass of low permeability.

Equipment required for jet grouting consists of a drill rig complete with a high flow pump and portable batch plant. Jet-grouted columns range from 1 to 16 feet in diameter and typically are interconnected to form cutoff barriers or structural sections. A construction crew usually consists of a site supervisor, pump operator, batch plant operator, chuck tender, and driller, and can construct two 6-foot diameter 50-foot columns per day consisting of about 100 cubic yards of grout injected per 8-hour shift.

To provide a wide enough working platform on the levee crown, the upper portion of some segments of the levee may require degradation with a paddle wheel scrapper. Material will be scraped and stockpiled at a nearby stockpile area. Hauling at the work area will involve scraper runs along the levee to the staging area, and grout, bentonite, and water deliveries to the batch plant.

Landside Berms

Seepage Berm: Seepage berms are constructed in areas where geotechnical investigations indicate that safely releasing seepage water on the landside is more appropriate than a cutoff wall. Generally a seepage berm extends outward from the landside toe of the levee to a width of 70 to 100 feet. The berm is about 5 feet high at the levee toe and tapers to about 3 feet high at the berm toe. The length of the berm is dependent upon the levee seepage concerns.

To construct a seepage berm, the ground is first cleared, grubbed and stripped. If the soil is found to be adequate for berm construction during levee degradation, it will be stockpiled for use later. Otherwise, soils from nearby borrow pits will be used, or if necessary, trucked onsite from other locations. A bulldozer and front-end loader will be used at borrow sites to load haul trucks. Motor graders will be used onsite to grade materials dumped by haul trucks. The fill material is placed in 1- to 2-foot lifts for compaction by sheepsfoot rollers. The width of the berm is dependent on the permeability of the fill material. Water trucks are used to aid compaction and decrease dust emissions. Upon completion, berms are hydroseeded with a native seed mix of grass and forbs.

Additionally, some seepage berms are constructed with a drainage relief trench at the toe of the berm. Generally, a drainage trench is made with loose gravel or sand beneath the toe of the berm materials to allow the drainage of permeated water. Also, a 15-foot vegetation free zone running parallel to the seepage berm is designed to allow O&M access.

Stability Berm: Stability berms are constructed along the landside toe of levees with the purpose of providing support to the levee as a buttress. The height of a stability berm is usually 2/3 the height of the levee, and the length is dependent on the structural needs of the levee reach. The construction of stability berms is similar to the construction of seepage berms. Plans for the South Cross levee reach include a stability berm.

Adjacent Levees
Adjacent levee designs essentially widen the existing levee, thereby allowing the adjacent levee geometry to be restructured on the landside to a 3H:1V slope, and also adding stability. Because adjacent levees are constructed on the landside, the waterside levee slopes are generally left with existing vegetation in place.

The first construction phase includes clearing, grubbing, and stripping the work site and any construction staging areas, if necessary. A trapezoidal trench is cut at the toe of the slope and the levee embankment then is cut in a stair-step fashion to allow the new material to be keyed into the existing material. As with berm construction, bulldozers excavate and stockpile material from a nearby borrow site. Front-end loaders load haul trucks with the borrow material, and the haul trucks subsequently transport it to the adjacent levee site. After the haul trucks dump the material, dozers level it as needed. Sheepsfoot rollers compact the material, and water trucks distribute water over the material to ensure proper moisture for compaction. The landside levee will be graded at a 3H:1V slope, and the levee crown will be at least 20 feet wide. The slope may be track-walked with a dozer. The levee crown will be finished with an aggregate base or paved road, depending on the type and level of access desired. Either condition will require importation of material with dump trucks, placement with a loader and motor grader, and compaction. A paver will be required for asphalt placement.

Sheet Pile Wall
A sheet pile wall is proposed at the Stone Locks to tie together the levees on both sides of the Barge Canal at the end of the Sacramento River Deep Water Ship Channel. A trench will be excavated along the sheet pile alignment to allow the pile to be driven to the proposed depth. A driving template fabricated from structural steel will control the alignment as the sheet pile is installed. A hydraulic or pneumatically operated pile driving head attached to a crane drives the sheet pile into the levee crown to the desired depth (up to 135 feet). An additional crane or excavator may be used to facilitate staging of the materials. The conditions of the site, driving pressure, hydrostatic loads, and corrosion considerations will determine the thickness and configuration of the sheet piles.

Relief Wells
Relief wells are used to address underseepage and will be applied only on site-specific conditions rather than as a segment-wide application. They will be located along adjacent and setback levee toes in the South Basin and only in segments where geotechnical analyses have identified continuous sand and gravel layers and the presence of an adequate impermeable layer. Relief wells are passive systems that are constructed near the levee landside toe to provide a low-resistance pathway for under-seepage to exit to the ground surface in a controlled and observable manner. Relief wells

generally are spaced at 50- to 150-foot intervals, dependent on the amount of underseepage, and extend to depths of up to 150 feet. Areas for relief well construction are cleared, grubbed, and stripped. During relief well construction, a typical well-drilling rig will be used to drill to the required depth and construct the well beneath the ground surface. The drill rig likely will be an all-terrain, track-mounted rig that could access the well locations from the levee toe.

Areas along the levee toe may be used to store equipment and supplies during construction of each well. Construction of each well and the lateral drainage system typically takes 10 to 20 days. Additional time may be required for site restoration.

<u>Overtopping Remediation</u>

Levee Height Raise
Height deficiencies are constructed as needed following the completion of cutoff wall installation and levee geometry corrections. The required additional materials will come from identified borrow pits, stockpiled in staging areas, and hauled to the site with trucks and front end loaders. The levee will be hydroseeded once construction is complete.

Floodwalls
Floodwalls are proposed along the Port North levee around the Port of West Sacramento. To begin the floodwall construction, the area will be cleared, grubbed, stripped, and excavation will occur to provide space to construct the footing for the floodwall. The floodwall largely will be constructed from pre-fabricated materials, although it may be cast or constructed in place, and will be constructed almost completely upright. The height of the floodwalls varies from 1 to 4 feet, as required by water surface elevations. 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 an aggregate base.

<u>Erosion Protection</u>

Levee Slope Revetment
The primary erosion protection measure consists of waterside armoring of the levees to prevent erosion and subsequent damage to the levee. This measure consists of placing rock revetment on the river bank, and in some locations on the levee slope, to prevent erosion. The extent of the revetment will be based on site-specific analysis. Along the Sacramento Bypass Training levee, revetment will be placed on both sides of the levee to protect the levee in place when the Sacramento and Yolo Bypasses contain water. When necessary, eroded portions of the bank will be filled and compacted prior to the rock placement. The sites will be prepared by clearing and stripping the site prior to construction. Rock revetment will be placed around existing trees on the lower portion of the slope. Trees on the upper portion of the slope will be removed during degrading of levees for slurry cutoff walls and bank protection will be placed following reconstruction of the levee. Temporary access ramps will be constructed, if needed, using imported borrow material that will be trucked on site.

Revetment will be imported from an offsite location via haul trucks or barges. Revetment transported by haul trucks will be temporarily stored at a staging area located in the immediate vicinity of the construction site. A loader will be used to move revetment from the staging area to an excavator that will place the material on site. 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 placement site.

Revetment transported by barges will not be staged, but placed directly on site by an excavator. Rock required within the channel, both below and slightly above the water line at the time of placement, will be placed by an excavator located on a barge. The excavator will construct a large rock berm in the water up to an elevation slightly above the mean summer water surface. Construction will require two barges: one barge will carry the excavator, while the other barge will hold the stockpile of rock to be placed on the channel slopes.

The bank protection will be placed on the existing bank at a slope varying from 2V:1H to 3V:1H depending on site specific conditions. After rock placement is complete, a small planting berm will be constructed in the rock, when feasible, to allow for some revegetation of the site outside of the vegetation free zone required by ETL 1110-2-583.

Levee Biotechnical Measures
Biotechnical measures will be implemented along lower velocity reaches to preserve existing vegetation. Biotechnical measures include the use of plant material and minimal amounts of rock to stabilize the eroded slope and prevent further loss of levee materials.

Setback Levee
A setback levee is an entirely new section of levee built at some distance inland from the existing levee section to be replaced. The new levee section is constructed to meet current design standards for height and geometry. Similar to the levee slope stabilization methods, a setback levee construction site is first cleared, grubbed, stripped, and all encroachments into the alignment are removed. Materials are stockpiled at staging areas after being removed and hauled from borrow sites. Heavy equipment is used to manipulate materials on site. Once the designed height is reached, a slurry cutoff wall is put in the levee crown via the conventional slot trench method or clamshell method, depending on the necessary depth. Topsoil is added and the new levee section is hydroseeded. An all-weather, aggregate base is constructed on the levee crown.

North Basin Levee Reaches

Table 2 shows the extent to which each construction measure will occur within each levee reach in the North Basin. Refer to Figure 1 for the approximate location of each proposed improvement.

<u>Sacramento River North</u>
The Sacramento North levee reach extends 5.5 miles from the Sacramento Bypass southward to the William Stone lock structure at the north end of the Sacramento River Deep Water Ship Channel. It is scheduled as the third reach for construction of the project. Slurry cutoff walls will be installed to different depths along the reach to address seepage and slope stability concerns. The conventional open trench method will be used to install walls up to 85 feet deep. A deep slurry method will be used for walls that are installed to a depth greater than 85 feet. Also, to alleviate height deficiencies in some areas, the levee geometry will be restructured with fill materials. Erosion concerns along nearly the entire length of the Sacramento North levee reach will be addressed by bank protection measures. In general, bank protection will involve the placement of rock on the existing bank at a slope between 2V:1H to 3V:1H, depending on specific site conditions.

Table 2. The construction length, improvement, and construction measure of each levee reach within the North Basin of the West Sacramento General Reevaluation Report, City of West Sacramento, Yolo County, California (Corps 2014b).

North Basin Levee Reach	Length of Levee Reach (feet)	Length of Measure (feet)	Improvement	Measure
Sacramento River North Levee and Stone Lock Closure	31,270	30,000	Erosion	Bank Protection
		11,000	Seepage	Slurry Cutoff Wall to 30 feet
		1,500		Slurry Cutoff Wall to 80 feet
		500		Slurry Cutoff Wall to 45 feet
		5,500		Slurry Cutoff Wall to 110 feet
		4,600	Height	Embankment Fill
		550	Stone Lock Closure	Embankment Fill, Sheet Pile Wall
Port North Levee	23,225	8,500	Height	Floodwall, 4-10 feet
		14,000	Height	Embankment Fill
Yolo Bypass Levee	19,749	2,500	Seepage	Slurry Cutoff Wall to 40 feet
		2,000	Seepage	Slurry Cutoff Wall to 100 feet
Sacramento Bypass Training Levee	3,000	3,000	Erosion	Bank Protection

Additionally, the William Stone lock structure will be closed and the Sacramento River Deep Water Ship Channel barge canal will be blocked from the Sacramento River via a new levee embankment and sheet pile wall. A coffer dam will be constructed on the east side of the lock structure, and the new levee and sheet pile wall will be built within the dry area. The new levee will permanently connect the North and South Basins. It will require the relocation of three utility poles, two storm drains, and the removal of concrete infrastructure.

Port North

The Port North levee work is scheduled as the final reach of the West Sacramento GRR Project, extending 4.9 miles west from the William Stone lock structure at the Sacramento River. Work through the levee reach generally involves the construction of flood walls through the Port of West Sacramento to alleviate overtopping concerns (see Figure 1).

Yolo Bypass

To address seepage and slope stability problems, slurry cutoff walls will be constructed at two points along the Yolo Bypass levee. A conventional open trench cutoff construction method will be used to install cutoff walls in two places to depths of 40 feet and 100 feet. The Yolo Bypass levee is scheduled as the fourth levee reach to be addressed in the West Sacramento GRR Project.

Sacramento Bypass Training Levee
Most of the south levee of the Sacramento Bypass was reconstructed as the CHP Academy Early Implementation Project in 2011. However, a 3,000-foot portion of the south levee that lies to the west of the CHP Academy Project is scheduled as the second levee reach to be addressed by the current West Sacramento GRR Project. Bank protection is proposed to address erosion issues.

South Basin Levee Reaches

Table 3 shows the extent to which each construction measure will occur within each levee reach in the South Basin. Refer to Figure 1 for the approximate location of each proposed improvement.

South Cross
The South Cross levee reaches west from the Sacramento River at the Riverview area of West Sacramento, to the Sacramento River Deep Water Ship Channel. Plans include a landside berm to address stability issues and a levee raise to address height concerns. It is scheduled as the eighth of the nine levee reaches to be addressed by construction under the project.

Sacramento River Deep Water Ship Channel East
The east levee along the Sacramento River Deep Water Ship Channel protects the South Basin from inundation. Noted deficiencies in the east levee are seepage, slope stability, and insufficient height. Slurry cutoff walls will be installed to address the seepage and slope stability issues. In reconstructing the levee prism to address height concerns, the irrigation ditch at the landside toe of the levee will be moved landward, and will be replaced by two 48-inch diameter pipes in the area adjacent to existing housing development. The Sacramento River Deep Water Ship Channel east levee is scheduled as the seventh levee reach for construction of the project.

Port South
The Port South levee has overtopping and seepage issues, as well as slope stability problems in a few areas. To alleviate the stability and seepage concerns, a seepage berm will be constructed. Also, relief wells will be added in certain areas to control additional seepage. The levee will be raised as well to address overtopping concerns. The Port South levee will be the sixth levee reach scheduled for construction in the project.

Sacramento River Deep Water Ship Channel West
The west levee along the Sacramento River Deep Water Ship Channel provides a barrier between the ship channel and the Yolo Bypass. As a worst-case scenario, levee deficiencies at various locations along nearly 19 miles of the levee will be addressed. Slurry cutoff walls and seepage berms will be constructed to control seepage issues, and the levee will be raised to address overtopping concerns. On the west side of the levee, facing the Yolo Bypass, rock slope protection will be used to address erosion concerns. The Sacramento River Deep Water Ship Channel west levee is scheduled as the fifth reach for construction in the project.

Table 3. The construction length, improvement, and construction measure of each levee reach within the South Basin of the West Sacramento General Reevaluation Report, City of West Sacramento, Yolo County, California (Corps 2014b).

South Basin Levee Reach	Length of Levee Reach (feet)	Length of Measure (feet)	Improvement	Measure
South Cross Levee	6,273	1,100	Stability/Height	Stability Berm Embankment Fill
		5,000	Seepage/Height	Relief Wells Embankment Fill
Deep Water Ship Channel East Levee	17,171	1,500	Seepage	Slurry Cutoff Wall to 120 feet
		7,100	Seepage	Slurry Cutoff Wall to 130 feet
		2,600	Height	Embankment Fill
Port South Levee	16,262	15,600	Height	Embankment Fill
		1,000	Seepage	Slurry Cutoff Wall to 70 feet
Deep Water Ship Channel West Levee	100,260	9,000	Height/Seepage	Slurry Cutoff Wall to 85 feet
		7,000	Height/Seepage	Slurry Cutoff Wall to 50 feet
		9,000	Height/Seepage	Slurry Cutoff Wall to 75 feet
		75,300	Height	Embankment Fill
		100,000	Erosion	Bank Protection
Sacramento River South Levee	31,000	31,000	Seepage/Erosion	Setback Levee Bank Protection Slurry Cutoff Wall to 80 feet 70-foot Wide Seepage Berm

Sacramento River South – *The Southport Project*

The Southport Project, an Early Implementation Project along the Sacramento River South levee, will be the first levee reach to be addressed in the project. Construction is scheduled to begin in 2015 by the city of West Sacramento, in advance of the overall West Sacramento GRR Project. The Southport Project is proposed to construct flood risk reduction measures along the Sacramento River South levee in order to provide 200-year level of performance consistent with the State mandate for urbanized areas, as well as to provide opportunities for ecosystem restoration and public recreation.

The Southport Project is divided into eight segments, A-G, from south to north (Appendix A). Table 4 outlines the construction measures to be built in each section.

Table 4. Levee remediation measures of the Southport Project portion of the West Sacramento GRR Project, West Sacramento, Yolo County, California.

Southport Segment	Length (linear feet)	Remediation Measures
A	4,830	Slurry cutoff wall
B	115	Slurry cutoff wall
	1,955	Slurry cutoff wall and seepage berm
	3,490	Setback levee, slurry cutoff wall, seepage berm, bank stabilization at levee breach
C	4,490	Setback levee, slurry cutoff wall, seepage berm, toe rock and bank stabilization at levee breaches
	940	Setback levee, slurry cutoff wall, seepage berm, bank stabilization at erosion sites, waterside toe rock upstream and downstream of erosion sites
D	1,985	Setback levee, slurry cutoff wall, waterside toe rock upstream of erosion sites
E	995	Setback levee and slurry cutoff wall
	2,297	Setback levee, slurry cutoff wall, and seepage berm
F	5,583	Setback levee, slurry cutoff wall, seepage berm, bank stabilization and waterside toe rock at decommissioned levee breach, waterside toe rock and bank stabilization at other decommissioned levee breach
G	2,795	Slurry cutoff wall and bank stabilization at erosion site

The Southport project involves the following elements:

- Construction of flood risk reduction measures, including seepage berms, slurry cutoff walls, setback levees, rock and biotechnical slope protection, and encroachment removal;
- Partial degrade of the existing levee, forming a decommissioned "remnant levee;"
- Construction of an offset floodplain area using setback levees, supplying about 160 acres in total for subsequent habitat restoration of riparian and floodplain habitats;
- Construction of breaches in the remnant levee to open up the offset areas to Sacramento River flows;
- Road construction;
- Drainage system modifications; and
- Utility line relocations.

The levee flood risk reduction measure footprint includes the following elements: a waterside O&M easement where available, the levee from toe to toe, a seepage berm, and the landside O&M easement. The waterside and landside O&M easements will be assumed to be 20 feet wide and unpaved. The landside O&M easement follows the toe of the levee or the landside toe of seepage berms, where present. The utility corridor is included largely within the Village Parkway right-of-way. In Segment G, where existing residences are close to the existing levee, the landside O&M easement will vary from about a few feet to 100 feet between the proposed flood risk reduction measure toe and the existing residential lot lines. In Segment A, the landside O&M easement coincides with South River Road. For segments where a suitable impermeable tie-in layer was not identified from the geotechnical explorations, a seepage berm will be constructed. Where a tie-in layer was located, a cutoff wall at the associated depth will be constructed. For levee reaches where a seepage berm will be constructed to address underseepage, a shallow cutoff wall also will be installed in lieu of an inspection trench.

A setback levee will be constructed in levee Segments B through F. A setback levee is an entirely new section of levee constructed at some distance behind the landside of the existing levee. The obsolete levee sections will remain in place and be breached to create and offset area containing two separate floodplains for the Sacramento River. The new section of levee will be tied into the existing levee to the south and north and become the Federal project levee. Once the foundation of the new setback is built up to a suitable elevation, a slurry cutoff wall will be constructed using either the conventional slot trench method or clamshell method.

The new levee section will be constructed to meet current design standards, including height and slope requirements. Levee slopes will be graded to a 3H:1V slope, and a crown at least 20 feet wide created. Topsoil will then be placed on the levee slopes and hydroseeded. For the purpose of levee inspection and emergency vehicle access, an aggregate base, all-weather levee-top patrol road will be constructed. Seepage berms for the Southport Project will vary from 50 to 100 feet in width. Lateral length will depend on seepage conditions along the area of identified levee deficiency.

Southport Project Bank Erosion Sites
Three bank erosion sites requiring repairs were identified in the project reaches along the Sacramento River; two sites are in Segment C and the third site is in Segment G (Appendix A). The Segment C sites will not be subject to the Corps vegetation policy, as they will be on the remnant levee; however, the Segment G site will be located on the Federal project levee and will comply with the vegetation policy. The repairs at all three sites are designed to protect against erosional forces that threaten levee stability, such as wind, waves, boat wake, and fluvial forces.

Southport Project Remnant Levee Sites
The two erosion sites on the remnant levee are C1 and C2. Once the setback levees for the Southport Project are complete, the existing levee in Segment C will no longer be part of the Federal project levee. Site C1 has a top length of 160 linear feet, while Site C2 has a length of 547 linear feet. Remediation at Site C1 will address a scour hole that has formed on the slope between elevations of -33 feet, North American vertical datum of 1988 (NAVD 88), and +11 feet NAVD 88, as well as slumping that has occurred at the base of the slope. Remediation at Site C2 will address general erosion problems that have been created by wave erosion.

<u>Design and Construction</u>: Erosion site repairs on the remnant levee are designed both to control erosion and to maintain existing vegetation and instream woody material. This will be accomplished by incorporating rock benches that serve as buffers against erosion while providing space for planting riparian vegetation and creating a platform to support aquatic habitat features (Appendix A). Rock will be placed onto the levee slope from the waterside by means of barges; one barge will

hold the stockpile of rock to be placed, and a second barge will hold the crane that will place the rock on the channel slopes. A backhoe will be used from the bank to adjust the rock. Clean rock fill will be placed over existing riprap between elevations of -33 feet NAVD 88 and +5 feet NAVD 88, and type C graded stone will be placed over the clean rock fill in a 2.5-foot thick layer with a 2H:1V slope from the toe of the slope to an elevation of +7 feet NAVD 88. The clean rock fill and graded stone at the top of the erosion site will be placed to form a planting bench at an elevation of +7 feet NAVD 88 to match the average annual low-water surface elevation, and the bench will have an average width of about 10 feet. At Site C1, stone will be placed at the upstream and downstream ends of the site to address problems created by a scour hole along the site.

After the rock is placed along the slope of the erosion sites, a 1-foot thick layer of 0.75-inch crushed clean rock will be placed at the upslope end of the stone bench to create a filter between the topsoil and the stone bench. Topsoil then will be placed above the newly constructed bench at a 3H:1V slope to meet the existing bank, and coir fabric will be placed over the soil to keep it in place. Topsoil will be placed from a barge, similar to the process for placing the rock. Pole plantings will be hand-placed in the planting bench between elevations of +7 feet NAVD 88 and +11.5 feet NAVD 88. Beaver fencing will be installed at the upslope and downslope extents of the topsoil installation. Instream woody material will be anchored along the remnant levee erosion sites to achieve at least 40% shoreline coverage, and placed between 1 and 3 feet below the elevation of the average annual low water surface. Instream woody material will likely come from trees removed in other portions of the project area, and will be selected based on suitability for the site. Existing vegetation and riprap at the erosion site will be retained.

The two erosion sites on the remnant levee are located on the outer bank of a bend in the river and are therefore subject to greater erosive forces. Rock will be placed along the toe of the bank (toe rock) at both sites, as well as upstream and downstream of the erosion sites to further protect the bank of the remnant levee. The toe rock will begin about 850 feet upstream of Site C1, will extend through both erosion sites, and will terminate about 300 feet downstream of Site C2. Portions of this area are currently riprapped, and the additional toe rock to be placed will be limited to areas where there is currently no rock below an elevation of +7 feet NAVD 88.

Southport Project Active Levee Erosion Site
Site G3 is located in Segment G and therefore will remain as part of the Federal project levee. Site G3 includes 410 linear feet of repairs to the top of the erosion scarp and the creation of a planting bench and vegetated slope to protect against boat wake and fluvial erosion.

The design, construction equipment, methods, and materials for Site G3 are similar to those described for Sites C1 and C2. However, Site G3 will require additional rock armoring and soil fill (up to elevation +25 feet NAVD 88) to repair the erosion scarp and meet Federal levee protection standards. The proposed design includes riprap toe protection, earth and rock fill to restore the levee prism between elevation -10 feet NAVD 88 and +25 feet NAVD 88, a soil-covered 10-foot-wide planting bench (10H:1V slope) and bank (3H:1V slope) planted with pole cuttings and large container plantings, and instream woody material anchored between 1 and 3 feet below the elevation of the average annual low water surface. The planting bench will be 15 feet outside the minimum levee template.

Southport Project Encroachment Removal
Levee standards for vegetation and encroachments require removing encroachments, such as structures, levee penetrations (e.g., pipes, conduits, cables), power poles, pump stations, and similar features, from the levee footprint. Encroachment removal includes demolition, relocation, retrofitting, or reconstruction as appropriate on a case-by-case basis. Existing pilings within the river at Oak Knoll Bend also will be removed.

Encroachment removal techniques will be implemented based on the needs of the specific encroaching feature. Smaller encroachments will be removed, relocated, or retrofitted by manual labor of small crews (about 2 to 10 workers) using hand tools. Larger encroachments require machinery such as an excavator, skid-steer, and bulldozer. The removal of sections of two-lane asphalt road will be required. Piling removal requires a barge with a crane for removal or cutting at the mud line. Dump trucks will be used for hauling and disposal of removed material at an offsite, permitted commercial source within 10 miles of the project area.

Southport Project Remnant Levee Degrade
With the construction of the setback levee, most of the decommissioned levee in Segments B through F will be degraded to provide additional borrow material for constructing seepage berms or for reclamation of other borrow areas. The remnant levee in Segment E will remain to maintain access to Sherwood Harbor Marina and Sacramento Yacht Club. Similarly, although the roadway will be removed up to the Sacramento Yacht Club, the levee will not be degraded on Segment F south of breach N2 to help protect the marinas during high flow events.

Prior to excavation, the area to be degraded will be cleared, grubbed, and stripped. The remnant levee will be degraded to an elevation of +30 feet NAVD 88, with a crown width of 20 feet and a landside slope of 3H:1V. Front-end loaders will load haul trucks with the excavated material. Haul trucks will transport the material to stockpile areas in the staging areas for later use for berms, or to borrow areas for use in site restoration. Material used for borrow area restoration will be spread evenly using motor graders and compactors. Disturbed areas will be planted as part of the offset area restoration plantings, and an unpaved O&M corridor will be established along the landside toe of the remnant segments.

Southport Project Levee Breaches
Portions of the remaining decommissioned levee will be breached to allow Sacramento River flows into two separate floodplain areas within the offset area during high flow events (Appendix A). The northern floodplain area breaches, from north to south, are North 1 (N1) and North 2 (N2) (both in Segment F), and the southern floodplain area breaches, from north to south, are South 1 (S1) (Segment C), South 2 (S2) (Segment C), and South 3 (S3) (Segment B). Construction of the breaches will occur during the summer–fall period to comply with Central Valley Flood Protection Board regulations. Both floodplain areas will be distinct from the existing Bees Lakes, which also will remain on the waterside of the new setback levee alignment.

Breaches S3 and N1 will be created in the third construction year and the remaining breaches will be completed 2 years later. Staggering the breaches will allow offset area restoration vegetation to establish before being exposed to flows. Until breaches S1, S2 and N2 are constructed, culverts will be installed at their proposed locations to drain the offset floodplain area. The culverts also will balance the hydraulic pressure on both sides of the degraded levee and to minimize fish stranding. Each culvert will be 54 inches in diameter and about 140 feet long. The culverts will be placed at about +7 NAVD in order to fully drain the offset floodplain area. To construct the breaches, the existing levee will be degraded with excavators to an elevation of +10 feet NAVD 88. Existing revetment in good condition will be retained below +10 NAVD 88. The breach shoulders will be armored with rock from the existing riprap on the waterside, over the degraded remnant levee crown, and down the landside slope. A 25-foot riprap apron then will extend out from the landside toe of the breach shoulder at an elevation of roughly +10 NAVD 88, as well as from the toe of the shoulder in the breach. All rock for the shoulder and apron armoring will be placed in a layer about 2.5 feet thick.

In-water construction activities are scheduled between July 1 and October 31, when water elevations in the Sacramento River along the project area are typically at the average annual low water elevation of +6.7 feet NAVD 88 to +7.1 feet NAVD 88. Installation of temporary cofferdams may be necessary prior to culvert installation to prevent river flows from entering the construction area. At a minimum, sandbags will be used to construct the cofferdam and water will be pumped out of the inundated construction area. Cofferdams will be constructed using sheet pile walls or other methods, and typically will extend up- and downstream of the end of the culverts to provide a temporary work area.

The upstream shoulder of breach N1 and the downstream shoulder of breach S3 have slightly different erosion control measures than the other breach shoulders. Breaches N1 and S3 are located at the sites where the new setback levee alignment deviates from the old, decommissioned levee alignment. Rock armoring will be placed on the slope of the waterside of the setback levee and will transition along the remnant levee segment.

On the waterside of the breaches, new riprap will be placed from the toe of the bank slope up to an elevation of +7 feet NAVD 88 in areas where the existing riprap is lacking. Breaches N1, N2, S1, and S2 also will have rock placed along portions of the base of the bank to further protect it from erosive forces. Coir fabric will be placed between elevations of +7 feet NAVD 88 and +10 feet NAVD 88, and will be planted with species suitable to create a vegetated bench. Coir fabric also will be placed in the zone between the edge of the +10 feet NAVD 88 elevation and the centerline of the breach, with jute netting continuing landward of the termination of the coir fabric for 100 feet. This area also will be planted with cuttings, rootstock, or container plants.

Rock will be placed onto the levee slope from atop the degraded levee, from the breach sill, from the waterside by means of barges, or by a combination of the three methods. Rock required within the channel, both below and slightly above the surface of the water at the time of placement, will be placed by a crane located on a barge and then spread by an excavator located on top of the levee or in the breach sill. Construction requires two barges—one barge to carry the crane and another to hold the stockpile of rock to be placed on the channel slopes—and one excavator located in the breach. 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 requires one excavator for each potential placement site. Loaders will haul rock from a permitted source within 25 miles of the project area and dump it within 100 feet of the levee breach. An excavator will move the rock from the stockpile to the waterside of the levee.

Southport Project Offset Floodplain Area Restoration
The offset floodplain area refers to the two expanded floodways located between the proposed setback levee and the decommissioned, remnant levee that will be created when portions of the

existing levee are breached (Appendix A). Project activities in this area will include floodplain and riparian habitat restoration and borrow excavation. The offset floodplain areas will be planted to provide mitigation for vegetation removed as part of construction.

If suitable for reuse, excavated material will be used in construction of the setback levee and seepage berms. Following excavation, the offset area will be graded to allow the creation and restoration of riverine floodplain and riparian habitats. Excavation in the offset areas may require groundwater management, done by pumping water out of excavated areas.

After the first two levee breaches are constructed and before the final three breaches are made, restoration plantings will be established in the offset floodplain areas during the fall, winter, and spring. Swales will be constructed in both offset floodplain areas, and the surrounding areas will be graded to create drainage to the swales as river stages decrease. Temporary and permanent erosion control measures such as jute netting, coconut fiber with net, live brush mattresses, and native turf will be used as appropriate to protect graded areas.

After breaches N2, S1, and S3 are constructed, three permanent cellular berms will be built across the offset area, between the setback levee and the remnant levee. The berms will be downstream of breaches N1, S1, and S2, and will create separate cells that will have independent drainage once water levels drop below the crest of the cellular berms. Material excavated from the breaches will be used to construct the cellular berms and construct terrain features. Berms will have a top elevation of +20 feet, top width of 20 feet, and side slopes no steeper than 10H:1V; they will overtop once water levels reach +20.0 feet NAVD 88. Floodplain upstream and downstream of the berms will be graded to drain away from the berms and to the closest existing levee breach location. Elevations in the offset floodplain area will vary from about +7.0 feet NAVD 88 to +20.0 feet NAVD 88 in order to provide broad habitat variability for a range of environmental and hydrodynamic conditions.

Habitats in the offset floodplain areas will be upland grasslands, riparian forest, shaded riverine aquatic habitat, and seasonal wetlands. Plants selected for establishment of each of the target plant communities were based on how the plants associate in nature, and the elevations at which these plants were observed growing along the Southport levee. A vegetation stratification survey on the Southport levee conducted by ICF in March of 2012 helped further inform and refine the restoration target plant communities. In the survey, different species of plants were observed to favor different elevation ranges based on species preferences and adaptations. The restoration design intends to mimic this vegetative stratification. Vegetation communities will include emergent marsh, riparian willow scrub, riparian cottonwood forest, mixed riparian woodland, elderberry shrubs and associated native plants for valley elderberry longhorn beetle habitat, and grassland. Planting of the offset area will take place in the fall following finish-grading operations and construction of the flood control features. Features of the offset area that are not finished in any given year will be kept free of vegetation to keep future construction areas clear.

Both container plants and pole cuttings may be used and will be spaced at regular intervals throughout the offset floodplain areas. Both overstory and understory species will be installed to mimic the natural structure of riparian forests along the Sacramento River. Supplemental irrigation will be provided for several years during the 3-year plant establishment period and then discontinued; irrigation water could possibly be pumped from the river or from an adjacent water supply by agreement with the owner. To avoid trampling or disturbing the plantings during the establishment period, signs will be posted at appropriate intervals providing notice that access to the restoration areas is not allowed.

A network of seasonal wetland swales will be excavated within the offset floodplain area cells and will inundate during high-water events on the Sacramento River to provide habitat for special-status native fish species. The swales will be constructed to elevations that provide shallow, low-velocity, off-channel habitat in the spring during high-water periods. Floodplain inundation is expected to occur at the 1-year recurrence interval event at depths between 0.5 and 3 feet, and at the 2-year recurrence interval event at depths ranging from 9 to 12 feet. Swale margins will be gently sloping to maximize edge habitat during flood events. Instream woody material structures will be installed in some of the swales to provide cover from predators. In larger flood events during the winter and spring, the upper riparian terraces will be inundated and provide additional areas of habitat for fish as well as contribute to the productivity of the river ecology.

The created swales will have several connections to the main river channel at the breach locations in order to maximize connectivity and minimize potential stranding as floodwaters recede. The swales will fully dewater by early summer in a given year, on average, to discourage use by nonnative fish. Areas of upland grassland in the offset floodplain area will serve as potential floodplain rearing habitat for native fish during periods of high flows, as well as foraging habitat for raptors during periods of low water.

O&M access to the offset areas will be provided by O&M corridors at the waterside toe of the setback levee and by unpaved O&M roads that cross the cellular berms. At a minimum, turnaround areas will be located at the breach shoulders.

Southport Project Offset Area and Remnant Levee Revegetation
Revegetation of the offset areas and remnant levee is proposed as a means to mitigate for construction effects. The riparian willow scrub target plant community will be established in zones with proper soil hydrology, between +8 feet and +10 feet NAVD 88. In the offset area, riparian willow scrub will be established just upslope from the constructed swales in a band width varying from about 10 to 150 feet. On the remnant levee, riparian willow scrub will be established in a narrow band varying from about 5 to 20 feet in width outside of the canopy of the existing trees that will remain. The plants selected for the riparian willow scrub planting are intended to establish a self-sustaining mix of riparian scrub dominated by four species of willows. The plant material installed could be container grown plants, cuttings, or a mixture of both. The areas within the offset area will be seeded, and the areas on the remnant levee with established herbaceous cover will not be seeded.

Southport Project Road Construction, Marina Access, and Bees Lakes
Village Parkway will be extended southward from its current intersection with Lake Washington Boulevard to Gregory Avenue near the project area's southern extent, moving South River Road traffic to the landside of the Sacramento River South Levee and to the future Village Parkway alignment. The existing alignment of South River Road in Segment A will be retained, as will the railroad abutments at the southern end of Segment A. However, a detour or permanent realignment of South River Road will be constructed at the south end of Segment A to maintain access on South River Road south of the project area during and after construction. Access roads will be built in Segment B to connect residences to the new Village Parkway alignment. At the project's northern extent, South River Road will be demolished. Where practicable, culverts will be constructed in

ditches that are crossed by proposed roadways. Drainage ditches will be constructed along both sides of the new Village Parkway alignment, with an average width of 5 feet.

To maintain access between Sherwood Harbor Marina and Sacramento Yacht Club, South River Road will continue in its current alignment on the existing levee at Segment E and a portion of Segment F. However, to maintain access to the marinas, two new roads will be routed over the levee crown, across the offset area, and the across the decommissioned levee. The two access roads will be constructed to the north and south of the Bees Lake area. While the embankments will not be part of the flood risk–reduction features, they will prevent hydraulic surface connectivity between Bees Lakes and the Sacramento River. Linden and Davis Roads will be connected to the new Village Parkway alignment to restore traffic circulation, and a cul-de-sac will be added at the end of Linden Road, past the intersection with Village Parkway.

Dual access ramps will be constructed along the levee alignment to provide O&M and emergency access to the levee-top patrol road. One ramp will be in Segment B where South River Road currently descends from the existing levee to meet Gregory Avenue; one ramp in Segment C; one ramp in Segment D at the terminus of Davis Road; one ramp In Segment F at the terminus of Linden Road; and one ramp in Segment G near the northern end of the project alignment. Access to the levee-top patrol road also will be provided where the Sherwood Harbor Marina and Sacramento Yacht Club access road embankments cross the proposed setback levee crown. Access ramps will be gated and will have "no parking" signs.

Southport Project Construction Schedule
Construction of the Southport Project will occur in more than one annual construction season, with construction of flood risk–reduction measures beginning in April of 2015, and finishing in 2017. Construction and restoration of the offset floodplain area will continue after 2017, with final remnant levee breaches constructed in 2020. Some of the Village Parkway construction and utility relocations may occur earlier, but most of the work for those portions of the project will be done in 2015. A description of construction activities and tentative construction year is provided below.

<u>2015:</u>
- Village Parkway construction and utility relocation will be completed.
- Construction of the entire length of the new setback levee will begin with the foundation and working platform. Construction of the cutoff wall will follow if weather allows.

<u>2016</u>:
- The setback levee cutoff wall and remaining buildup of the setback levee will be constructed to a finished elevation of +40 feet NAVD 88.
- South River Road will be detoured at south end of Segment A.
- Seepage berms will be constructed following completion of the setback levee segments.
- Segment A and the southern portion of Segment B will be degraded to an elevation of +32 feet NAVD 88, and in Segment G the levee will be degraded to an elevation of +34.5 feet NAVD 88. Cutoff walls will then be constructed in these segments, tying into the setback levee cutoff walls in Segments B and F. The levee crown in Segment A and the southern portion of Segment B will then be built back up to a finished elevation of +39 feet NAVD 88, and the levee in Segment G will be built back up to a finished elevation of +40 feet NAVD 88. The slurry cutoff wall toe will be at an elevation of -5 feet NAVD 88 through

Segments A, B, C, and D; at 0 feet NAVD 88 for Segments E, F, and the southern portion of G; and will be at -67 feet NAVD 88 for the remainder of Segment G.

- The remnant levee in Segments B, C, D, and F will be degraded to an elevation of +30 feet NAVD 88, and will have a 20-foot-wide crown. Remnant levee degrading will be concurrent with setback levee and seepage berm construction.
- Offset floodplain area grading will begin.
- Erosion site repairs at C1, C2, and G3 will be constructed.

2017:

- Offset area grading will be completed. Culverts will be installed through the remnant levee at breaches N2, S1, and S2 to allow Sacramento River water flow into the offset floodplain areas.
- Breaches N1 and S3 will be constructed.
- Offset area planting will begin.

2018:

- Offset area planting will continue.

2019:

- The three remaining breaches and the offset area cellular berms will be constructed, and the southern offset area will be contoured.

2020:

- Offset area planting will be completed.

At the end of each construction season, the levee system will be restored, at a minimum, to the level of flood risk–reduction performance existing at the project outset. During construction Years 1 and 2, "tie-ins" will be built connecting the existing levee to newly constructed segments, as needed. These tie-ins will be achieved by benching the existing levee and installing compacted lifts to completely bond the new and existing levee materials. During the flood season, maintenance of the flood risk–reduction structures will be undertaken by the maintaining agency, RD 900.

Southport Project Sources of Borrow Material

To meet borrow material demands for constructing the flood risk–reduction measures, multiple sources may be used, including the following.

- Embankment fill material excavated from the existing levee structure as part of construction.
- Material excavated from the offset areas.
- Material excavated from borrow sites located on open land within the city, or close to the city limits.
- Dredged material previously removed from the Sacramento River Deep Water Ship Channel (presently stockpiled on high-terrace, upland benches adjacent to the west of the channel).
- Material purchased from permitted commercial borrow locations within 20 miles of the project site (as described on pages 7-8).

Southport Project Vegetation Removal
Vegetation clearing activities entail removing larger woody vegetation, such as trees and shrubs. Grubbing activities consist of removing roots, and stripping activities requires excavating about 6 inches of organic material from the levee surface. Vegetation on the decommissioned levee segments along the Sacramento River levee will be retained where feasible, with the exception of the five breach locations. However, some vegetation will be removed as part of construction of the new setback levee, seepage berms, and the landside utility O&M corridor.

Southport Project Staging Areas and Equipment Access
Five staging areas are designated for the Southport Project. The staging areas are located on the landside of the levee at Segments C, D, and E, and occupy about 25.2 acres in total (Appendix A). Areas where seepage berms are proposed also may be used for staging until construction begins on the seepage berms. To facilitate project construction, temporary earthen ramps will be constructed to permit equipment access between the levee crown and each staging area. The earthen ramps will not affect any delineated water bodies and will be removed when construction is complete.

Southport Project Operations and Maintenance
Following construction of the Southport Project, only the rock slope protection, native vegetation, and other biotechnical features will be permanent. Anticipated O&M actions include regular visual inspections of the site, vegetation maintenance and irrigation for up to 3 years, and periodic repairs, as needed, to prevent or repair localized scour along the bank and rock toe of the site. The previously mentioned O&M activities that pertain to the project as a whole will also occur along Sacramento River South levee reach following the Southport Project construction.

Conservation Measures

As part of the West Sacramento GRR Project description, the Corps and WSAFCA have committed to implementing the following conservation measures to avoid and minimize potential effects on the snake, beetle, smelt, and smelt critical habitat. A number of measures will be applied to the entire project or specific actions, and other measures may be appropriate at specific locations within the study area. Avoidance activities to be implemented during final design and construction include, but are not limited to:

- Avoiding vegetation removal to the extent feasible.
- Avoiding, to the extent possible, grubbing and contouring activities.
- Identifying all habitats containing, or with a substantial possibility of containing, listed terrestrial, wetland, and plant species in the potentially affected project areas. To the extent practicable, efforts will be made to minimize effects by modifying engineering design to avoid potential direct and indirect effects.
- Incorporating sensitive habitat information within project bid specifications.
- Incorporating requirements for contractors to avoid identified sensitive habitats within project bid specifications.

<u>General Conservation Measures</u>

- The Corps will seek a variance exempting the Sacramento River levee reaches from vegetation removal as per ETL 1110-2-583 in the lower one-third of the waterside of the levee prior to final construction and design phase. Construction will require removal of vegetation on the upper two-thirds of the waterside and landside slope. Full ETL vegetation compliance will occur on the Sacramento and Yolo Bypasses, Yolo Bypass Toe Drain, South Cross Toe Drain, and the Sacramento River Deep Water Ship Channel, Barge Canal, and Port of West Sacramento levee reaches.

- The Corps will use a rock soil mixture (a 70:30 rock to soil ratio) to facilitate re-vegetation of the Sacramento River project sites that require bank protection work. The soil-rock mixture will be placed on top of the of the rock revetment along the Sacramento River levees to allow native riparian vegetation to be planted and ensure that shaded riverine aquatic habitat is replaced or enhanced.
- In addition to an approved vegetation variance, the Corps will avoid the removal of existing vegetation in the proposed project area. To the extent possible, disturbance or removal of trees or larger woody vegetation will be replaced onsite with native riparian species, except in the vegetation-free zone, as established in ETL 1110-2-583.
- Best management practices will be implemented to prevent slurry seeping out to the river and require a piping system on the landside.
- Construction materials such as portable equipment, vehicles, and supplies, will be stored at designated construction staging areas and barges, exclusive of any riparian and wetlands areas.
- All liquid chemicals and supplies will be stored at a designated impermeable membrane fuel and refueling station.
- Erosion control measures, including a Storm Water Pollution Prevention Program and a Water Pollution Control Program, will be implemented to minimize soil or sediment from entering the river. The measures shall be installed, monitored for effectiveness, and maintained throughout construction operations to minimize any effects to federally-listed fish and their designated critical habitat.
- Construction will be scheduled when listed terrestrial and aquatic species will be least likely to occur in the project area.
- Site access will be limited to the smallest area possible in order to minimize disturbance.
- Litter, debris, and unused materials will be removed from the project area daily. Such materials or waste will be deposited at an appropriate disposal or storage site.
- Any spills of hazardous materials will be cleaned up within 24 hours and reported 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.
- A Corps-appointed biologist will serve 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. The representative shall be identified to the employees and contractors during an all employee education program conducted by the Corps.
- Screen any water pump intakes, as specified by NMFS and 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.

Giant Garter Snake Conservation Measures

The following measures will be implemented to minimize effects on giant garter snake habitat that occurs within 200 feet of any construction activity. These measures are based on Service guidelines for restoration and standard avoidance measures (Service 1997).

- Construction will be initiated only during the snake's active period of May 1–October 1, when they are able to move away from disturbance.
- Construction personnel will participate in a Service-approved worker environmental awareness program.
- A snake survey will be conducted 24 hours prior to construction in potential habitat. Should there be any interruption in work for greater than 2 weeks, a biologist will survey the project area again no later than 24 hours prior to the restart of work.
- Snakes encountered during construction activities 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 snake aquatic habitat.
- 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.
- For projects that anticipate that work may be required past the end of the giant garter snake active season (October 1) and into their inactive season, additional measures must be implemented by the applicant. All of the following minimization measures must be implemented in order for work to continue past the October 1 deadline:
    - The Corps shall contact the Service on or before August 15, to determine if any additional measures are needed to minimize effects to the snake.
    - Work activities must commence on or before September 15.
    - A service-approved biologist will be on-site daily to monitor all construction activities associated with the project throughout the entire extension period.
    - Snake exclusion fencing must be completely installed prior to the October 1 deadline. Snake exclusion fencing will be used to enclose the entire work area preventing the snake from entering the work area. The exclusion fencing will remain in place and in good working order until project activities are completed.

If any giant garter snake habitat is affected by construction, the following measures will be implemented to compensate for the habitat loss:

- Aquatic and upland habitat temporarily affected for one season (May 1–October 1) will be restored after construction by applying appropriate erosion control techniques and replanting/seeding with appropriate native plants.
- Habitat temporarily affected for two seasons will be restored and replacement habitat will be created at a 2:1 ratio of created to disturbed acres.
- Habitat temporarily affected for more than two seasons will be replaced at a 2:1 ratio, or restored plus 2:1 replacement.
- Habitat permanently affected will be replaced at a 3:1 ratio. Habitat permanently or temporarily affected outside of the May 1-October 1 work window will be created at a 2:1 ratio.
- All replacement habitats will include both upland and aquatic habitat components at a 2:1 ratio of upland to aquatic acres.
- One year of monitoring will be conducted for all restored areas. Ten years of monitoring will be conducted for created habitats. A monitoring report with photo documentation will

be due to Service each year following implementation of restoration or habitat creation activities.

- The Corps will work to develop appropriate mitigation prior to or concurrent with any disturbance of giant garter snake habitat.
- Habitat will be protected in perpetuity and have an endowment attached for management and maintenance.

Valley Elderberry Longhorn Beetle Conservation Measures

The following is a summary of measures based on the Conservation Guidelines for the Valley Elderberry Longhorn Beetle (Conservation Guidelines) (Service 1999a). These measures will be implemented to minimize any potential effects on the beetle, the sole host plant for the beetle, including restoration and maintenance activities, long-term, protection, and compensation if elderberry shrubs cannot be avoided. Based on worst-case scenario estimates of project effects and surveys between 2011 and 2013, a total of 120 elderberry shrubs may be adversely affected by construction of the West Sacramento GRR Project.

- When a 100-foot or wider buffer is established and maintained around elderberry shrubs, complete avoidance will be assumed. Where encroachment on the 100-foot buffer will occur, 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.
- Contractors will be briefed on the need to avoid damaging elderberry shrubs and the possible penalties for not complying with these requirements.
- Signs will be erected every 50 feet along the edge of the avoidance area containing information about the beetle and its habitat.
- Any damage done to the buffer area will be restored.
- During construction activities, no insecticides, herbicides, fertilizers, or other chemicals that might harm the beetle or its host plant will be used in the buffer areas.
- Elderberry shrubs that cannot be avoided and can be accessed safely will be transplanted to an appropriate off-site riparian area at least 100 feet from construction activities.
- Elderberry shrubs will be transplanted during their dormant season, which occurs from November, after they have lost their leaves, through the first two weeks in February. If transplantation occurs during the growing season, increased mitigation ratios will apply.
- Any areas that receive transplanted elderberry shrubs, as well as elderberry and associated native species plantings, will be protected in perpetuity.
- The Corps will work to develop off-site compensation areas prior to or concurrent with any take of valley elderberry longhorn beetle habitat.
- Management of these lands will include all measures specified in the Conservation Guidelines related to weed and litter control, fencing, and the placement of signs.
- Monitoring will occur for 10 consecutive years or for 7 non-consecutive years over a 15-year period. Annual monitoring reports will be submitted to the Service.
- Off-site compensation areas will be protected in perpetuity and have a funding source for maintenance (an endowment).

Conservation Measures for the Southport Project

Because the Southport Project along the Sacramento River South levee is scheduled as an Early Implementation Project it will be the first construction project under the West Sacramento GRR Project, and therefore conservation measures have been established in greater detail. The Corps and WSAFCA have committed to implementing the following conservation measures as part of the Southport Project.

Southport Project General Conservation Measures

Conduct mandatory biological awareness training for all project personnel and implement general requirements:

Before any ground-disturbing work (including vegetation clearing and grading) occurs in the Southport Project action area, a Service-approved biologist will conduct a mandatory biological resources awareness training for all construction personnel about Federally listed species that could potentially occur onsite. The training will include the natural history, representative photographs, and legal status of each Federally listed species and avoidance and minimization measures to be implemented. Proof of personnel attendance will be provided to the Service within 1 week of the training. If new construction personnel are added to the Southport Project, the contractor will ensure that the new personnel receive the mandatory training before starting work. The subsequent training of personnel can include videotape of the initial training and/or the use of written materials rather than in-person training by a biologist. Elements of the training that will be followed by construction personnel are listed below:

- Where suitable habitat is present for listed species, WSAFCA will clearly delineate the construction limits through the use of survey tape, pin flags, orange barrier fencing, or other means, and prohibit any construction-related traffic outside these boundaries.
- Project-related vehicles will observe the posted speed limit on hard-surfaced roads and a 10-mile-per-hour speed limit on unpaved roads during travel in the project construction area.
- Project-related vehicles and construction equipment will restrict off-road travel to the designated construction areas.
- All food-related trash will be disposed of in closed containers and removed from the project construction area at least once per week during the construction period. Construction personnel will not feed or otherwise attract fish or wildlife to the project area.
- No pets or firearms will be allowed in the project area.
- To prevent possible resource damage from hazardous materials, such as motor oil or gasoline, construction personnel will not service vehicles or construction equipment outside designated staging areas.
- Any worker who inadvertently injures or kills a federally-listed species or finds one dead, injured, or entrapped will immediately report the incident to the biological monitor and construction foreman. The construction foreman will immediately notify WSAFCA, who will provide verbal notification to the Service within 1 working day. WSAFCA will follow up with written notification to the Service within 5 working days. The biological monitor will follow up with WSAFCA to ensure that the wildlife agencies were notified.

Prepare and implement a Stormwater Pollution Prevention Plan

Because ground disturbance would be greater than 1 acre, WSAFCA will obtain coverage under the U.S. Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) general construction activity stormwater permit. The Central Valley Regional Water Quality Control Board administers the NPDES stormwater permit program in Yolo County.

Obtaining coverage under the NPDES general construction activity permit generally requires that the project applicant prepare a stormwater pollution prevention plan that describes the Best Management Practices that will be implemented to control accelerated erosion, sedimentation, and other pollutants during and after project construction. The SWPPP will be prepared prior to commencing earth-moving construction activities.

The plan likely will include, but not be limited to, one or more of the following standard erosion and sediment control practices:

- The construction contractor will conduct all construction activities during the typical construction season to avoid ground disturbance during the rainy season. To the extent possible, equipment and materials will be staged in areas that have already been disturbed. No equipment or materials would be stored in the floodway during the flood season.
- The construction contractor will minimize ground disturbance and the disturbance/destruction of existing vegetation. This will be accomplished in part through the establishment of designated equipment staging areas, ingress and egress corridors, and equipment exclusion zones prior to the commencement of any grading operations.
- Grading spoils generated during the construction will be temporarily stockpiled in staging areas. Silt fences, fiber rolls, or similar devices will be installed around the base of the temporary stockpiles to intercept runoff and sediment during storm events. If necessary, temporary stockpiles may be covered with an appropriate geotextile to increase protection from wind and water erosion.
- The construction contractor may install silt fences, fiber rolls, or similar devices to prevent sediment-laden runoff from leaving the construction area.
- The construction contractor may install silt fences, drop inlet sediment traps, sandbag barriers, and/or other similar devices.
- The construction contractor will install structural and vegetative methods to permanently stabilize all graded or otherwise disturbed areas once construction is complete. Structural methods may include the installation of biodegradable fiber rolls and erosion control blankets. Vegetative methods may involve the application of organic mulch and tackifier and/or the application of an erosion control native seed mix.

Prepare and Implement a Bentonite Slurry Spill Contingency Plan (Frac-Out Plan)

Before excavation begins, WSAFCA will ensure the contractor will prepare and implement a bentonite slurry spill contingency plan (BSSCP) for any excavation activities that use pressurized fluids (other than water). If the contractor prepares the plan, it will be subject to approval by the Corps, NMFS, and WSAFCA before excavation can begin. The BSSCP will include measures intended to minimize the potential for a frac-out ("fracture-out event") associated with excavation and tunneling activities; provide for the timely detection of frac-outs; and ensure an organized, timely, and minimum-effect response in the event of a frac-out and release of excavation fluid (bentonite). The BSSCP will require, at a minimum, the following measures:

- If a frac-out is identified, all work will stop, including the recycling of the bentonite fluid. In the event of a frac-out into water, the location and extent of the frac-out will be determined, and the frac-out will be monitored for 4 hours to determine whether the fluid congeals (bentonite will usually harden, effectively sealing the frac-out location).
- NMFS, CDFW, and the Central Valley Regional Water Quality Control Board will be notified immediately of any spills and will be consulted regarding clean-up procedures. A

Brady barrel will be on site and used if a frac-out occurs. Containment materials, such as straw bales, also will be on site prior to and during all operations, and a vacuum truck will be on retainer and available to be operational on site within a 2-hour notice. The site supervisor will take any necessary follow-up response actions in coordination with agency representatives. The site supervisor will coordinate the mobilization of equipment stored at staging areas (e.g., vacuum trucks), as needed.

- If the frac-out has reached the surface, any material contaminated with bentonite will be removed by hand to a depth of 1 foot, contained, and properly disposed of, as required by law. The drilling contractor will be responsible for ensuring that the bentonite is either properly disposed of at an approved Class II disposal facility or properly recycled in an approved manner.
- If the bentonite fluid congeals, no other actions, such as disturbance of the streambed, will be taken that potentially would suspend sediments in the water column.
- The site supervisor has overall responsibility for implementing this BSSCP. The site supervisor will be notified immediately when a frac-out is detected. The site supervisor will be responsible for ensuring that the biological monitor is aware of the frac-out; coordinating personnel, response, cleanup, and regulatory agency notification and coordination to ensure proper clean-up; coordinating disposal of recovered material; and timely reporting of the incident. The site supervisor will ensure all waste materials are properly containerized, labeled, and removed from the site to an approved Class II disposal facility by personnel experienced in the removal, transport, and disposal of drilling mud.
- The site supervisor will be familiar with the contents of this BSSCP and the conditions of approval under which the activity is permitted to take place. The site supervisor will have the authority to stop work and commit the resources necessary to implement this plan. The site supervisor will ensure that a copy of this plan is available onsite and accessible to all construction personnel. The site supervisor will ensure that all workers are properly trained and familiar with the necessary procedures for response to a frac-out prior to the commencement of excavation operations.

Prepare and Implement a Spill Prevention, Control, and Counter-Measure Plan

A spill prevention, control, and counter-measure plan (SPCCP) is intended to prevent any discharge of oil into navigable water or adjoining shorelines. WSAFCA or its contractor will develop and implement an SPCCP to minimize the potential for and 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 will be taken in the event of a spill (e.g., an oil spill from engine refueling will be immediately cleaned up with oil absorbents). The SPCCP will outline descriptions of containments facilities and practices such as double-walled tanks, containment berms, emergency shutoffs, drip pans, fueling procedures, and spill response kits. It will describe how and when employees are trained in proper handling procedure and spill prevention and response procedures. WSAFCA will review and approve the SPCCP before onset of construction activities and routinely inspect the construction area to verify that the measures specified in the SPCCP are properly implemented and maintained. WSAFCA will notify its contractors immediately if there is a noncompliance issue and will require compliance. If a spill is reportable by regulation, the contractor's superintendent will notify WSAFCA, and WSAFCA will take action to contact the appropriate safety and cleanup crews to ensure that the SPCCP is followed. If an appreciable spill occurs and results determine that project activities have adversely affected surface or groundwater quality, a detailed analysis will be performed by a registered environmental assessor or professional engineer to identify the likely cause of contamination. This analysis will conform to American Society for Testing and Materials standards and will include recommendations for reducing or eliminating the source or mechanisms of contamination. Based on this analysis, WSAFCA and its contractors will select and implement measures to control contamination, with a performance standard that surface water quality and groundwater quality must be returned to baseline conditions.

Monitor Turbidity in Adjacent Water Bodies

WSAFCA or its contractor will monitor turbidity in the adjacent water bodies, where applicable criteria apply, to determine whether turbidity is being affected by construction and ensure that construction does not affect turbidity levels, which ultimately increase the sediment loads. The Water Quality Control Plan for the Central Valley Regional Water Quality Control Board (Basin Plan) contains turbidity objectives for the Sacramento River. WSAFCA or its contractor will monitor ambient turbidity conditions upstream during construction and adhere to the Surface Water Quality Ambient Monitoring Program requirements for turbidity monitoring. Monitoring will continue approximately 300 feet downstream of construction activities to determine whether turbidity is being affected by construction. Grab samples will be collected at a downstream location that is representative of the flow near the construction site. If there is a visible sediment plume being created from construction, the sample will represent this plume. Monitoring will occur hourly when construction encroaches into the Sacramento River. If construction does not encroach into the river, the monitoring will occur once a week on a random basis. If turbidity limits exceed Basin Plan standards, construction-related earth-disturbing activities will slow to a point that results in alleviating the problem. WSAFCA will notify the Central Valley Regional Water Quality Control Board of the issue and provide an explanation of the cause.

Prepare and implement a Mitigation and Monitoring Plan (MMP)

A draft MMP for the restoration areas is being developed and will be approved by the Corps, NMFS, Service, and CDFW before implementation of the Southport Project. The restoration objectives of the plan are listed below:

- Provide compensatory mitigation credits for effects on protected land cover-types and to special-status species and potential habitat for these species.
- Maximize shaded riverine aquatic cover/nearshore habitat, over and above current erosion stabilization efforts using biotechnical methods.
- Enhance setback ecological values using topographic and vegetation/habitat heterogeneity.
- Restore portions of the historic Sacramento River floodplain (i.e., waters of the United States).
- Restore riparian and oak woodland habitat on the restored floodplain that will create continuous habitat corridors for fish and wildlife movement.
- Design habitat features to minimize future maintenance obligations (e.g., reduce opportunities for sediment and debris accumulation).
- Design floodplain planting and vegetation management schemes to avoid undesirable hydraulic and sediment transport effects to the offset levee and offset area.
- Comply with current Corps levee vegetation policy to balance habitat needs with flood management objectives.

The monitoring objectives of the MMP are listed below:

- Monitor and evaluate the hydrologic and hydraulic performance of the restored floodplain relative to the ecological design criteria for the target species.
- Monitor and evaluate the success of the riparian/floodplain plantings and other habitat features in compensating, restoring, or enhancing fish and wildlife habitat values on the levee slopes and offset areas.
- Monitor and evaluate the effectiveness of the grading and drainage features in preventing fish stranding.
- Monitor the occurrence and extent of potential sedimentation and scour that may compromise the success of the habitat restoration and mitigation components of the project.

Giant Garter Snake Conservation Measures for the Southport Project

Conservation measures for giant garter snake were developed using portions of the Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties, California (Service 1997).

<u>Conduct all construction activities during the active period for the giant garter snake</u>: To the maximum extent possible, all construction activity within giant garter snake aquatic and upland habitat within 200 feet of aquatic habitat will be conducted during the snake's active period (May 1–October 1). During this time frame, potential for injury and mortality are lessened because snakes are actively moving and avoiding danger. Construction of the setback levee in Segment B through Segment F will begin in 2015. The setback levee and the remaining flood risk – reduction measures for all segments would be completed in 2016. Some preparation of construction may occur during the 2014 construction season, but no changes will be made to the existing levee prism. The construction season is typically from April 15 to October 31, subject to weather and other conditions. Because some construction may extend into the giant garter snakes dormant period (October 2 to April 30), additional protective measures will be implemented at these locations.

<u>Install and maintain construction barrier fencing around suitable giant garter snake habitat</u>: To reduce the likelihood of snakes entering the construction area, exclusion fencing and orange barrier fencing will be installed along the portions of the construction area that are within 200 feet of suitable aquatic and upland habitat. The exclusion and barrier fencing will be installed during the active period for giant garter snakes to reduce the potential for injury and mortality during this activity.

The construction specifications will require a provision to retain a qualified biologist to identify the areas that are to be avoided during construction. Areas adjacent to the directly affected area required for construction, including staging and access, will be fenced off to avoid disturbance in these areas. Before construction, the contractor will work with the qualified biologist to identify the locations for the barrier fencing and will place flags or flagging around the areas to be protected to indicate the locations of the barrier fences. The protected area will be clearly identified on the construction specifications. The fencing will be installed the maximum distance practicable from the aquatic habitat areas and will be in place before construction activities are initiated.

The barrier fencing will consist of 4-foot-tall erosion fencing buried at least 6–8 inches below ground level. The barrier fencing will ensure that giant garter snakes are excluded from the construction area and that suitable upland and aquatic habitat is protected throughout construction. The exclusion fencing will be commercial-quality, tightly-woven polypropylene fabric, orange in color, and 4 feet high (Tensor Polygrid or equivalent). The fencing will be tightly strung on posts with a maximum of 10-foot spacing.

Barrier and exclusion fences will be inspected daily by a qualified biological monitor during ground-disturbing activities. Once all initial ground-disturbing activities are completed, the biological monitor will perform weekly checks of the site for the duration of construction in order to ensure that construction barrier fences and exclusion fences are in good order, trenches are being covered, project personnel are conducting checks beneath parked vehicles prior to their movement, and that all other required biological protection measures are being complied with. The biological monitor will document the results of monitoring on construction monitoring log sheets, which will be provided to the Service within 1 week of each monitoring visit. Monitoring will continue until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the buffer area fences around giant garter snake habitat are maintained throughout construction. Biological inspection reports will be provided to the project lead and the Service.

<u>Minimize potential effects on giant garter snake habitat</u>: The following measures will be implemented to minimize potential effects on giant garter snake habitat:

- Staging areas will be located at least 200 feet from suitable snake habitat;
- Any dewatered habitat will remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat;
- Vegetation clearing within 200 feet of the banks of suitable snake aquatic habitat will be limited to the minimum area necessary. Avoided snake habitat within or adjacent to the action area will be flagged and designated as an environmentally sensitive area, to be avoided by all construction personnel;
- The movement of heavy equipment within 200 feet of the banks of suitable snake aquatic habitat will be confined to designated haul routes to minimize habitat disturbance; and
- Conduct preconstruction surveys and monitoring for the giant garter snake.

Prior to ground-disturbing activities within 200 feet of suitable habitat, a Service-approved biological monitor will conduct a preconstruction survey of suitable aquatic and upland habitat and inspect exclusion and orange barrier fencing to ensure they are both in good working order each morning. If any snakes are observed within the construction area at any other time during construction the biological monitor will be contacted to survey the site for giant garter snakes. The biological monitor will have the authority to stop construction activities until appropriate corrective measures have been completed or it is determined that the snake will not be harmed. Giant garter snakes encountered during construction activities will be allowed to move away from construction activities on their own. If they are unable to move away on their own, trapped or injured, giant garter snakes will only be removed by Service-permitted personnel and will be placed in the nearest suitable habitat that is outside of the construction area. The biological monitor will immediately report these activities to the Service by phone and will provide a written account of the details of the incident within 24 hours.

<u>Provide escape ramps or cover open trenches at the end of each day</u>: To avoid the entrapment of snakes, all excavated areas more than 1 foot deep will be provided with one or more escape ramps constructed of earth fill or wooden planks at the end of each workday. If escape ramps cannot be provided, then holes or trenches will be covered with plywood or other hard material. The biological monitor or construction personnel designated by the contractor will be responsible for thoroughly inspecting trenches for the presence of giant garter snakes at the beginning of each workday. If any snakes become trapped, the Service-approved biological monitor will be contacted to relocate the snake, and no work will occur in that area until approved by the biological monitor.

<u>Implement additional protective measures during work in suitable habitat during the giant garter snake dormant period</u>: The following additional protective measures will be implemented during time periods when work must occur during the giant garter snake dormant period (October 2–April 30), when snakes are more vulnerable to injury and mortality:

- A full-time Service-approved biological monitor will be onsite for the duration of construction activities;
- All emergent vegetation and vegetation within 200 feet of suitable aquatic habitat will be cleared prior to the giant garter snake hibernation period (i.e., vegetation clearing must be completed by October 1); and
- Exclusion and barrier fencing will be installed around the perimeter of the work area and across drainage areas where activities associated with levee slope flattening and pipe reconstruction activities will occur. The fencing will enclose the work area to the maximum extent possible to prevent snakes from entering the work area. Fencing will be installed during the active period for snakes (May 1–October 1) to reduce the potential for injury and mortality during fence installation. The Service-approved biological monitor will work with the contractor to determine where fencing should be placed and will monitor fence installation. The barrier fencing will consist of 3- to 4-foot-tall erosion fencing buried at least 6 to 8 inches below ground level. The barrier fencing will minimize opportunities for giant garter snake hibernation in the adjacent upland area.

Portions of the construction area that are temporarily disturbed during construction will be re-vegetated with emergent vegetation and adjacent disturbed upland habitat will be re-vegetated with native grasses and forbs after construction is complete.

<u>Restore temporarily disturbed aquatic and upland habitat to pre-project conditions</u>: Upon completion of the Southport Project, 155 acres of suitable upland habitat will be restored in the borrow areas for giant garter snake to pre-project conditions. There will be no temporary loss of aquatic habitat. All of the temporary habitat effects will occur in the borrow areas within West Sacramento. The actual temporary effects from borrow activities will be substantially less pending an analysis on the suitability of potential borrow materials.

Suitable upland habitat for giant garter snakes consists of fallow agricultural fields and nonnative annual grassland. Cultivated and disked agricultural fields were not considered suitable upland habitat for giant garter snake because they are frequently disturbed during farming activities. Temporarily affected upland habitat will be restored to pre-project conditions within a maximum of one season (a season is defined as the calendar year between May 1 and October 1 [Service 1997]).

Restoration of upland habitat will be detailed in a mitigation and monitoring plan that will be reviewed and approved by the Service prior to the start of construction.

Compensate for the direct loss of giant garter snake upland habitat: The permanent loss of 2.24 acres of upland habitat will be compensated for by restoring habitat onsite or by purchasing credits from a Service-approved mitigation bank. There will be no permanent loss of aquatic habitat.

Valley Elderberry Longhorn Beetle Conservation Measures for the Southport Project

Conservation measures for beetle for the Southport Project are based on the Service's Conservation Guidelines (Service 1999a).

Fence Elderberry Shrubs to be Protected and Monitor Fencing during Construction: Elderberry shrubs and clusters within 100 feet of the construction area that will not be removed will be protected during construction. A qualified biologist (i.e., with elderberry/beetle experience), under contract with WSAFCA, will mark the elderberry shrubs and clusters that will be protected during construction. Orange construction barrier fencing will be placed at the edge of the respective buffer areas. The buffer area distances will be proposed by the biologist and approved by Service. No construction activities will be permitted within the buffer zone other than those activities necessary to erect the fencing. Signs will be posted every 50 feet along the perimeter of the buffer area fencing. The signs will contain the following information:

"This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment."

In some cases, where the elderberry shrub dripline is within 10 feet of the work area, k-rails will be placed at the shrub's dripline to provide additional protection to the shrub from construction equipment and activities. Temporary fences around the elderberry shrubs and k-rails at shrub driplines will be installed as the first order of work. Temporary fences will be furnished, constructed, maintained, and later removed, as shown on the plans, as specified in the special provisions, and as directed by the project engineer. Temporary fencing will be 4 feet high, commercial-quality woven polypropylene, and orange in color.

Buffer area fences around elderberry shrubs will be inspected weekly by a qualified biological monitor during ground-disturbing activities and monthly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around elderberry shrubs throughout construction. Biological inspection reports will be provided to the project lead and Service.

Conduct Stem Counts Prior to Elderberry Shrub Transplantation: Surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. The biologist will survey the area surrounding the shrub to be transplanted to ensure that there are not additional elderberry shrubs that need to be removed. Surveys will consist of counting and measuring the diameter of each stem at ground level and examining elderberry shrubs for the presence of beetle exit holes. Survey results and an analysis of the number of elderberry seedlings/cuttings and associated native plants based on the survey results will be submitted to Service. Elderberry seedlings/cuttings and associated native plants will be planted prior to transplantation of elderberry shrubs. The data collected during the surveys prior to transplantation will be used to determine if compensation requirements or take limits are being exceeded, and if additional plantings are necessary. Because construction of the Southport project will occur over multiple years, elderberry survey data for each year will be used to rectify any discrepancies in compensation and to ensure full compensation of effects on the beetle. Surveys for the beetle are valid for a period of 2 years (Service 1999a).

Water the construction area to control dust: The construction contractor will ensure that the project construction area will be watered as necessary to prevent dirt from becoming airborne and accumulating on elderberry shrubs within the 100–foot buffer.

Compensate for direct effects on valley elderberry longhorn habitat: Before construction begins, compensation will be implemented for direct effects on elderberry shrubs by transplanting shrubs that cannot be avoided to a Service-approved conservation area. Elderberry seedlings or cuttings and associated native species will also be planted in the conservation area. Each elderberry stem measuring 1 inch or greater in diameter at ground level that is adversely affected will be replaced in the conservation area, with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). The numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether the shrub lies in a riparian or non-riparian area. Stock of either seedlings or cuttings will be obtained from local, Service-approved sources. At the discretion of the Service, shrubs that are unlikely to survive transplantation because of poor condition or location, or a plant that will be extremely difficult to move because of access problems, may be exempted from transplantation. In cases in which transplantation is not possible, minimization ratios will be increased to offset the additional habitat loss.

The relocation of elderberry shrubs will be conducted according to Service-approved procedures outlined in the Conservation Guidelines (Service 1999a). Elderberry shrubs within the project construction area that cannot be avoided will be transplanted during the plant's dormant phase, which is November through the first 2 weeks of February. A qualified biological monitor will remain onsite while the shrubs are being transplanted.

Proposed Conservation Area
About 120 acres of riparian habitat in the Offset floodplain area will be restored or enhanced as part of the project implementation. Based on the Conservation Guidelines (Service 1999a), a total of 13.51 acres of the floodplain will be riparian habitat required for beetle compensation plantings for the Southport Project.

Evidence of the beetle occurrence in the conservation area, the condition of the elderberry shrubs in the conservation area, and the general condition of the conservation area itself will be monitored over a period of 10 consecutive years or for 7 years over a 15-year period from the date of transplanting. Monitoring reports will be provided to the Service in each of the years in which monitoring is required. As specified in the Conservation Guidelines, the report will include information on timing and rate of irrigation, growth rates, and survival rates and mortality.

To meet the success criteria specified in the Conservation Guidelines, a minimum survival rate of 60% of the original number of elderberry replacement plantings and associated native plants must be maintained throughout the monitoring period.

Action Area

The action areas 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 purposes of the effects assessment, the action area encompasses the Sacramento River from the Sacramento Bypass downstream to the South Cross Levee, the Sacramento Deep Water Ship Channel and the Port of West Sacramento, and the Sacramento and Yolo Bypasses (Figure 1).

The City of West Sacramento is bisected into two basins by the Sacramento River Deep Water Ship Channel and the Port of West Sacramento, and is contained within the levees of the West Sacramento GRR Project. The north basin encompasses 6,100 acres, while the south basin is 6,900 acres. Potential borrow areas, transportation routes, and staging areas have been identified within the city, as well as within 20 miles of West Sacramento. The potential borrow areas identified in Figure 2 are also part of the action area.

The action area also includes the perennial waters extending 200 feet perpendicular from shorelines adjacent to construction areas, and 1,000 feet downstream of the in-water construction areas. These distances represent the extent to which turbidity and sedimentation from the West Sacramento GRR Project may affect the waters.

Analytical Framework for the Jeopardy and Adverse Modifications Determinations

<u>Jeopardy Determination</u>
In accordance with policy and regulation, the jeopardy analysis in this biological opinion relies on four components: (1) the Status of the Species, which evaluates snake, beetle, and smelt range-wide conditions, the factors responsible for these conditions, and the survival and recovery needs of each species; (2) the Environmental Baseline, which evaluates the condition of the snake, beetle, and smelt in the action area, the factors responsible for these conditions, and the relationship of the action area to the survival and recovery of each species; (3) the Effects of the Action, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on the snake, beetle, and smelt; and (4) the Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the snake, beetle, and smelt.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the snake, beetle, and smelt, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of recovery of each species in the wild.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the snake, beetle, smelt, as well as the role of the action area in the survival and recovery of each species as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.2. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this biological opinion relies on four components: (1) the Status of the Critical Habitat, which evaluates the range-wide condition of critical habitat for the smelt in terms of primary constituent elements (PCE)s, the factors responsible for that condition, and the intended recovery function of the critical habitat at the provincial and range-wide scale; (2) the Environmental Baseline, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the Effects of the Action, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units and; (4) Cumulative Effects which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on smelt critical habitat are evaluated in the context of the range-wide condition of the critical habitat at the provincial and range-wide scales, taking into account any cumulative effects, to determine if the critical habitat range-wide will remain functional (or will retain capable habitat) to serve its intended recovery role for the smelt.

The analysis in this biological opinion places an emphasis on using the intended range-wide recovery function of smelt critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

Status of the Species

Giant Garter Snake

Please refer to the Giant Garter Snake (*Thamnophis gigas*) 5-year Review: Summary and Evaluation for the current status of the species (Service 2006).

Environmental Baseline

Suitable habitat for the snake exists along the western border of both the North and South Basins of the West Sacramento GRR Project. In the North Basin, some additional suitable habitat can be found along the Sacramento Bypass. In the South Basin, drainages along the toe of the South Cross Levee may also provide habitat for the snake. However, most of the developed and undeveloped lands within the City of West Sacramento do not provide suitable habitat for the snake.

There are 28 occurrence records of the snake within 5 miles of the City of West Sacramento (CDFW 2014b). The closest occurrences are about 1.5 miles west of the Sacramento Bypass Training Levee, while 11 occurrences are to the north in the Natomas Basin, across the Sacramento

River from West Sacramento. There are 77 CNDDB occurrences within 10 miles of West Sacramento (CDFW 2014b). Seven of the occurrence records within 10 miles of West Sacramento are across the Sacramento River and southeast of the City of Sacramento, near Elk Grove. Giant garter snakes are apparently absent from larger rivers, and from wetlands with sand, gravel, or rock substrates (R. Hansen 1980; Rossman and Stewart 1987; Brode 1988; G. Hansen 1988; Brode and Hansen 1992). The North and South Basins contain limited suitable snake aquatic habitat in drainages and canals, yet the Sacramento River generally does not offer suitable habitat and is a significant barrier to snake movement.

Valley Elderberry Longhorn Beetle

For the most recent comprehensive assessment of the range-wide status of the beetle, 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; Proposed Rule, Withdrawal* (Service 2014a).

Environmental Baseline

The majority of lands within North and South Basins of West Sacramento are urban and suburban lands in private ownership. Suitable habitat for the beetle (i.e., elderberry shrubs) occurs throughout the City of West Sacramento. Although the status of the beetle and its habitat on most of these private lands is unknown, there are documented occurrences of beetles in both the North and South Basins (CDFW 2014b). In the South Basin, occurrence number 208 near river mile 52 of the Sacramento River, and occurrence number 209 along a railroad access north of Davis road, have identified both male and female beetles. At occurrence number 209, one female was observed laying eggs in 2006 (CDFW 2014b). In the North Basin, occurrences 18, 28, 29, and 56 have all documented elderberry shrubs with exit holes in stems, a sign of beetle presence.

Delta Smelt

Listing Status

The Service proposed to list the smelt as threatened with proposed critical habitat on October 3, 1991 (Service 1991). The Service listed the smelt as threatened on March 5, 1993, and designated critical habitat for this species on December 19, 1994 (Service 1994). The smelt was one of eight fish species addressed in the Recovery Plan for the Sacramento–San Joaquin Delta Native Fishes (Service 1995). This recovery plan is currently under revision. A 5-year status review of the smelt was completed on March 31, 2004 (Service 2004). The 2004 review affirmed the need to retain the smelt as a threatened species. A 12-month finding on a petition to reclassify the delta smelt was completed on April 7, 2010 (Service 2010). After reviewing all available scientific and commercial information, the Service determined that re-classifying the smelt from a threatened to an endangered species was warranted but precluded by other higher priority listing actions (Service 2010).

Distribution

The smelt is endemic to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta) in California, and is restricted to the area from San Pablo Bay upstream through the Delta in Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties (Moyle 2002). Their range extends from San Pablo Bay upstream to Verona on the Sacramento River and Mossdale on the San Joaquin River. The smelt was formerly considered to be one of the most common pelagic fish in the upper Sacramento-San Joaquin Estuary.

Description
Delta smelt are a small, slender bodied fish of the Osmeridae (smelts) (Moyle 2002). They are nearly translucent with a steely-blue sheen to their sides and a pronounced odor reminiscent of cucumber (Moyle 2002). Although delta smelt have been recorded to reach lengths of up to 120 mm (4.7 in) (Moyle 2002), catch data from 1992 - 2004 showed mean fork length to be 54.1 ± .01 mm (Bennett 2005; Sweetnam 1999). Delta smelt are also identifiable by their relatively large eye to head size (Moyle 2002) and their small, translucent adipose fin located between the dorsal and caudal fins. Occasionally one chromatophore may be found between the mandibles, but most often there is none (Moyle 2002).

The delta smelt is one of six species currently recognized in the Hypomesus genus (Bennett 2005). Genetic analyses have confirmed that delta smelt presently exists as a single intermixing population (Stanley et al. 1995; Trenham et al. 1998; Fisch et al. 2011). Within the genus, delta smelt are most closely related to surf smelt (*H. pretiosis*), a species common along the western coast of North America. The wakasagi *(H. nipponensis*), an anadromous western Pacific smelt species introduced to Central Valley reservoirs in 1959, is thought to be seasonally sympatric with the delta smelt in the estuary (Trenham et al. 1998). Despite morphological similarities, allozyme studies have demonstrated that wakasagi and delta smelt are genetically distinct and presumably derived from different marine ancestors (Stanley et al. 1995).

Life History
Adult delta smelt spawn during the late winter and spring months, with most spawning occurring during April through mid-May (Moyle 2002). Spawning occurs primarily in sloughs and shallow edge areas in the Delta and has been recorded in Suisun Marsh and the Napa River (Moyle 2002). Most spawning occurs at temperatures between 12-18°C. Spawning may occur at temperatures up to 22°C, but hatching success of the larvae is very low (Bennett 2005). Fecundity of females ranges from about 1,200 to 2,600 eggs, and is correlated with female size (Moyle 2002). In captivity, females survive after spawning and develop a second clutch of eggs (Mager et al. 2004) and field collections of ovaries containing eggs of different size and stage indicate that this also occurs in the wild (Adib-Samii 2008). While most adults do not survive to spawn a second season, a small percentage do (<5 percent) (Moyle 2002; Bennett 2005) and are typically larger (90-110 mm Standard Length [sdl]). These females may contribute disproportionately to the population's egg supply (Moyle 2002 and references therein) since two-year-old females may have 3-6 times as many ova as first year spawners.

The locations in the Delta where newly hatched larvae are present most likely indicates spawning occurrence and most of what is known about delta smelt spawning habitat in the wild is inferred from the location of spent females and young larvae captured in the DFW's Spring Kodiak Trawl (SKT) (CDFW 2014a) and 20-mm Survey, respectively. In the laboratory, delta smelt spawned at night (Baskerville-Bridges et al. 2000; Mager et al. 2004). Other smelts, including marine beach spawning species and estuarine populations are secretive spawners, entering spawning areas during the night and leaving before dawn. If this behavior is exhibited by delta smelt, then delta smelt distribution based on the SKT, which is conducted during daylight hours in offshore habitats, may reflect general regions of spawning activity, but not actual spawning sites.

Delta smelt spawning has only been directly observed in the laboratory. Consequently, what is known about the mechanics of smelt spawning is derived from laboratory observations and observations of related smelt species. Delta smelt eggs are 1 millimeter diameter and are adhesive and negatively buoyant (Moyle 2002; Mager et al. 2004; Wang 1986; Wang 2007). Laboratory observations indicate that delta smelt are broadcast spawners, discharging eggs and milt close to the bottom over substrates of sand and/or pebble in current (DWR and Reclamation 1994; Brown and Kimmerer 2002; Lindberg et al. 1997; Wang 2007). Spawning over gravel or sand can also aid in the oxygenation of smelt eggs and eggs that are laid in silt or muddy substrates might get buried or smothered, preventing their oxygenation from water flow (Lindberg pers. comm. 2011). The eggs of surf smelts and other beach spawning smelts adhere to sand particles, which keeps them negatively buoyant but not immobile, as the sand may "tumble" them with water currents and turbulence (Hay 2007). It is not known whether delta smelt eggs "tumble incubate" in the wild, but tumbling of eggs may moderately disperse them, which might reduce predation risk within a localized area.

Mager et al. (2004) reported that embryonic development to hatching takes 11-13 days at 14-16° C for delta smelt, and Baskerville-Bridges et al. (2000) reported hatching of delta smelt eggs after 8-10 days at temperatures between 15-17° C. Wang (2007) reported high hatching rates at temperatures between 14-17° C. At hatching and during the succeeding three days, larvae are buoyant, swim actively near the water surface, and do not react to bright direct light (Mager et al. 2004). As development continues, newly hatched delta smelt become semi-buoyant.

Analyses of otoliths indicate larval delta smelt grow to twice their size after 40 days (Bennett 2005), and by 70 days, most wild fish were 30-40 mm long and beyond the larval stage. This suggests there is a strong selective pressure for rapid larval growth in nature, a situation that is typical for fish in general (Houde 1987). Successful feeding seems to depend on a high density of food organisms and turbidity, and increases with stronger light conditions (Baskerville-Bridges et al. 2000; Mager et al. 2004; Baskerville-Bridges et al. 2004). The food available to larval smelt is constrained by mouth gape and status of fin development. Larval smelt cannot capture as many kinds of prey as larger individuals, but all life stages have small gapes that limit their range of potential prey. Prey availability is also constrained by habitat use, which affects what types of prey are encountered. Larval smelt are visual feeders and their ability to see prey in the water is enhanced by turbidity (Baskerville-Bridges et al. 2004). Thus, smelt diets are largely comprised of small crustacea that inhabit the estuary's turbid, low-salinity, open-water habitats (i.e., zooplankton). Larval smelt have particularly restricted diets (Nobriga 2002) and they do not feed on the full array of zooplankton with which they co-occur; they mainly consume three copepods, *Eurytemora affinis*, *Pseudodiaptomus forbesi*, and freshwater species of the family Cyclopidae. Further, the diets of first-feeding smelt larvae are largely restricted to the larval stages of these copepods; older, larger life stages of the copepods are increasingly targeted as the smelt larvae grow, their gape increases, and they become stronger swimmers.

The triggers for, and the duration of, delta smelt larval movement from spawning areas to rearing areas are not known. Most larvae gradually move downstream toward the two parts per thousand isohaline (X2), where X2 is scaled as the distance in kilometers from the Golden Gate Bridge (Jassby et al. 1995). Young-of-the-year smelt rear in the low-salinity zone (LSZ) from late spring through fall and early winter. Once in the rearing area growth is rapid, and juvenile fish are 40-50 mm sdl by early August (Erkkila et al. 1950; Ganssle 1966; Radtke 1966). They reach adult size (55-70 mm sdl) by early fall (Moyle 2002) and smelt growth slows considerably (only 3-9 mm total) during the fall months, presumably because most of the energy ingested is being directed towards gonadal development (Erkkila et al. 1950; Radtke 1966).

Population Dynamics and Abundance Trends- CDFW conducts several long-term monitoring surveys that have been used to index the relative abundance of smelt. The 20-mm Survey (CDFW 2014a) has been conducted every year since 1995 and samples April-June, targeting late-stage smelt larvae. The summer townet survey (TNS) has been conducted nearly every year between June-August, since 1959, and targets 38-mm striped bass, but collects similar-sized juvenile smelt. The FMWT has been conducted nearly every year since 1967, and like the TNS, the survey targets age-0 striped bass but collects smelt > 40 mm in length. The FMWT samples from September through December. The smelt catch data and relative abundance indices derived from these sampling programs have been used in numerous publications (e.g., Stevens and Miller 1983; Moyle et al. 1992; Jassby et al. 1995; Kimmerer 2002b; Dege and Brown 2004; Bennett 2005; Feyrer et al. 2007; Sommer et al. 2007; Kimmerer 2008; Newman 2008; Nobriga et al. 2008; Kimmerer et al. 2009; Mac Nally et al. 2010; Thomson et al. 2010; Feyrer et al. 2011; Maunder and Deriso 2011) and the abundance index time series documents the long-term decline of the smelt.

At all life stages, delta smelt are found in greatest abundance in the water column and usually not in close association with the shoreline. They inhabit open, surface waters of the Delta and Suisun Bay, where they presumably aggregate in loose schools where conditions are favorable (Moyle 2002). In years of moderate to high Delta outflow, delta smelt larvae are abundant in the Napa River, Suisun Bay and Montezuma Slough, but the degree to which these larvae are produced by locally spawning fish versus the degree to which they originate upstream and are transported by tidal currents to the bay and marsh is uncertain.

Sampling of larval delta smelt in 1989 and 1990 suggested that spawning occurred in the Sacramento River; in Georgiana, Prospect, Beaver, Hog, and Sycamore sloughs; in the San Joaquin River adjacent to Bradford Island and Fisherman's Cut; and possibly other areas (Wang 1991). However, in recent years, the densest concentrations of both spawners and larvae have been recorded in the Cache Slough/Sacramento Deepwater Ship Channel complex in the North Delta. Some delta smelt spawning occurs in the Napa River, Suisun Bay and Suisun Marsh during wetter years (Sweetnam 1999; Wang 1991; Hobbs et al. 2007). Early stage larval delta smelt have also been recorded in Montezuma Slough near Suisun Bay (Wang 1986).

The timing of spawning may affect delta smelt population dynamics. Lindberg (2011) has suggested that smelt larvae that hatch early, around late February, have an advantage over larvae hatched during late spawning in May. Early season larvae have a longer growing season and may be able to grow larger faster during more favorable habitat conditions in the late winter and early spring. An early growing season may result in higher survivorship and a stronger spawning capability for that generation. Larvae hatched later in the season have a shorter growing season which effectively reduces survivorship and spawning success for the following spawning season.

Early statistical assessments of delta smelt population dynamics concluded that at best, the relative abundance of the adult delta smelt population had only a very weak influence on subsequent juvenile abundance (Sweetnam and Stevens 1993). Thus, early attempts to describe abundance variation in delta smelt ignored stock-recruit effects and researchers looked for environmental variables that were directly correlated with interannual abundance variation (e.g., Stevens and Miller 1983; Moyle et al. 1992; Sweetnam and Stevens 1993; Herbold 1994; Jassby et al. 1995). Because delta smelt live in a habitat that varies in size and quality with Delta outflow, the authors cited above searched for a linkage between Delta outflow (or X2) and the TNS and FMWT indices. Generally, these analyses did not find strong support for an outflow-abundance linkage, which led to a prevailing conceptual model that multiple interacting factors had caused the delta smelt decline (Moyle et al. 1992; Bennett and Moyle 1996; Bennett 2005). It has also recently been noted that delta smelt's FMWT index is partly influenced by concurrent environmental conditions (Feyrer et al. 2007; 2011). This may be a partial explanation for why few analyses could consistently link springtime environmental conditions to delta smelt's fall index.

Delta smelt abundance plays an important role in subsequent abundance (Bennett 2005; Maunder and Deriso 2011). Bennett (2005) assessed data from CDFW's FMWT and TNS, and concluded that two-year-old delta smelt might play an important role in delta smelt population dynamics, that it was not clear whether juvenile production was a density-independent or -dependent function of adult abundance, and that adult production is a density-dependent function of juvenile abundance. He also concluded that the carrying capacity of the estuary to support this life-stage transition had declined over time. These conclusions are also supported by Maunder and Deriso (2011).

Delta smelt population dynamics may have also changed over time. Previous publications have reported a delta smelt step-decline during 1981-1982 (Kimmerer 2002b; Thomson et al. 2010). Prior to this decline, the stock-recruit data are consistent with "Ricker" type density-dependence where increasing adult abundance resulted in decreased juvenile abundance. Since the decline, recruitment has been positively and essentially linearly related to prior adult abundance, suggesting that reproduction has been basically density-independent for about the past 30 years. This means that since the early 1980s, more adults translates into more juveniles and fewer adults translates into fewer juveniles without being "compensated for" by density-dependence.

In contrast to the transition among generations, the weight of scientific evidence strongly supports the hypothesis that, at least over the history of Interagency Ecological Program fish monitoring, delta smelt has experienced density-dependence during the juvenile stage of its life cycle (Bennett 2005; Maunder and Deriso 2011). This has been inferred because, statistically, the FMWT index does not increase linearly with increases in the TNS index. Rather, the best-fitting relationships between the TNS index and the FMWT index show the FMWT indices approach an asymptote as the TNS indices increases, or possibly even declines at the highest TNS indices.

From a species conservation perspective, the most relevant aspect of this juvenile density dependence is that the carrying capacity of the estuary for delta smelt has declined (Bennett 2005). Thus, the delta smelt population decline has occurred for two basic reasons. First, the compensatory density-dependence that historically enabled juvenile abundance to rebound from low adult numbers stopped happening. The reason is still not known, but the consequence of the change is that for the past several decades, adult abundance drives juvenile production in a largely density-independent manner. Thus, if numbers of adults or adult fecundity decline, juvenile production will also decline (Kimmerer 2011). Second, because juvenile carrying capacity has declined, juvenile production hits a "ceiling" at a lower abundance than it once did. This limits adult abundance and possibly per capita fecundity, which cycles around and limits the abundance of the next generation of juveniles. The mechanism causing carrying capacity to decline is likely due to the long-term accumulation of deleterious habitat changes – both physical and biological – during the summer-fall (Bennett et al. 2008; Feyrer et al. 2007; 2011; Maunder and Deriso 2011).

Habitat

The existing physical appearance and hydrodynamics of the Delta have changed substantially from the environment in which native fish species like delta smelt evolved. The Delta once consisted of tidal marshes with networks of diffuse dendritic channels connected to floodplains of wetlands and upland areas (Moyle 2002). The in-Delta channels were further connected to drainages of larger and smaller rivers and creeks entering the Delta from the upland areas. In the absence of upstream reservoirs, freshwater inflow from smaller rivers and creeks and the Sacramento and San Joaquin Rivers were highly seasonal and more strongly and reliably affected by precipitation patterns than they are today. Consequently, variation in hydrology, salinity, turbidity, and other characteristics of the Delta aquatic ecosystem was greater in the past than it is today (Kimmerer 2002a). The following is a brief description of the changes that have occurred to delta smelt's habitat.

Changes to the LSZ: There have been documented changes to the delta smelt's LSZ habitat that have led to present-day habitat conditions. The close association of delta smelt with the San Francisco estuary LSZ has been known for many years (Stevens and Miller 1983; Moyle et al. 1992). Peterson (2003) developed a conceptual model that hypothesized how, "stationary and dynamic components of estuarine habitats" interacted to influence fisheries production in tidal river estuaries. Peterson's model suggests that when the dynamic and static aspects of estuarine habitat sufficiently overlap, foraging, growth, density, and survival are all high, and that enables fish production to outpace losses to predators. The result is high levels of successful recruitment of new individuals. The model also hypothesizes that when the dynamic and static aspects of an estuarine habitat do not sufficiently overlap, foraging, growth, density, and survival are impaired such that losses to predators increase and recruitment of new individuals decreases. This model was developed specifically for species spawned in marine environments that were subsequently transported into estuaries. However, the concept of X2, which was developed in the San Francisco estuary to describe how freshwater flow affected estuarine habitat (Jassby et al. 1995), played a role in the intellectual development of Peterson's model.

Current information indicates the most suitable delta smelt habitat is when low-salinity water is near 20°C, highly turbid, oxygen saturated, low in contaminants, supports high densities of calanoid copepods and mysid shrimp (Moyle et al. 1992; Lott 1998; Nobriga 2002), and occurs over comparatively static 'landscapes' that support sandy beaches and bathymetric variation that enables the fish and their prey to aggregate (Kimmerer et al. 2002a; Bennett et al. 2002; Hobbs et al. 2006). Almost every component listed above has been degraded over time and the Service has determined that this accumulation of habitat change is the fundamental reason or mechanism that has caused delta smelt to decline.

Alterations to estuarine bathymetry and salinity distribution- The position of the LSZ, where delta smelt rear, has changed over the years. The first major change in the LSZ was the conversion of the landscape over which tides oscillate and river flows vary (Moyle et al. 2010). Most of the historic wetlands within the system were diked and reclaimed for agriculture or other human uses by 1920 (Atwater et al. 1979) and channels were dredged to accommodate shipping traffic from the Pacific Ocean and San Francisco Bay to ports in Sacramento and Stockton. These changes left Suisun Bay and the confluence of the Sacramento-San Joaquin Rivers as the largest and most bathymetrically variable places in the LSZ. This region remained a highly productive nursery for many decades (Stevens and Miller 1983; Moyle et al. 1992; Jassby et al. 1995); however, the deepened channels required more freshwater outflow to maintain the LSZ in the large Suisun Bay and at the confluence than was once required (Gartrell 2010).

The construction of the Central Valley Water Project and the State Water Project not only provided water supply for urban, agricultural and industrial users, but also provided water needed to combat salinity intrusion into the Delta, which was observed by the early 20th century. California's demand for freshwater continues to increase and the seasonal salinity intrusion perpetually reduces the temporal overlap of the LSZ (indexed by X2) within the Suisun Bay, especially in the fall (Feyrer et al. 2007; 2011). Consequently, a major habitat change in the Delta has been in the frequency with which the LSZ is maintained in Suisun Bay for any given amount of precipitation. There was a step-decline in the LSZ in 1977 from which it has never recovered for more than a few years at a time. Based on model forecasts of climate change and water demand, this trend is expected to continue (Feyrer et al. 2011).

Summer and fall environmental quality has decreased overall in the Delta because outflows are lower and water transparency is higher. The confluence of the Sacramento and San Joaquin Rivers has, as a result, become increasingly important as a rearing location for delta smelt, with physical environmental conditions constricting the species range to a relatively narrow area (Feyrer et al. 2007; Nobriga et al. 2008). This has increased the likelihood that most of the juvenile population is exposed to chronic and cyclic environmental stressors, or catastrophic events. For instance, all seven delta smelt collected during the September 2007 fall mid-water trawl (FMWT) survey were captured at statistically significantly higher salinities than what will be expected based upon historical distribution data generated by Feyrer et al. (2007). During the same year, the annual bloom of toxic cyanobacteria (Microcystis aeruginosa) spread far downstream to the west Delta and beyond during the summer (Lehman et al. 2005), and this has been suggested as an explanation for the anomaly in the distribution of delta smelt relative to water salinity levels (USBR 2008).

Turbidity: From 1999 to present, the Delta experienced a change in estuarine turbidity that culminated in an estuary-wide step-decline in 1999 (Schoellhamer 2011). Since delta smelt associate with highly turbid waters, there is a negative correlation between the frequency of delta smelt occurrence in trawls during the summer, fall and early winter, at a given sampling station with increasing clarity, or Secchi depth (Feyrer et al. 2007, Nobriga et al. 2008). This is very consistent with behavioral observations of captive delta smelt (Nobriga and Herbold 2008). Few daylight trawls catch delta smelt at Secchi depths over 0.50 m and capture probabilities for delta smelt are highest at 0.40 m or less. Turbid waters are thought to increase foraging efficiency (Baskerville-Bridges et al. 2004) and reduce the risk of predation for delta smelt.

Temperature: Delta smelt of all sizes are found in the main channels of the Delta and Suisun Marsh and the open waters of Suisun Bay where the water is well oxygenated and temperatures are usually less than 25° C in summer (Nobriga et al. 2008). Swanson and Cech (1995) and Swanson et al. (2000) indicate delta smelt tolerate a range of temperatures (<8° C to >25° C), however warmer water temperatures >25° C restrict their distribution more than colder water temperatures (Nobriga and Herbold 2008). Currently, delta smelt are subjected to thermally stressful temperatures every summer, and all available regional climate change projections predict central California will be warmer still in the coming decades (Dettinger 2005). Water temperatures are presently above 20°C for most of the summer in core habitat areas, sometimes even exceeding the nominal lethal limit of 25°C for short periods. Coldwater fishes begin to have behavioral impairments (Marine and Cech 2004) and lose competitive abilities (Taniguchi et al. 1998) prior to reaching their thermal tolerance limits. Thus, the estuary can already be considered thermally stressful to delta smelt and can only become more so if temperatures warm in the coming decades.

Foraging Ecology: Delta smelt feed primarily on small planktonic crustaceans, and occasionally on insect larvae (Moyle 2002). Historically, the main prey of delta smelt was the euryhaline copepod *Eurytemora affinis* and the euryhaline mysid *Neomysis mercedis*. The slightly larger *Pseudodiaptomus forbesi* has replaced *E. affinis* as a major prey source of delta smelt since its introduction into the Bay-Delta (Moyle 2002). Another smaller copepod, *Limnoithona tetraspina*, was introduced to the Bay-Delta in the mid-1990s and is now one of the most abundant copepods in the LSZ, but not abundant in delta smelt diets. *Acartiella sinensis*, a calanoid copepod species that invaded the Delta at the same time as *L. tetraspina*, also occurs at high densities in Suisun Bay and in the western Delta over the last decade. Delta smelt eat these newer copepods, but Pseudodiaptomus remains their dominant prey (Baxter et al. 2008).

River flows influence estuarine salinity gradients and water residence times and thereby affect both habitat suitability for benthos and the transport of pelagic plankton upon which delta smelt feed. High tributary flow leads to lower residence time of water in the Delta, which generally results in lower plankton biomass (Kimmerer 2004). Higher residence times, which result from low tributary flows, can result in higher plankton biomass, but water diversions, overbite clam grazing (Jassby et al. 2002), and possibly contaminants (Baxter et al. 2008) remove a lot of plankton biomass when residence times are high. Delta smelt cannot occupy much of the Delta anymore during the summer (Nobriga et al. 2008) and there is a potential disconnect between regions of high zooplankton abundance in the Delta and delta smelt distribution.

<u>Aquatic Macrophytes</u>: For many decades, the Delta's waterways were turbid and growth of submerged plants was apparently unremarkable. That began to change in the mid-1980s, when the Delta was invaded by the non-native plant, *Egeria densa*, a fast-growing aquatic macrophyte that has now taken hold in many shallow habitats throughout the Delta (Brown and Michnuik 2007; Hestir 2010). The large canopies formed by *E. densa* and other non-native species of submerged aquatic vegetation (SAV) have physical and biological consequences for the ecosystem (Kimmerer et al. 2008) and delta smelt. First, the dense nature of SAV promotes sedimentation of particulate matter from the water column, which increases water transparency that then limits the amount of habitat available for delta smelt (Feyrer et al. 2007; Nobriga et al. 2008). Second, dense SAV canopies provide habitat for a suite of non-native fishes that occupy the Delta, displacing native fishes (Nobriga et al. 2005; Brown and Michniuk 2007) and increasing predation pressure on delta smelt. Third, the rise in SAV over the last three decades has led to a shift in the dominant trophic pathways that fuel fish production in the Delta. Until the latter 1980s, the food web of most fishes was often dominated by mysid shrimp (Feyrer et al. 2003) that were subsidized by phytoplankton food sources (Rast and Sutton 1989). Most littoral and demeral fishes of the Delta have diets dominated by the epibenthic amphipods that eat SAV detritus or the epiphytic algae attached to SAV (Grimaldo et al. 2009). Lastly, SAV can overwhelm littoral habitats (inter-tidal shoals and beaches) where delta smelt may spawn making them unsuitable for spawning.

<u>Predators</u>: Nothing is known about the historic predators of delta smelt or their possible influence on delta smelt population dynamics. Fish eggs and larvae can be opportunistically preyed upon by many invertebrate and vertebrate animals. The eggs and newly-hatched larvae of delta smelt are thought to be prey for Mississippi silversides (Bennett 2005), and potentially yellowfin goby, centrarchids, and Chinook salmon. Centrarchid fishes and Chinook salmon smolts released in the Delta for research may prey on larval delta smelt (Brandes and McLain 2001; Nobriga and Chotkowski 2000) and studies during the early 1960s found delta smelt were an occasional, but rare, prey fish for striped bass, black crappie and white catfish (Turner and Kelley 1966). Since delta smelt were a comparatively rare fish historically, it is not surprising that they were also a rare prey item.

The introduction of striped bass into the San Francisco Estuary in 1879 added a permanently resident, large piscivorous fish to the LSZ. The LSZ is a habitat not known to have had an equivalent predator prior to the establishment of striped bass (Moyle 2002). The current influence of striped bass and other predators on delta smelt population dynamics is unknown, mainly because predator effects on rare prey are extremely difficult to quantify. Delta smelt were observed in the stomach contents of striped bass and other fishes in the 1960s (Stevens 1963; Turner and Kelley 1966), but have not been in more recent studies (Feyrer et al. 2003; Nobriga and Feyrer 2007).

Potential native predators of juvenile and adult delta smelt will have included numerous bird and fish species, which may be reflected in delta smelt's life-history. Annual fish species, also known as "opportunistic strategists", are adapted to high mortality rates in the adult stage (Winemiller and Rose 1992). This high mortality is usually due to predation or highly unpredictable environmental conditions, both of which could have characterized the ancestral niche of delta smelt.

Predation is a common source of density-dependent mortality in fish populations (Rose et al. 2001), thus, it is possible that predation was a mechanism that historically generated the density-dependence observation in delta smelt population dynamics that has been noted by Bennett (2005) and Maunder and Deriso (2011). As is the case with other fishes, the vulnerability of delta smelt to predators may be influenced primarily by habitat suitability. It is widely documented that pelagic fishes, including many smelt species, experience lower predation risks under turbid water conditions (Thetmeyer and Kils 1995; Utne-Palm and Stiansen 2005; Horpilla et al. 2004,). Growth rates, a result of feeding success plus water temperature, are also well known to affect fishes' cumulative vulnerability to predation (Sogard 1997).

<u>Competition</u>: It has been hypothesized that delta smelt are adversely affected by competition from other introduced fish species that use overlapping habitats, including Mississippi silversides, (Bennett and Moyle 1996) striped bass, and wakasagi (Sweetnam 1999). Laboratory studies show that delta smelt growth is inhibited when reared with Mississippi silversides (Bennett 2005) but there is no empirical evidence in the wild to support this conclusion.

The LSZ historically had the highest primary productivity and is where zooplankton populations were historically most dense (Knutson and Orsi 1983; Orsi and Mecum 1996). However, since the introduction of the overbite clam, this has not always been true (Kimmerer and Orsi 1996). There is some speculation that the overbite clam competes with delta smelt for copepod nauplii (Nobriga and Herbold 2008) but it is unknown how intensively overbite clam grazing and delta smelt directly compete for food.

<u>Contaminants</u>: Contaminants can change ecosystem functions and productivity through numerous pathways. However, contaminant loading and its ecosystem effects within the Delta are not well understood. Although a number of contaminant issues were first investigated during the Pelagic Organism Decline (POD) years, concern over contaminants in the Delta is not new. Current science suggests the possible link between contaminants and the POD may be the effects of contaminant exposure on prey items, resulting in an indirect effect on the survival of POD species (Johnson et al. 2010). Pyrethroids are of particular interest because use of these pesticides has increased within the Delta watershed (Amweg et al. 2005, Oros and Werner 2005). Urban source waters with pyrethroid pesticides have shown toxicity to the amphipod *Hyalella azteca*, and high mortality rates and swimming impairment in fishes (Weston and Lydy 2010).

The association of delta smelt spawning with turbid winter runoff and the association of pesticides including pyrethroids with sediment is of potential concern. Persistent confinement of the spawning population of delta smelt to the Sacramento River increases the likelihood that a substantial portion of the spawners will be affected by a catastrophic event or localized chronic threat. For instance, large volumes of highly concentrated ammonia released into the Sacramento River from the Sacramento Regional County Sanitation District may affect embryo survival or inhibit prey production. Further, agricultural fields in the Yolo Bypass and surrounding areas are regularly sprayed by pesticides, and water samples taken from Cache Slough sometimes exhibited toxicity to *H. azteca* (Werner et al. 2008; 2010). The extent to which delta smelt larvae are exposed to contaminants varies with flow entering the Delta, where flow pulses during spawning increase exposure to many pesticides (Kuivila and Moon 2004) but decrease ammonia concentrations from wastewater treatment plants. The thresholds of toxicity for delta smelt for most of the known contaminants have not been determined, but the exposure to a combination of different compounds increases the likelihood of adverse effects.

Delta Smelt Critical Habitat

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). Critical habitat is defined in section 3 of the Act as: (1) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (a) essential to the conservation of the species and (b) that may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by a species at the time it is listed, upon determination that such areas are essential for the conservation of the species. In determining which areas to designate as critical habitat, the Service considers those physical and biological features that are essential to a species' conservation and that may require special management considerations or protection (50 CFR 424.12(b)). The Service is required to list the known PCEs together with the critical habitat description. Such physical and biological features include, but are not limited to, the following:

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, rearing of offspring, or dispersal; and
5. Generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

The PCEs defined for the delta smelt were derived from its biological needs. In designating critical habitat for the delta smelt, the Service identified the following primary constituent elements essential to the conservation of the species: physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration. Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay.

1. Physical habitat is defined as the structural components of habitat. Because delta smelt is a pelagic fish, spawning substrate is the only known important structural component of habitat. It is possible that depth variation is an important structural characteristic of pelagic habitat that helps fish maintain position within the estuary's LSZ (Bennett et al. 2002, Hobbs et al. 2006).

2. Water is defined as water of suitable quality to support various delta smelt life stages with the abiotic elements that allow for survival and reproduction. Delta smelt inhabit open waters of the Delta and Suisun Bay. Certain conditions of temperature, turbidity, and food availability characterize suitable pelagic habitat for delta smelt and are discussed in detail in the Status of the Species section above. Factors such as high entrainment risk and contaminant exposure can degrade this PCE even when the basic water quality is consistent with suitable habitat.

3. River flow is defined as transport flow to facilitate spawning migrations and transport of offspring to LSZ rearing habitats. River flow includes both inflow to and outflow from the Delta, both of which influence the movement of migrating adult, larval, and juvenile delta smelt. Inflow, outflow, and Old and Middle Rivers flow influence the vulnerability of delta smelt larvae, juveniles, and adults to entrainment at Banks and Jones. River flow interacts with the fourth PCE, salinity, by influencing the extent and location of the highly productive LSZ where delta smelt rear.

4. Salinity is defined as the LSZ nursery habitat. The LSZ is where freshwater transitions into brackish water; the LSZ is defined as 0.5-6.0 parts per thousand salinity (psu) (Kimmerer 2004). The 2 psu X2 is a specific point within the LSZ where the average daily salinity at the bottom of the water is 2 psu (Jassby et al. 1995). By local convention the location of the LSZ is described in terms of the distance from the 2 psu X2 to the Golden Gate Bridge; X2 is an indicator of habitat suitability for many San Francisco Estuary organisms and is associated with variance in abundance of diverse components of the ecosystem (Jassby et al. 1995, Kimmerer 2002b). The LSZ expands and moves downstream when river flows into the estuary are high. Similarly, it contracts and moves upstream when river flows are low. During the past 40 years, monthly average X2 has varied from San Pablo Bay (45 kilometers) to as far upstream as Rio Vista on the Sacramento River (95 kilometers). At all times of year, the location of X2 influences both the area and quality of habitat available for delta smelt to successfully complete their life cycle. In general, delta smelt habitat quality and surface area are greater when X2 is located in Suisun Bay. Both habitat quality and quantity diminish as the LSZ moves more frequently and further upstream, toward the confluence.

Environmental Baseline

Delta smelt critical habitat extends along the Sacramento River to the I Street Bridge, and marks the eastern boundary of both basins of the West Sacramento Project. Delta smelt critical habitat also includes the Sacramento River Deep Water Ship Channel, which extends along the western boundary of the West Sacramento GRR Project South Basin and separates the North and South Basins at the Port of Sacramento.

Monitoring surveys along the Sacramento River adjacent to project construction areas have confirmed the presence of the smelt in trawl surveys (Service 2014b) and shallow water seine net surveys (Service 2014c). Trawl surveys conducted in March and April from Sherwood Harbor at River Mile 55, adjacent to the Sacramento River South levee, have recorded 51 smelt (Service 2012b). Similarly, one smelt was identified in a seine net survey at Sherwood Harbor in 2014, and over 50 smelt were netted between river miles 43 and 49, just downstream of the project South Basin, between 2012 and 2014 (Service 2014c). The surveys were conducted between November and April of successive years. The seine net surveys also noted 7 records of smelt adjacent to the project North Basin in February and March 2014, between river miles 60 and 62 (Service 2014c).

The Sacramento River Deep Water Ship Channel also provides suitable spawning habitat for the smelt (CDFW 2014c). At survey station 719, about 12 miles downstream of the South Cross Levee in the Sacramento Deep Water Ship Channel, March, 2014, 20mm surveys noted 48.84 smelt per 10,000 cubic meters, which is the highest catch rate of smelt in the Delta at that period. SKT trawl surveys during March and April of the past 3 years also showed the highest catch rates in the Delta (CDFW 2014a), demonstrating the importance of the Sacramento River Deep Water Ship Channel as a smelt spawning ground. In dry years, river flows can be expected to be relatively low, and hence the LSZ nursery habitat would move much further upstream, toward the project construction area.

Effects of the Proposed Action

Giant Garter Snake

Construction activities of the West Sacramento GRR Project, such as fill removal, grading, fill placement, wall construction, and vehicle movement will permanently degrade 30 acres of snake habitat, and results in temporary effects to 211 acres (Table 5). Permanent effects include the direct loss of snake habitat, while temporary effects result from seasonal construction activities that will be restored upon completion of the construction activities at each levee reach. Effects to the snake from the Southport Project portion of the West Sacramento GRR Project are noted in Appendix B.

Table 5. Effects on giant garter snake (*Thamnophis gigas*) habitat in the West Sacramento General Reevaluation Report Project, West Sacramento, Yolo County, California.[1]

Habitat	Temporary Effects	Permanent Effects
Aquatic Habitat	11	20
Upland Habitat[2]	200[1]	10

[1] The estimate of 200 acres is based on a worst-case scenario when considering necessary borrow material.

[2] Southport Project effects are included.

The Corps has proposed to compensate for the temporary loss of snake habitat through the purchase of snake credits from a Service-approved conservation bank at a ratio of 2:1. The Corps has proposed to compensate for the permanent loss of snake habitat through the purchase of snake credits from a Service-approved conservation bank at a ratio of 3:1.

Habitat affected by the snake includes rice fields, which offer many similarities to the historical, natural wetlands of the area around the City of West Sacramento. Open agricultural fields within the action area of the West Sacramento GRR Project are largely fallow or planted in wheat. These fields are not irrigated with standing water in a manner that mimics the natural wetlands used by the giant garter snake. Although the drainage canals offer little in terms of prey base and vegetative cover, the drains lining the agricultural fields can provide avenues for snake travel.

Potential snake upland habitat is generally considered upland habitats within 200 feet of snake aquatic habitat. The Sacramento Bypass to the north, the Yolo Bypass to the west, and the South Cross Levee drainage canal to the south of the action area do provide suitable habitat for the snake. In the North Basin, work along the Sacramento Bypass Training Levee and Yolo Bypass Levees will border the Yolo Bypass, an area of agricultural and natural wetlands that provides suitable aquatic snake habitat. In the South Basin, work along the South Cross Levee, and along with the Sacramento Bypass west levee can provide suitable upland snake habitat.

Valley Elderberry Longhorn Beetle

As an Early Implementation Project, the Southport Project area along the South Sacramento River Levee was surveyed for elderberry shrubs 2011-2013. Surveys identified 41 shrubs containing 424 stems within the action area (Appendix B). An estimate of 18 shrubs (including 4 on inaccessible private lands) will be directly affected by construction activities, and will be removed and transplanted to the project offset floodplain area riparian zone if possible.

Transplanting the elderberry shrubs may cause them to die, become stressed, or become unhealthy due to transplanting. This may reduce the shrub's quality as habitat for the beetle, or impair production of habitat-quality stems in the future. Branches containing larvae may be cut, broken, or crushed during the transplantation process. These effects to the shrubs may cause the beetle to be harmed, harassed, injured, or killed.

The remaining 23 elderberry shrubs within 100 feet of construction activities will be protected during construction activities by implementing the listed Conservation Measures for the beetle. These measures will reduce the likelihood that the health and survival of the elderberry shrubs would be adversely affected by project activities to the point that take of the beetle is not reasonably likely to occur.

For the West Sacramento GRR Project as a whole, shrub counts were extrapolated to provide reasonable effects estimates for the complete project (Table 6). An estimated 215 elderberry shrubs will be affected by the West Sacramento GRR Project. To provide a worst-case scenario for analyses, all shrubs are assumed to be in riparian habitat and with evidence of beetle presence (holes in stems). Based on the results of these analyses, 118.42 acres will be required for elderberry and associated native species compensation plantings (Service 1999a). As part of the proposed conservation measures, the Corps is planning to use at least 13.51 acres of the Southport Project offset area riparian zone as an area for elderberry compensation plantings for the Southport Project portion of the West Sacramento GRR Project. The suitability of the offset area riparian zone for additional compensation will be dependent on site-specific conditions; additional compensation for the beetle will be acquired offsite.

Delta Smelt and Delta Smelt Critical Habitat

Potential spawning habitat includes shallow channel edge waters of the Sacramento River and Sacramento River Deep Water Ship Channel. Potential construction-related effects to smelt physical

Table 6. Estimates of elderberry shrubs affected by the West Sacramento General Reevaluation Report Project, West Sacramento, Yolo County, California.[1]

Location	Stem Diameter	Holes	Number of Stems	Elderberry Ratios	Elderberry Plantings	Associate Ratios	Associate Plantings
Riparian	≥ 1 inch and ≤ 3 inches	Yes	1,524	4:1	5,588	2:1	10,580
Riparian	> 3 inches and < 5 inches	Yes	391	6:1	2,160	2:1	4,032
Riparian	≥ 5 inches	Yes	303	8:1	2,237	2:1	4,109
Totals[2]			2,218		9,985		18,721

[1] Information based on the Conservation Guidelines for the Valley Elderberry Longhorn Beetle (Service 1999a).
[2] Southport Project effects are included.

habitat would include disruption of spawning activities, disturbance or mortality of eggs and newly hatched larvae, alteration of spawning and incubation habitat, and loss of shallow water habitat for spawning. The Corps has estimated that 13.35 acres of shallow water habitat that may be used for spawning or dispersal will be permanently lost through the completion of the West Sacramento GRR Project. In contrast, 118.81 acres of suitable delta smelt shallow water habitat will be created by the project in the Southport Project offset area, for a net gain of 105.46 acres of shallow water habitat. The floodplain is designed to contain water during months (December – May) when smelt larva are most likely to be present.

The West Sacramento GRR Project could detrimentally affect delta smelt by increasing turbidity, increasing noise, reducing water quality, creating predator habitat, restricting channels, and changing water velocities. Re-suspended sediments may contain toxic substances which may interfere with the development of young delta smelt. The substrate upon which delta smelt may depend for egg attachment and refugia may become silted over or removed by the proposed actions. As shallow water habitat is removed and turbidity increased, the delta smelt's feeding, breeding, and sheltering would likely be reduced as food sources associated with the aquatic plants and found in the water column is destroyed, and habitat used for spawning substrate and refugia is eliminated.

Rock slope protection can limit the lateral mobility of a river channel, increase flow velocities (Sedell et al.1990), limit sediment transport, and thus eliminate bankside refugia areas (Gregory et al. 1991). In turn, many of the streamside effects of increased velocity are transferred downstream (Larsen and Greco 2002). Although work along the Sacramento River includes additional rock slope protection, the negative effects to shallow water habitat, both at the project construction areas and downstream along the Sacramento River, are expected to be offset by the creation of the riparian and floodplain area of the Southport Project. The offset floodplain area is designed to absorb much of the increased flow energy, instead of having it transferred downstream. The floodplain area is expected to provide more space for population growth, additional cover or shelter, and additional habitat that is, for the most part, protected from large fluctuations in river velocities.

Adult delta smelt migrate upstream between December and January and spawn between January and July, with a peak in spawning activity between April and mid-May (Moyle 2002). The above effects are reduced by the restriction of project in-water work to time periods when delta smelt eggs, larvae, and juveniles are not present and delta smelt adults are rarely present or present in low numbers, between August 1 and November 30. In addition, the above effects are further greatly reduced by the creation of suitable shallow water habitat in the Southport Project offset floodplain area.

However, the creation of the Southport Project offset floodplain area could introduce increased predation and competition from exotic species. Fishes introduced to the Sacramento-San Joaquin Delta, such as the largemouth bass (*Micropterus salmoides*) and smallmouth bass (*M. dolomieu*), thrive as predators in warm, shallow water habitat. Such introduced fish may increase predation pressure upon the delta smelt in newly designed shallow water habitat. Reduced feeding efficiency and ingestion rates due to introduced competition into the designed smelt habitat, such as from the wagasaki (*Hypomesus nipponensis*), could weaken and slow the growth of young delta smelt and make them more vulnerable to starvation and predation.

Cumulative Effects

Cumulative effects are those effects of future State, Tribal, county, local agency, and private actions that are reasonably certain to occur within the action area. 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.

The California Department of Finance (2013) has projected the population within Sacramento County to rise 65% from 2010 levels to 2060, while Yolo County similarly is expected to experience nearly 66% growth over the same period. The West Sacramento GRR Project will afford increased flood protection for a growing community, which in turn could increase human-based pressures incrementally on the federally-listed species. For example, drainage areas that may now be used by snakes as travel corridors may cease to be useful for snakes with the onset of increased human activity in close proximity to waterways with no appropriate snake cover. Also, project effects to the snake, beetle, and smelt are expected to extend for several years as project construction progresses sequentially over time. To minimize unavoidable effects to the federally-listed species, the Corps has proposed several compensatory measures that will be implemented and maintained in perpetuity.

Cumulative effects on the delta smelt and its designated critical habitat include the effects of point and non-point source chemical contaminant discharges. These contaminants include numerous pesticides and herbicides associated with discharges related to agricultural and urban activities. Implicated as potential sources of mortality for delta smelt, these contaminants may adversely affect delta smelt reproductive success and survival rates. Spawning habitat may also be affected if submersed aquatic plants used as substrates for adhesive egg attachment are lost due to toxic substances.

Additional cumulative effects may result from diversions of water that may entrain adult or larval fish or that may change outflows incrementally, either excluding delta smelt from Sacramento River flow or shifting the position of the delta smelt from its preferred habitat.

Conclusion

After reviewing the current status of the snake, beetle, smelt, and smelt critical habitat, the environmental baseline for the action area covered in this biological opinion, the effects of the proposed project, the cumulative effects, and the proposed conservation measures, it is the Service's biological opinion that the West Sacramento GRR Project, as proposed, is not likely to jeopardize the continued existence of these species. Also, the project will not result in net destruction or adverse modification of smelt critical habitat. The Service reached this conclusion because the anticipated level of take of the snake, beetle, and smelt, upon analyses of project effects in relation the environmental baseline for these species, will not rise to levels precluding the recovery of these species, or reduce the likelihood of survival of these species.

The West Sacramento GRR Project will contribute to the conservation of the snake by preserving suitable snake habitat at a conservation bank. Also, the description of the West Sacramento GRR Project contains the Southport Project, which includes the creation of an offset floodplain area that will provide riparian habitat with space for transplanting elderberry shrubs displaced by the project. Any additional offsite areas necessary for elderberry compensation will be protected in perpetuity. In addition, the offset floodplain area will provide a net gain in the amount of suitable smelt shallow water habitat during the spring months, when the area is most likely to be used by the smelt for feeding and reproduction.

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 the 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 applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, 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

The Service anticipates incidental take of giant garter snakes will occur in the form of disturbance, harm, and harassment. Incidental take also may occur in the form of injury or death to snakes occupying levee holes or crevices unseen during construction. Within the West Sacramento GRR Project action area, effects to snakes at individual levee reaches will vary. Giant garter snakes are secretive and sensitive to human activities. 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. In instances in which the total number of individuals anticipated to be taken cannot be determined, the Service may use the amount of habitat impacted as a surrogate; because the take of individuals anticipated will result from the destruction of the snake habitat, the quantification of suitable habitat serves as a direct surrogate for the snakes that will be lost. Over the course of project construction, the Service anticipates that all giant garter snakes found in 241 acres of habitat will be disturbed, harassed, harmed, or killed by project activities resulting in temporary impacts and permanent impacts, especially from dewatering, channel reconfiguration, and use of heavy equipment within or near aquatic habitat. Thirty acres of giant garter snake habitat may be permanently lost over the course of project construction.

Implementation of the West Sacramento GRR Project will result in the incidental take of the beetle resulting from project impacts to 215 elderberry shrubs with 2,218 stems one inch or greater in diameter at ground level. The life stage affected by this action will be the beetle larvae living within the stems of the elderberry shrubs. The life cycle of the beetle takes 1 or 2 years to complete, during which it spends most of its life in the larval stage. It is not possible to know how many beetle larvae are in the stems of any elderberry shrub, therefore the Service cannot quantify the total number of beetles that we anticipate will be taken as a result of the proposed action. Because the take of individuals anticipated will result from the destruction of the elderberry shrubs, the quantification of suitable habitat serves as a direct surrogate for the beetles that will be lost. Therefore, the Service anticipates take incidental to this project as the 215 elderberry shrubs with 2,218 stems one inch or greater in diameter at ground level that could potentially be destroyed.

The Service anticipates that incidental take of delta smelt will occur. However, the Service anticipates that any take of delta smelt will be difficult to detect and quantify for a number of reasons: they have a relatively small body size; they are relatively secretive; their presence in the Delta and associated areas coincides with relatively turbid conditions, which makes their detection difficult. Therefore, it is not possible to provide precise numbers of delta smelt that could be injured, harassed, harmed, or killed from the project. The Service anticipates that all delta smelt inhabiting up to 13.35 acres of shallow water habitat may be harmed, harassed, injured, or killed as a result of the project. Low mortality is anticipated because of the work restriction windows. Because the species is wide-ranging and its distribution varies from one year to the next, take may vary from year to year over the 19-year construction period. Additionally, losses of the species may be masked by seasonal fluctuations in fish presence. Upon implementation of the following reasonable and prudent measure, incidental take associated with the project in the form of harm, harassment, injury, or mortality to delta smelt, the Corps will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the snake, beetle, or smelt. Also, the West Sacramento GRR Project will not result in the destruction or adverse modification of designated critical habitat for the delta smelt.

Reasonable and Prudent Measure

The Service has determined that the following reasonable and prudent measure is necessary and appropriate to minimize the effects of the proposed project on the snake, beetle, and smelt:

1. All conservation measures proposed in the biological assessment, and as re-stated in the project description section of this biological opinion, must be fully implemented and adhered to. Further, this Reasonable and Prudent Measure shall be supplemented by the Terms and Conditions listed 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 Service shall be informed of any changes in project construction scheduling as soon as possible. Should the project schedule be altered from that described herein, the Corps must immediately reinitiate formal consultation as per 50 §CFR 402.16.

2. The Corps shall comply with the latest Conservation Guidelines for the Valley Elderberry Longhorn Beetle (Service 1999a). The Corps shall check with the Service before each construction season to ensure that any and all updates to these guidelines are incorporated into the project. The Service shall be informed of conservation area monitoring plans to ensure that success criteria outlined in these guidelines are accurately assessed.

3. To monitor whether the amount or extent of incidental take anticipated from implementation of the proposed project is approached or exceeded, the Corps shall adhere to the following reporting requirement. Should this anticipated amount or extent of incidental take be exceeded, the Corps must immediately reinitiate formal consultation as per 50 §CFR 402.16.

    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 will provide monthly updates to the Service with a precise accounting of the total acreage of habitat impacted. Updates shall also include any information about proposed changes in project implementation that result in habitat disturbance not described in the Project Description and not analyzed in this biological opinion.

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 that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information or data bases. The Service is providing the following conservation recommendations:

1. The Corps should communicate with the Service to ensure that the most up to date plans for the recovery of each federally-listed species are recognized and followed:

    a. The Corps should work with the Service to assist us in meeting the goals of the latest Recovery Plan for the valley elderberry longhorn beetle, which currently is the Valley Elderberry Longhorn Beetle Recovery Plan (Service 1984);

    b. The Corps should work with the Service to assist us in meeting the goals of the latest Recovery Plan for the giant garter snake, which currently is the 1999 Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*) (Service 1999b); and

    c. The Corps should work with the Service to assist us in meeting the goals of the latest Recovery Plan for the delta smelt, which currently is the 1996 Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes (Service 1996).

2. The Corps and WSAFCA should monitor the effectiveness of the offset floodplain area in providing spawning and rearing habitat, as well the effectiveness of the floodplain in providing juvenile and adult transport and migration

So the Service can 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 recommendation.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the West Sacramento Project General Reevaluation Report Project in Yolo County, California. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (a) if the amount or extent of taking specified in the incidental take statement is exceeded; (b) 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; (c) if the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion; or (d) if a new species is listed or critical habitat designated that may be affected by the identified action.

If you have questions regarding the West Sacramento West Sacramento GRR Project, please contact Harry Kahler, Fish and Wildlife Biologist, or Doug Weinrich, Assistant Field Supervisor, at (916) 414-6600.

Sincerely,

Jennifer M. Norris
Field Supervisor

Enclosure:

cc:
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Maria Rae, National Marine Fisheries Service, Sacramento, California
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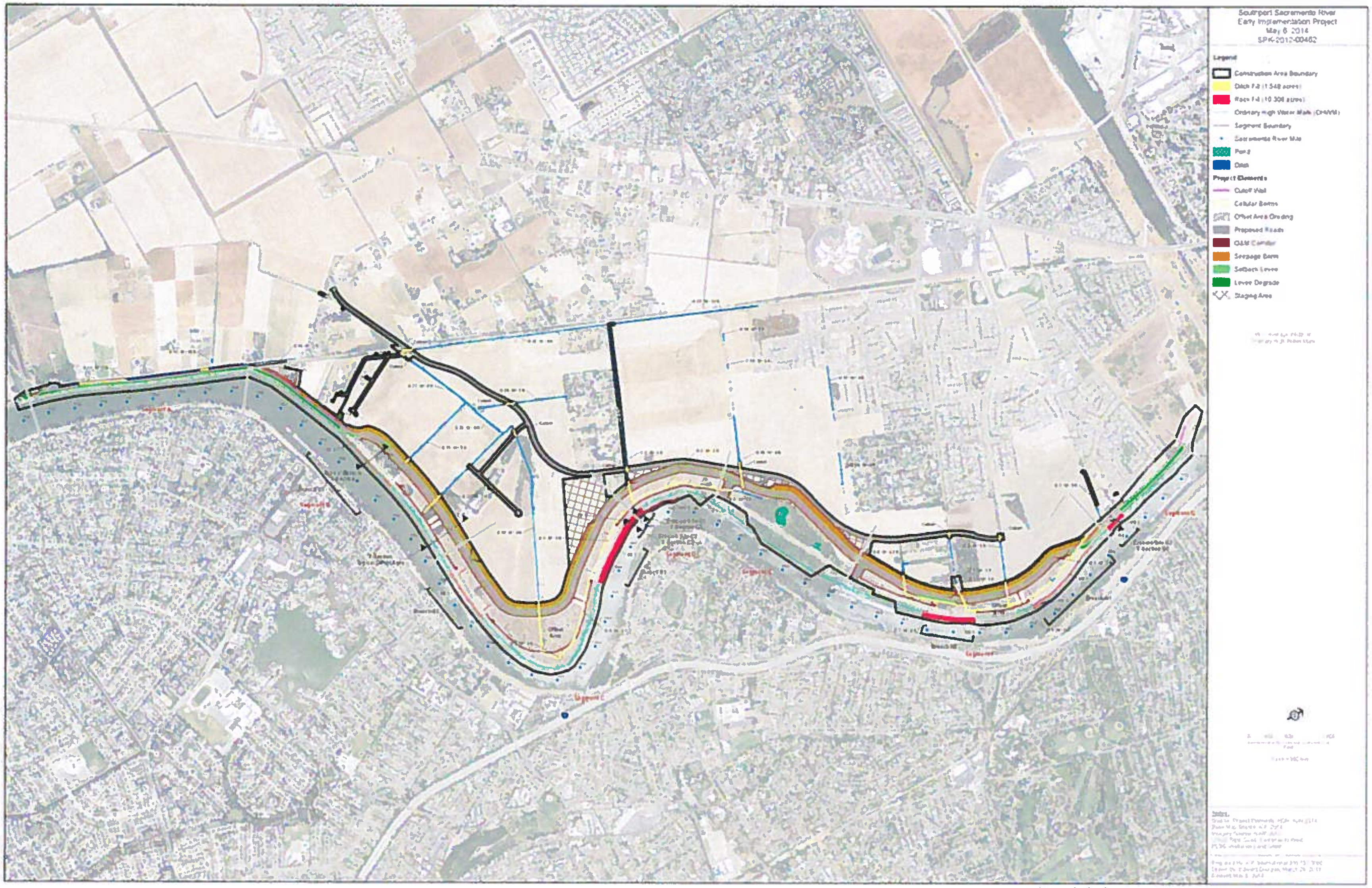
APPENDIX A

SOUTHPORT EARLY IMPLEMENTATION PROJECT

Project Plan View

APPENDIX A
FF08ESMF00-2014-F-0434-2



Appendix A. Sacramento River South Levee Reach
Southport Early Implementation Project
West Sacramento General Reevaluation Report

APPENDIX B

SOUTHPORT EARLY IMPLEMENTATION PROJECT

Project Effects on Federally-Listed Species Within U.S. Fish and Wildlife Service Jurisdiction

Table B-1. Effects on giant garter snake (*Thamnophis gigas*) in the Southport Early Implementation Project action area of the West Sacramento General Reevaluation Report Project, West Sacramento, Yolo County, California.

Habitat	Temporary Effects	Permanent Effects
Aquatic Habitat	0	0
Upland Habitat	155	2.24

Table B-2. Estimates of elderberry shrubs affected by the Southport Project Early Implementation Project of the West Sacramento General Reevaluation Report Project, West Sacramento, Yolo County, California.[1]

Location	Stem Diameter	Holes	Number of Stems	Elderberry Ratios	Elderberry Plantings	Associate Ratios	Associate Plantings
Non-riparian	≥ 1 inch and ≤ 3 inches	No	6	1:1	6	1:1	6
		Yes	135	2:1	270	2:1	540
Non-riparian	> 3 inches and < 5 inches	No	1	2:1	2	1:1	2
		Yes	22	4:1	88	2:1	176
Non-riparian	≥ 5 inches	No	1	3:1	3	1:1	3
		Yes	37	6:1	222	2:1	444
Riparian	≥ 1 inch and ≤ 3 inches	No	110	2:1	220	1:1	220
		Yes	25	4:1	100	2:1	200
Riparian	> 3 inches and < 5 inches	No	46	8:1	138	1:1	138
		Yes	10	6:1	60	2:1	120
Riparian	≥ 5 inches	No	27	4:1	108	1:1	108
		Yes	4	8:1	32	2:1	64
Totals			424		1,249[2]		2,021[2]

[1] Information based on the Conservation Guidelines for the Valley Elderberry Longhorn Beetle (Service 1999a).
[2] Plantings require 588,600 square feet or 13.51 acres.

Table B-3. Effects on delta smelt (*Hypomesus transpacificus*) critical habitat in the Southport Early Implementation Project action area of the West Sacramento General Reevaluation Report Project, West Sacramento, Yolo County, California.

Shallow Water Habitat Created	Shallow Water Habitat Affected
118.81 acres	8.49 acres (0.04 permanently)

Appendix J.5

NMFS Biological Opinion for the Southport Sacramento River Early Implementation Project

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814-4700

APR 23 2015

Refer to NMFS No: WCR-2015-2522

Alicia Kirchner
Chief, Planning Division
Department of the Army
United States Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, for the City of West Sacramento's Southport Early Implementation Project

Dear Ms. Kirchner:

Thank you for your letter of November 24, 2014, requesting initiation 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 the West Sacramento GRS and your subsequent request on March 5, 2015 to separate the Southport Early Implementation Project (EIP) from the West Sacramento General Reevaluation Study (GRS). The purpose of your request to separate the Southport EIP is based on construction timing. The City of West Sacramento would like to begin construction of the Southport EIP next summer while the West Sacramento GRS is on a longer schedule that involves seeking congressional authority before any individual flood management actions can occur. This biological opinion (BO) addresses the Southport EIP. The West Sacramento GRS will be analyzed in a separate BO. The BO was developed using the November biological assessment (BA) and associated appendices as a primary reference.

This letter also transmits NMFS's essential fish habitat (EFH) conservation recommendations for Pacific salmon as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended (16 U.S.C. 1801 *et seq.*).

Based on the best available scientific and commercial information, the BO concludes that the Southport EIP is not likely to jeopardize the continued existence of the federally listed threatened Central Valley (CV) spring-run Chinook salmon evolutionarily significant unit (ESU) (*Oncorhynchus tshawytscha*), endangered Sacramento River winter-run Chinook salmon ESU (*O. tshawytscha*), threatened California CV steelhead distinct population segment (DPS) (*O. mykiss*), or the threatened Southern DPS (sDPS) of North American green sturgeon (*Acipenser* *medirostris*) and is not likely to destroy or adversely modify their designated critical habitats. For the above species, NMFS has included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the project. The EFH consultation concludes that the proposed action would adversely affect the EFH of Pacific salmon in the action area. The EFH consultation adopts the ESA reasonable and prudent measures and associated terms and conditions from the BO and includes additional conservation recommendations specific to the adverse effects to fall- and late fall-run Chinook salmon (*O. tshawytscha*) EFH.

The U.S. Army Corps of Engineers (Corps) has a statutory requirement under section 305(b)(4)(B) of the MSA to submit a detailed written response to NMFS within 30 days of receipt of these conservation recommendations, and 10 days in advance of any action, that includes a description of measures adopted by the Corps for avoiding, minimizing, or mitigating the impact of the project on EFH (50 CFR 600.920(j)). If unable to complete a final response within 30 days, the Corps should provide an interim written response within 30 days before submitting its final response. In the case of a response that is inconsistent with our recommendations, the Corps must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the Southport EIP and the measures needed to avoid, minimize, or mitigate (also referred to as compensate by NMFS) such effects.

Please contact Howard Brown at the NMFS California Central Valley Office, 916-930-3608, or at Howard.Brown@noaa.gov, if you have any questions concerning this section 7 consultation, or if you require additional information.

Sincerely,

for William W. Stelle, Jr.
Regional Administrator

Enclosure

CC: CHRON File (pdf) ARN 151422SWR2013SA00158
Division- File copy

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation.

Southport Early Implementation Project
NMFS Consultation Number: 2014-SA00214

Action Agency: U.S. Army Corps of Engineers (Corps), West Sacramento Area Flood Control Agency (WSAFCA)

Affected Species and NMFS' Determinations:

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

Fishery Management Plan That Describes 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:

for William W. Stelle, Jr.
Regional Administrator

Date: 4-23-15

List of Acronyms

BA	Biological Assessment
BCSSRP	Battle Creek Salmon and Steelhead Restoration Program
BMP	Best Management Practices
BO	Biological Opinion
BSSCP	Bentonite Slurry Spill Contingency Plan
CCV	California Central Valley
CDFG	California Department of Fish and Game
CDFW	California Department of Fish Wildlife
CEQA	California Environmental Quality Act
cfs	Cubic Feet per Second
CNFH	Coleman National Fish Hatchery
Corps	US Army Corps of Engineers
CRR	Cohort Replacement Rate
CV	Central Valley
CVP	Central Valley Project
CVFPB	Central Valley Flood Protection Board
CWA	Clean Water Act
CWT	Coded Wire Tag
dbh	Diameter at Breast Height
DCC	Delta Cross Channel
Delta	Sacramento-San Joaquin Delta
DO	Dissolved Oxygen
DPS	distinct population segment
DWR	California Department of Water Resources
DWSC	Deep Water Ship Channel
EFH	Essential Fish Habitat
EIP	Early Implementation Project
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
ETL	Engineering Technical Letter
FRFH	Feather River Fish Hatchery
GCID	Glenn-Colusa Irrigation District
GRS	General Reevaluation Study
HU	Hydrologic Unit
ITS	Incidental Take Statement
IWM	Instream Woody Material
JPE	Juvenile Production Estimate
Kelts	Post-Spawning Steelhead
lf	Linear Feet
LSNFH	Livingston Stone National Fish Hatchery
LWM	Large Woody Material
mm	millimeter
MMP	Mitigation and Monitoring Plan

MSA	Magnuson-Stevens Fishery Conservation and Management Act
nDPS	Northern Distinct Population Segment
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NTUs	Nephelometric Turbidity Units
O&M	Operation and Maintenance
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PCE	primary constituent elements
PL	Public Law
PVA	Population Viability Analysis
RBDD	Red Bluff Diversion Dam
RD	Reclamation District
Reclamation	United States Department of the Interior, Bureau of Reclamation
RM	River Mile
RPA	Reasonable and Prudent Alternative
RWQB	Regional Water Quality Control Board
SAM	Standard Assessment Methodology
SDFPF	Skinner Delta Fish Protection Facility
sDPS	Southern Distinct Population Segment
SJRRP	San Joaquin River Restoration Program
SPCCP	Spill Prevention, Control, and Counter-Measure Plan
SRA	Shaded Riverine Aquatic
SRBPP	Sacramento River Bank Protection Project
SRFCP	Sacramento River Flood Control Project
SWP	State Water Project
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TCP	Temperature Compliance Point
TFCF	Tracy Fish Collection Facility
TRT	Technical Review Team
USACE	United State Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
VSP	Viable Salmonid Populations
VVR	Vegetation Variance Request
WRDA	Water Resources Development Act
WRI	Weighted Species Response Index
WRO	Water Rights Order
WSAFCA	West Sacramento Area Flood Control Agency

Note: Throughout this document there are references cited as CDFG. This refers to the California Department of Fish and Game. This name was changed to California Department of Fish and Wildlife on January 1, 2013. However, for consistency on publications, references prior to January 1, 2013, will remain CDFG.

1. INTRODUCTION

The U.S. Army Corps of Engineers (Corps) and the West Sacramento Area Flood Control Agency (WSAFCA) propose to implement flood risk management improvements for the City of West Sacramento. The Corps is the Federal lead agency for the West Sacramento General Reevaluation, which is proposing, in part, improvements to levees surrounding the City of West Sacramento. This would include construction of the Southport Early Implementation Project (Southport EIP). In a separate but related action, WSAFCA is proposing to construct the Southport EIP and is requesting permission from the Corps pursuant to Section 14 of the Rivers and Harbors Act of 1899 (Title 33 of the United States Code [USC], Section 408 [33 USC 408]) referred to as Section 408, for the alteration of the Federal flood management project. WSAFCA is also seeking a permit under Section 404 of the Clean Water Act (CWA) for regulation of dredged or fill material in jurisdictional waters of the United States, and under Section 10 of the Rivers and Harbors Act of 1899 for regulation of navigable waters. The purpose of this Biological Opinion (BO) is to analyze the potential effects from the Southport EIP on listed threatened or endangered species and on designated critical habitat, within the project's area of effect (action area).

1.1 Southport Study Area

The Southport EIP construction footprint extends approximately 5.6 miles along the Sacramento River South Levee from the southern end of the Corps Sacramento River Bank Protection Project (SRBPP) at River Mile (RM) 57.2 south to the South Cross levee at RM 51.6. It is comprised of a 3.6-square mile project area, which encompasses 5.8 miles of the existing levee structure along the Sacramento River corridor, the construction footprint in which flood risk–reduction measures will be constructed, the footprint of the Village Parkway extension and associated residential access roads, and potential soil borrow sites located throughout the Southport area of West Sacramento (Figure 1). All direct and indirect effects will occur within this area and the 200-foot buffer around this area. Potential borrow sites make up large portions of the construction footprint, as soil may be extracted from these areas prior to or during construction of the flood risk–reduction measures.

South River Road runs along the top of the levee for the majority of this reach of the river. The road diverts off of the levee top and merges with Gregory Avenue and runs along the landside toe for a short distance to the southern end of the construction area. The landside of the levee is bordered mainly by private agricultural lands containing rural residences. Two small bodies of water referred to as Bees Lakes are located adjacent to the levee landside toe near the middle of the construction area, and two marinas and multiple boat docks are located on the waterside of the levee near Bees Lakes.

The project construction area was defined as the area in which flood risk reduction measures such as setback levees, seepage berms, and slurry cutoff walls are likely to be constructed, the area in which Village Parkway and ancillary roadways will be constructed, as well as areas in which soil borrow activities may occur. All direct and indirect effects will occur within this area and the 200-foot buffer around this area.

1.2 Background, Authority and Policy

The National Marine Fisheries Service (NMFS) prepared the 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.

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 (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS' Public Consultation Tracking System, https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts. A complete record of this consultation is on file at the NMFS California Central Valley Office.

1.3 Background

The current levee system does not adequately protect the city of West Sacramento during a 100-year event (HDR 2008). The history of the Sacramento River Flood Control Project (SRFCP) dates back to the mid-1800s with the initial construction of levees along the Sacramento, American, Feather, and Yuba rivers. This levee system has been characterized by a history of levee failure, followed by improvement. This continued until the California Legislature authorized a comprehensive plan for controlling the floodwaters of the Sacramento River and its tributaries in the Flood Control Act of 1911. Federal participation in the SRFCP began shortly after authorization in 1917 and continued for approximately 40 years.

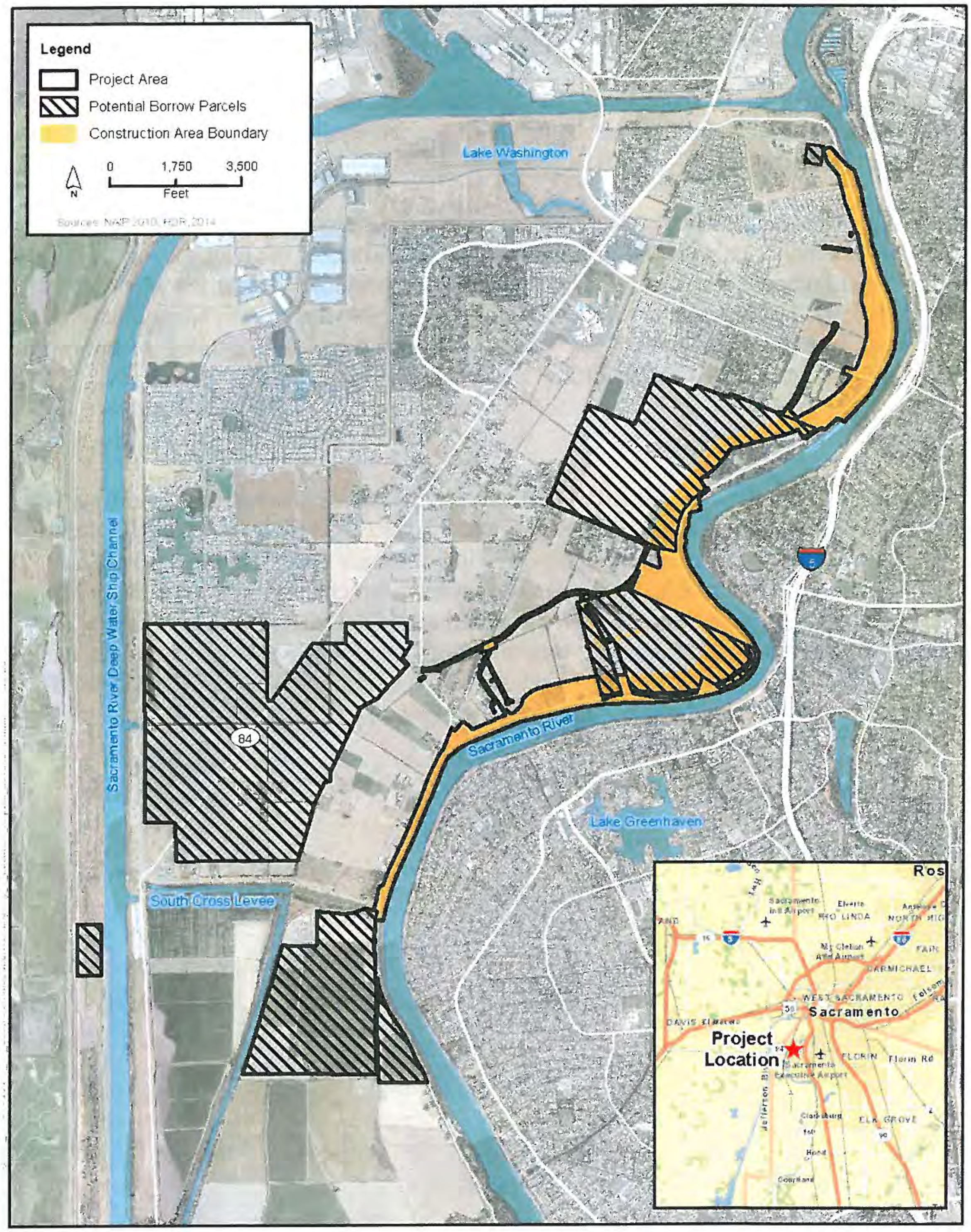


Figure 1. Southport EIP Project Area (Corps 2014).

Historically, from the mid-1800s to the early 1900's, most hydraulic engineers at the Federal, State, and local level thought that the most effective way to control flood flows in the river system was to construct levees close to the main channel. The record floods of 1907 and 1909 forced a reevaluation of this historic approach. It was clear from the size of these flood events in relation to existing channel capacities that major bypass systems were needed to control excess flood flows. These bypasses were designed to divert flood flows away from urban centers. Throughout the SRFCP, the frequency that flow starts to divert from the Sacramento River to the bypass system varies between a 3-year to 5-year flood event.

NMFS issued a final recovery plan Central Valley Chinook salmon and steelhead in July 2014. The recovery plan identifies numerous high priority actions that can be taken to improve the viability of salmon and steelhead, including reconfiguring levee alignments away from the edge of the Sacramento River, reclaiming, restoring and enhancing floodplains along the Sacramento River, and increasing the quantity and quality of riparian and nearshore aquatic habitat along the Sacramento River. The proposed action incorporates these actions into a project that will enhance ecosystem health and flood system reliability.

1.4 Authority and Policy Specific to Southport EIP

WSAFCA is in the process of requesting permission from the Corps pursuant to Section 14 of the River and Harbors Act of 1899 (Title 33 of the United States Code [USC], Section 408, [33 USC 408]), for the alteration of the Federal flood management project. WSAFCA plans to construct the Southport EIP, which is also considered to be an advance action of the USACE and City of West Sacramento led West Sacramento Project. The new setback levee will be designed and constructed to be ETL compliant without a variance. Once the setback levee is constructed and tied into the existing levee, the old remnant levee will not be part of the Federal project and will therefore not be subject to the ETL. WSAFCA and the Corps do not require additional Congressional actions or approvals to implement the Southport EIP; however, the West Sacramento GRR will require Congressional authorization and funds appropriation before the Federal government can participate in implementing or funding the West Sacramento Project.

1.5 Consultation History

NMFS received a request for initiation of consultation on June 10, 2014. However, the initial request did not contain an appropriate effects determination. Also, the Biological Assessment (BA) was missing key information in order to perform a species impact analysis. After phone conversations, emails, and inter-agency meetings, the Corps agreed to send out a revised initiation letter along with an updated BA. The revised initiation letter was dated November 24, 2014. The revised BA was delivered on November 24, 2014 (Corps 2014). In the November 24, 2014, letter the Corps requested concurrence from NMFS that the West Sacramento GRS will adversely affect threatened Central Valley (CV) spring-run Chinook salmon evolutionarily significant unit (ESU) (*Oncorhynchus tshawytscha*), endangered Sacramento River winter-run Chinook salmon ESU (*O. tshawytscha*), threatened California CV (CCV) steelhead distinct population segment (DPS) (*O. mykiss*), and threatened Southern DPS (sDPS) of North American green sturgeon (*Acipenser medirostris*), and their designated critical habitats. Additionally, the Corps has determined that the West Sacramento Project may adversely affect Essential Fish

Habitat (EFH) pursuant to the Magnuson-Stevens Fishery Conservation and Management Act. The Corps also states that there is an expectation that the West Sacramento GRS (particularly the Southport EIP project) may benefit long-term EFH quality in the action area.

For much of this process, coordination with the Corps occurred independently on the Southport EIP and the portions of the West Sacramento GRS that occur outside the Southport EIP. On April 21, 2014, an interagency meeting was held to discuss the BAs for both actions. In part, as a result of that meeting, the Corps decided to combine the two BAs because the two projects were determined to be too related to be considered in two separate consultations. The Corps and WSAFCA consulted with NMFS regarding proposed actions that may affect Federally listed species and their habitat.

1. 2008 through 2010—NMFS staff participated in site visits and meetings associated with WSAFCA's overall levee improvements program, leading to completed consultations for The Rivers, and California Highway Patrol Academy projects.
2. May 26, 2011—NMFS staff participated in the kick-off of an environmental stakeholder group for the Southport EIP.
3. August 15, 2011—NMFS staff participated in an informal meeting of the Southport EIP environmental stakeholder group and attended a field visit led by WSAFCA.
4. November 14, 2011—NMFS staff participated in an environmental stakeholder group meeting on project alternatives development.
5. March 28, 2013—NMFS staff participated in National Environmental Policy Act/California Environmental Quality Act (NEPA/CEQA) scoping meeting.
6. June 4, 2013—Corps requested initiation of consultation with NMFS on the Southport EIP.
7. August 27, 2013 – NMFS staff met with WSAFCA and Corps staff to discuss project design and BA comments.
8. September 30, 2013 – NMFS staff correspondence requested additional information from the Corps to support consultation.
9. December 11 and 18, 2013— NMFS staff participated in public meetings on the Southport EIP Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR).
10. December 18, 2013 – NMFS staff participated in an environmental stakeholder group meeting on project design development.
11. June 10, 2014 – NMFS received an initiation letter from the Corps for the West Sacramento Project, General Reevaluation Report.
12. September 9, 2014 – NMFS delivered an insufficiency letter to the Corps requesting a revised BA and initiation letter.
13. October and November 2014 – The Corps and NMFS had a number of meetings, phone calls, emails, and related correspondence with the purpose of producing a revised BA and updated initiation letter.
14. November 24, 2014 – NMFS received a revised initiation letter and BA for the West Sacramento, General Reevaluation Study.
15. On March 5, 2015, the Corps requested NMFS to issue a separate BO for the Southport EIP to facilitate the construction schedule of the project.

1.6 Proposed Southport EIP Action

This section summarizes the proposed action. The term "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). "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). There are no interrelated or interdependent actions associated with the Southport EIP.

The Southport EIP includes a number of different flood risk reduction measures selected based on their effectiveness in addressing deficiencies, compatibility with land uses, minimization of real estate acquisition, avoidance of adverse effects, and cost. The Southport EIP includes a combination of setback levees, cutoff walls, and seepage berms (along with other measures). WSAFCA is proposing the Southport EIP to implement flood risk reduction measures along the Sacramento River South Levee in order to provide 200-year level of performance consistent with the state goal for urbanized areas, as well as to provide opportunities for ecosystem restoration and public recreation. The overall project involves the following elements.

1. Construction of flood risk reduction measures, including seepage berms, slurry cutoff walls, setback levees, rock and biotechnical slope protection, and encroachment removal.
2. Partial degrade of the existing levee, forming a "remnant levee."
3. Construction of offset areas using setback levees.
4. Construction of breaches in the remnant levee to open up the offset areas to Sacramento River flows.
5. Offset area restoration.
6. Road construction.
7. Drainage system modifications.
8. Utility line relocations.

The following elements of the Southport EIP pertain to fish species and their habitat under NMFS jurisdiction and are not a comprehensive description of all of the Southport EIP actions. A complete description of actions is in the November BA (Corps 2014).

1.7 Setback Levee Construction

An approximately 19,000 foot long setback levee would be constructed as the key flood protection feature of the Southport EIP. A setback levee is an entirely new section of levee constructed at some distance behind the landside of the existing levee. The existing levee (remnant levee) would remain in place or be removed or breached, depending on conditions. The new section of levee would be tied into the landside of the existing levee and then become the Federal project levee. The Southport EIP's new levee section would be constructed to meet current design standards, including height and slope requirements. To begin construction activities, the area required to construct the new levee would be cleared, grubbed, and stripped, and encroachments into the new levee footprint would be removed. The new setback levee would be designed to be compliant with the Corps levee vegetation policy.

1.8 Bank Erosion Sites

The Southport EIP includes placement of rock bank protection along the segments of the existing levee that will remain in place at the northern and southern extents of the project area, and at two sites along the remnant levee. Rock bank protection along the existing levee, which is presently rocked to limit levee erosion, will be minimally supplemented as needed to maintain levee stability and protect its flood risk reduction function. Rock bank protection on the remnant levee will be constructed to protect existing riparian vegetation and instream woody material (IWM). The construction details are described in the BA (2014). Once rock has been place on the erosion sites, topsoil would be placed over the rock and the sites would be planted with riparian vegetation and IWM would installed to achieve 40 percent shoreline coverage for fish habitat enhancement.

1.9 Levee Breaches and Setback Area

The Southport EIP will breach and remove approximately 6,070 linear feet of existing levee. The offset floodplain area refers to the expanded floodways located between the proposed Southport setback levee and the remnant levee. The offset area will contain approximately 119 acres of seasonal shallow water habitat below the ordinary high water mark. The restoration of the offset area will, in part be used to provide compensatory mitigation for the adverse effects of the Southport EIP implementation, and to the extent feasible, offset adverse effects of associated with future implementation of projects generated from future West Sacramento flood risk management projects, like the West Sacramento GRS. Project activities in this area will include floodplain and habitat restoration. Following excavation, the offset area will be graded to allow creation and restoration of riverine floodplain and riparian habitats. The offset areas and existing levee will be degraded, and the existing levee will be breached initially in two locations at such time as permitted to ensure completion of the setback levee before the flood season. The breaches would be constructed to allow for inlet and outlet of floodplain-inundating flows.

Native riparian plant species will be installed as container plants and pole cuttings spaced at regular intervals throughout the offset floodplain area. Both overstory and understory species will be installed to mimic the natural structure of riparian forests along the Sacramento River. Supplemental irrigation would be provided for several years during the plant establishment period.

The period between when the first two breaches are constructed and when the remaining three breaches are constructed is referred to as the "interim condition." The interim condition would allow restoration plantings to establish in the offset areas during the fall, winter, and spring following construction Year 3 without exposure to through-flows from the Sacramento River, increasing the likelihood of long-term planting success.

The target plant communities in the offset floodplain area would include emergent marsh, riparian willow scrub, riparian cottonwood forest, mixed riparian woodland, elderberry shrubs and associated plants for valley elderberry longhorn beetle habitat, and grassland. The restoration design intends to mimic this stratification of vegetation. Plants selected for establishment of each of the target plant communities were based on how the plants associate in nature, and the elevations at which these plants were observed growing along the Southport levee.

A network of seasonal wetland swales will be excavated in the offset floodplain area and inundate during high-water events on the Sacramento River to provide habitat for special-status native fish species, including Chinook salmon and steelhead. Areas of upland grassland in the offset floodplain area would serve as potential floodplain rearing habitat for native fish during periods of high flows, as well as foraging habitat for raptors during periods of low water.

1.10 Operations and Maintenance of Remnant Levee

Post-construction, only the rock slope protection, native vegetation, and other biotechnical features would be permanent. Anticipated O&M actions include regular visual inspections of the site, vegetation maintenance and irrigation for up to 3 years, and periodic repairs, as needed, to prevent or repair localized scour along the bank and rock toe of the site.

1.11 Vegetation Policy Compliance

The Southport EIP would only remove vegetation within the construction footprint of flood risk reduction features required to address other levee deficiencies. Consistent with the Central Valley Flood Protection Plan (CVFPP) guidance, new levees (such as setback levees) would be designed to be compliant with Corps levee vegetation policy. Any vegetation removed as part of direct construction activities would not be replaced at that specific location, but may be planted in the project's offset area, or planted offsite as in-kind mitigation, to be determined in consultation with the appropriate resource agencies.

1.12 Construction Schedule

The following construction schedule is being proposed for the Southport EIP. Construction of the project will occur in more than one construction season, with construction of flood risk–reduction measures beginning in April of 2016, and likely finishing in 2018. It is possible the start year will be delayed, but the schedule sequence will look similar regardless. Construction and restoration of the offset area will likely continue after 2017, with final remnant levee breaches constructed in 2020. Further detail below:

1. **Year 1**
   a. Village Parkway construction and utility relocation will be completed.
   b. The entire length of the setback levee will be started in Year 1, beginning with the foundation and working platform. Construction of the cutoff wall will follow if weather allows.
2. **Year 2**
   a. The setback levee cutoff wall and remaining buildup of the setback levee will be constructed to a finished elevation.
   b. South River Road detour implemented.
   c. Seepage berms will be constructed following completion of the setback levees.

    d. In the existing levee, various segments will be degraded. Cutoff walls will then be constructed in these segments. The levee crowns in the degraded sections will then be built back up to a finished elevation.
    e. The remnant levee will be degraded and will have a 20-foot-wide crown. Remnant levee degrading will be concurrent with setback levee and seepage berm construction.
    f. Offset area grading will begin.
    g. Erosion site repairs at will be constructed.
3. **Year 3**
    a. Offset area grading will be completed. Culverts will be installed through the remnant levee.
    b. Breaches will be constructed.
    c. Offset area planting will begin and will continue through Year 6.
4. **Year 4**
    a. Offset area planting will continue.
5. **Year 5**
    a. The three remaining breaches and the offset area cellular berms will be constructed, and the southern offset area will be contoured.
6. **Year 6**
    a. Offset area planting will be completed.

At the end of each primary construction season, the levee system will be restored, at a minimum, to the level of flood risk reduction performance existing at the Southport EIP project outset. During construction Years 1 and 2, "tie-ins" will be built connecting the existing levee up-and-downstream to the segments constructed that season, as needed. These tie-ins will be achieved by benching the existing levee and installing compacted lifts to completely bond the new and existing levee materials.

1.13 Conservation Actions Proposed for Southport EIP

WSAFCA will implement the following conservation measures to avoid or minimize effects on Federally listed fish and wildlife species and their habitat. To ensure their implementation, the following measures will be included in the project specifications by the Corps.

Conservation Measure 1: Conduct Mandatory Biological Resources Awareness Training for All Project Personnel and Implement General Requirements. Before any ground-disturbing work (including vegetation clearing and grading) occurs in the Southport EIP Action Area, a USFWS-approved biologist will conduct a mandatory biological resources awareness training for all construction personnel about Federally listed species that could potentially occur onsite (VELB and giant garter snake). The training will include the natural history, representative photographs, and legal status of each Federally listed species and avoidance and minimization measures to be implemented.

Conservation Measure 2: Prepare and Implement a Stormwater Pollution Prevention Plan: WSAFCA will obtain coverage under the U.S. Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) general construction activity stormwater permit. The Central Valley RWQCB administers the NPDES stormwater permit program in Yolo County. Obtaining coverage under the NPDES general construction activity permit generally requires that the project applicant prepare a stormwater pollution prevention plan (SWPPP) that describes the BMPs that will be implemented to control accelerated erosion, sedimentation, and other pollutants during and after project construction. The SWPPP will be prepared prior to commencing earth-moving construction activities.

The BMPs that will be incorporated into the erosion and sediment control plan and SWPPP will be site-specific and will be prepared by the construction contractor in accordance with the CV RWQCB's Field Manual. The plan will include, but not be limited to, one or more of the following standard erosion and sediment control BMPs:

1. **Timing of construction.** The construction contractor will conduct all construction activities to best avoid ground disturbance during the rainy season.
2. **Staging of construction equipment and materials.** To the extent possible, equipment and materials will be staged in areas that have already been disturbed. No equipment or materials will be stored in the floodway during the flood season.
3. **Minimize soil and vegetation disturbance.** The construction contractor will minimize ground disturbance and the disturbance or destruction of existing vegetation.
4. **Stabilize grading spoils.** Grading spoils generated during the construction will be temporarily stockpiled in staging areas. Silt fences, fiber rolls, or similar devices will be installed around the base of the temporary stockpiles to intercept runoff and sediment during storm events.
5. **Install sediment barriers.** The construction contractor may install silt fences, fiber rolls, or similar devices to prevent sediment-laden runoff from leaving the construction area.
6. **Stormwater drain inlet protection.** The construction contractor may install silt fences, drop inlet sediment traps, sandbag barriers, and/or other similar devices.
7. **Permanent site stabilization.** The construction contractor will install structural and vegetative methods to permanently stabilize all graded or otherwise disturbed areas once construction is complete. Implementation of a SWPPP will substantially minimize the potential for project-related erosion and associated adverse effects on water quality.
8. Before excavation begins, WSAFCA will ensure the contractor will prepare and implement a bentonite slurry spill contingency plan (BSSCP) for any excavation activities that use pressurized fluids (other than water). If the contactor prepares the plan, it will be subject to approval by the Corps, NMFS, and WSAFCA before excavation can begin.
9. NMFS, CDFW, and the CV RWQCB will be notified immediately of any spills and will be consulted regarding clean-up procedures.

Conservation Measure 3: Prepare and Implement a Bentonite Slurry Spill Contingency Plan (Frac-Out Plan): Before excavation begins, WSAFCA will ensure the contractor will prepare and implement a bentonite slurry spill contingency plan (BSSCP) for any excavation activities that use pressurized fluids (other than water). If the contactor prepares the plan, it will be subject to approval by the Corps, NMFS, and WSAFCA before excavation can begin. The BSSCP will include measures intended to minimize the potential for a frac-out (short for "fracture-out event") associated with excavation and tunneling activities; provide for the timely detection of frac-outs; and ensure an organized, timely, and minimum- effect response in the event of a frac-out and release of excavation fluid (bentonite).

Conservation Measure 4: Prepare and Implement a Spill Prevention, Control, and Counter-Measure Plan: A spill prevention, control, and counter-measure plan (SPCCP) is intended to prevent any discharge of oil into navigable water or adjoining shorelines. WSAFCA or its contractor will develop and implement an SPCCP to minimize the potential for and 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 will be taken in the event of a spill (e.g., an oil spill from engine refueling will be immediately cleaned up with oil absorbents). The SPCCP will outline descriptions of containments facilities and practices such as double-walled tanks, containment berms, emergency shutoffs, drip pans, fueling procedures, and spill response kits. It will describe how and when employees are trained in proper handling procedure and spill prevention and response procedures.

Conservation Measure 5: Monitor Turbidity in Adjacent Water Bodies: WSAFCA or its contractor will monitor turbidity in the adjacent water bodies, where applicable criteria apply, to determine whether turbidity is being affected by construction and ensure that construction does not affect turbidity levels, which ultimately increase the sediment loads. The Water Quality Control Plan for the Central Valley RWQCB (Basin Plan) contains turbidity objectives for the Sacramento River. Specifically, the plan states that where natural turbidity is between 5 and 50 nephelometric turbidity units (NTUs), turbidity levels may not be elevated by 20% above ambient conditions. Where ambient conditions are between 50 and 100 NTUs, conditions may not be increased by more than 10 NTUs (Central Valley RWQCB 2009).

Conservation Measure 6: Prepare and Implement a Mitigation and Monitoring Plan: A draft Mitigation and Monitoring Plan (MMP) for the restoration areas is being developed and will be approved by the Corps, NMFS, USFWS, and CDFW before implementation of the Southport EIP project. In addition, an interagency group, including WSAFCA, USACE, and NMFS, will be established to support adaptive management of the setback area. The restoration objectives of the plan are listed below:

1. Provide compensatory mitigation credits for impacts on protected land cover types and to special-status species and potential habitat for these species as a result of unavoidable adverse effects associated with the proposed action and, to the extent feasible, to provide compensatory mitigation for future projects associated with the West Sacramento GRS.
2. Maximize SRA cover/nearshore habitat, over and above current erosion stabilization efforts using biotechnical methods.
3. Enhance setback ecological values using topographic and vegetation/habitat heterogeneity.
4. Restore portions of the historic Sacramento River floodplain (i.e., waters of the United States).
5. Restore riparian and oak woodland habitat on the restored floodplain that will create continuous habitat corridors for fish and wildlife movement.

6. Design habitat features to minimize future maintenance obligations (e.g., reduce opportunities for sediment and debris accumulation).
7. Design floodplain planting and vegetation management schemes to avoid undesirable hydraulic and sediment transport impacts to the offset levee and offset area.
8. Comply with current Corps levee vegetation policy to balance habitat needs with flood management objectives.

The monitoring objectives of the plan include:

1. Monitor and evaluate the hydrologic and hydraulic performance of the restored floodplain relative to the ecological design criteria for the target species.
2. Monitor and evaluate the success of the riparian/wetland plantings and other habitat features (e.g., IWM) in compensating, restoring, or enhancing fish and wildlife habitat values on the levee slopes and offset areas.
3. Monitor and evaluate the effectiveness of the grading and drainage features in preventing fish stranding.
4. Monitor the occurrence and extent of potential sedimentation and scour that may compromise the success of the habitat restoration and mitigation components of the project.

The MMP will include a methodology for quantifying permanent habitat loss caused by the project caused by placement of revetment in the channel of the Sacramento River or the loss of riparian vegetation caused by project construction. The MMP will address the habitat created within the offset area (i.e., new inundated floodplain areas, newly established riparian habitat), and the portion of that habitat needed to fully compensate and offset the project's unavoidable effects to habitat features essential to fish species that are subject to this consultation. The MMP will also include representative plans and cross sections of the Southport EIP Proposed Action elements; fish stranding and vegetation monitoring methods; habitat compensation and restoration success criteria; and a protocol for implementing remedial actions should any success criteria not be met. The composition and role of the interagency group will be described in the MMP. Appropriate existing O&M requirements and practices will also be incorporated into the plan. Annual monitoring reports that describe each year's monitoring activities and progress toward the success criteria would be submitted to the resource agencies during the course of the monitoring period. Monitoring would be conducted until the projected benefits of the compensation and restoration actions have been substantially achieved as defined within the MMP.

1.14 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 Southport EIP action area extends approximately 5.6 miles along the Sacramento River South Levee from River Mile (RM) 57.2 south to the South Cross levee at RM 51.6 (Figure 1).

The action area includes perennial waters of the Sacramento River extending 200 feet perpendicular from the average summer-fall shoreline and 1,000 feet downstream from proposed in-water construction areas. This represents the potential area of turbidity and sedimentation effects based on the reported limits of visible turbidity plumes in the Sacramento River during similar construction activities (NMFS 2008).

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, Federal agencies must ensure that their 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 provides an opinion stating how the agency's actions will affect listed species and their critical habitat. If incidental take is expected, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This BO includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that will 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.

The adverse modification analysis considers the impacts of the Federal action on the conservation value of designated critical habitat. This BO does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[1]

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

1. Identify the rangewide status of the species and critical habitat likely to be adversely affected by the proposed action.
2. Describe the environmental baseline in the action area.
3. Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
4. Describe any cumulative effects in the action area.

[1] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

5. Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat.
6. Reach jeopardy and adverse modification conclusions.
7. If necessary, define a reasonable and prudent alternative to the proposed action.

2.1.1 Use of Analytical Surrogates

The effects of the Southport EIP are 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 this consultation.

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 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 provide on- or off-site compensatory mitigation 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, either by direct quantification of bank stabilization design parameters (*e.g.*, bank slope, substrate). The preferred hierarchy of mitigation in all cases is avoid, minimize, compensate on-site and compensate off-site. In the case of most levee projects, most or all of these mitigation strategies are applied due to their large size, challenges associated with completely avoiding and minimizing impacts to species and habitat, temporal delays in habitat function of on-site compensatory mitigation, and limitations associated with being able to provide full compensation at project sites, which warrants the need for some form of offsite compensation.

In 2003, the Corps established a program to carry out "a process to review, improve, and validate analytical tools and models for USACE Civil Works business programs". Reviews are conducted to ensure that planning models used by the Corps are technically and theoretically sound, computationally accurate, and in compliance with the Corps planning policy. As such, all existing and new planning models developed by the Corps are required to be certified through the appropriate Planning Center of Expertise and Headquarters in accordance with Corps rules and procedures.

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 sDPS 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 2009, USACE 2009).

In late 2010, the certification process for the SAM was initiated by the Corps, Sacramento District in coordination with the Ecosystem Planning Center of Expertise. The process entailed charging a panel of six experts to review the SAM, along with the SAM (version 3.0). The Review Panel was composed of a plan formulation expert, fisheries biologist, aquatic ecologist, geomorphologist/geologist, population biologist/modeling expert, and software programmer. A major advantage of the SAM is that it integrates species life history and seasonal flow-related variability in habitat quality and availability to generate species responses to project actions over time. The SAM systematically evaluates the response of each life stage to habitat features affected by bank protection projects.

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 represent and index of harm to a species, since the values are expressed as "weighted bankline 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. The *Effects Analysis section of this* BO analyzes the Southport EIP.

2.1.2 Compensation Timing

As described in the proposed action, projects such as this often propose compensation for unavoidable short-term effects to species and impacts to habitat. Under the Corps BA, compensation timing is defined and in practice adopts an approach that the SAM modeled impact at the proposed timing (Green sturgeon: 15 years: Chinook salmon, 5 years: Central Valley steelhead, 4 years) is sufficient to compensate for project effects. NMFS adopts a slightly different approach to the analysis of the BO in that the compensation time should be a target for avoiding exposure of more than one generation of a population with a multiple age class structure. Negative SAM-modeled values beyond those years would be expected to have significant effects to the species and impacts to critical habitat that could reduce the species survival and recovery in the wild or substantially reduce the conservation value of the species.

As such, this BO applies the following compensation, based roughly on life cycle (salmon and steelhead) or in the case or sturgeon, the fact that they are long-lived species that may spawn multiple times, as general targets for avoiding such long-term effects:

1. Green sturgeon, 15 years;
2. Chinook salmon, 5 years;
3. Central Valley steelhead, 4 years

2.2 Rangewide Status of the Species and Critical Habitat

This BO examines the status of each species that will 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 conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential physical and biological features that help to form that conservation value.

One factor affecting the rangewide status of the CV spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, CCV steelhead, and the North American green sturgeon, and aquatic habitat at large is climate change.

The following federally listed species and designated critical habitats occur in the action area and may be affected by the proposed action:

Sacramento River winter-run Chinook salmon ESU (*Oncorhynchu tshawytscha*)
Listed as endangered (70 FR 37160, June 28, 2005)

Sacramento River winter-run Chinook salmon designated critical habitat
(June 16, 1993, 58 FR 33212)

CV spring-run Chinook salmon ESU (*O. tshawytscha*)
Listed as threatened (70 FR 37160, June 28, 2005)

CV spring-run Chinook salmon designated critical habitat
(70 FR 52488, September 2, 2005)

CCV steelhead DPS (*O. mykiss*)
Listed as threatened (71 FR 834, January 5, 2006)

CCV steelhead designated critical habitat
(70 FR 52488, September 2, 2005)

Southern DPS of North American green sturgeon (*Acipenser medirostris*)
Listed as threatened (71 FR 17757, April 7, 2006)

Southern DPS of North American green sturgeon designated critical habitat
(74 FR 52300, October 9, 2009)

Critical habitat designations identify those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration or protection. Within the West Sacramento GRS this includes the river water, river bottom, 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 is defined by the bankfull elevation (defined as the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a recurrence interval of one to two years on the annual flood series) used by listed salmonids and sturgeon.

NMFS has recently completed an updated status review of five Pacific salmon ESUs and one steelhead DPS, including Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon and CCV steelhead, and concluded that the species' status should remain as previously listed (76 FR 50447; August 15, 2011). The 2011 status reviews (NMFS 2011a, 2011b, 2011c) additionally stated that, although the listings should remain unchanged, the status of these populations have worsened over the past five years since the 2005/2006 reviews and recommended that status be reassessed in two to three years as opposed to waiting another five years.

2.2.1 Sacramento River Winter-run Chinook salmon

The Sacramento River winter-run Chinook salmon (winter-run *Oncorhynchus tshawytscha*) ESU, currently listed as endangered, was listed as a threatened species under emergency provisions of the ESA on August 4, 1989 (54 FR 32085) and formally listed as a threatened species in November 1990 (55 FR 46515). On January 4, 1994 (59 FR 440), NMFS re-classified winter-run as an endangered species. NMFS concluded that winter-run in the Sacramento River warranted listing as an endangered species due to several factors, including: (1) the continued decline and increased variability of run sizes since its first listing as a threatened species in 1989; (2) the expectation of weak returns in future years as the result of two small year classes (1991 and 1993); and (3) continued threats to the "take" of winter-run (August 15, 2011, 76 FR 50447).

On June 28, 2005, NMFS concluded that the winter-run ESU was "in danger of extinction" due to risks to the ESU's diversity and spatial structure and, therefore, continues to warrant listing as an endangered species under the ESA (70 FR 37160). In August 2011, NMFS completed a 5-year status review of five Pacific salmon ESUs, including the winter-run ESU, and determined that the species' status should again remain as "endangered" (August 15, 2011, 76 FR 50447). The 2011 review concluded that although the listing remained unchanged since the 2005 review, the status of the population had declined over the past five years (2005–2010).

The winter-run ESU currently consists of only one population that is confined to the upper Sacramento River (spawning downstream of Shasta and Keswick dams) in California's CV. In addition, an artificial propagation program at the Livingston Stone National Fish Hatchery (LSNFH) produces winter-run that are considered to be part of this ESU (June 28, 2005, 70 FR 37160). Most components of the winter-run life history (*e.g.*, spawning, incubation, freshwater rearing) have been compromised by the habitat blockage in the upper Sacramento River. All historical spawning and rearing habitats have been blocked since the construction of Shasta Dam in 1943. Remaining spawning and rearing areas are completely dependent on cold water releases from Shasta Dam in order to sustain the remnant population.

Life History

1. Adult Migration and Spawning

Winter-run exhibit a unique life history pattern (Healey 1994) compared to other salmon populations in the CV (*i.e.*, spring-run, fall-run, and late-fall run), in that they spawn in the summer, and the juveniles are the first to enter the ocean the following winter and spring. Adults first enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate up the Sacramento River, past the RBDD from mid-December through early August (NMFS 1997). The majority of the run passes RBDD from January through May, with the peak passage occurring in mid-March (Hallock and Fisher 1985). The timing of migration may vary somewhat due to changes in river flows, dam operations, and water year type (Table 5; Yoshiyama *et al.* 1998, Moyle 2002).

Winter-run tend to enter freshwater while still immature and travel far upriver and delay spawning for weeks or months upon arrival at their spawning grounds (Healey 1991). Spawning occurs primarily from mid-May to mid-August, with the peak activity occurring in June and July in the upper Sacramento River reach (50 miles) between Keswick Dam and RBDD (Vogel and Marine 1991). Winter-run deposit and fertilize eggs in gravel beds known as redds excavated by the female that then dies following spawning. Average fecundity was 5,192 eggs/female for the 2006–2013 returns to LSNFH, which is similar to other Chinook salmon runs [*e.g.*, 5,401 average for Pacific Northwest (Quinn 2005)]. Chinook salmon spawning requirements for depth and velocities are broad, and the upper preferred water temperature is between 55–57°F (13–14°C) degrees (Snider *et al.* 2001). The majority of winter-run adults return after three years.

Table 5. The temporal occurrence of adult (a) and juvenile (b) winter-run in the Sacramento River. Darker shades indicate months of greatest relative abundance.

Winter run relative abundance	High				Medium				Low			
a) Adults freshwater												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento River basin[a,b]												
Upper Sacramento River spawning[c]												
b) Juvenile emigration												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento River at Red Bluff[d]												
Sacramento River at Knights Landing[e]												
Sacramento trawl at Sherwood Harbor[f]												
Midwater trawl at Chipps Island[g]												

Sources: [a] (Yoshiyama *et al.* 1998); (Moyle 2002); [b](Myers *et al.* 1998) ; [c] (Williams 2006) ; [d] (Martin *et al.* 2001); [e] Knights Landing Rotary Screw Trap Data, CDFW (1999-2011); [f,g] Delta Juvenile Fish Monitoring Program, USFWS (1995-2012)

2. Eggs/Fry Emergence

Winter-run incubating eggs are vulnerable to adverse effects from floods, flow fluctuations, siltation, desiccation, disease, predation during spawning, poor gravel percolation, and poor water quality. The optimal water temperature for egg incubation ranges from 46–56°F (7.8–13.3°C) and a significant reduction in egg viability occurs in mean daily water temperatures above 57.5°F (14.2°C; Seymour 1956, Boles 1988, USFWS 1998, EPA 2003, Richter and Kolmes 2005, Geist *et al.* 2006). Total embryo mortality can occur at temperatures above 62°F (16.7°C; NMFS 1997). Depending on ambient water temperature, embryos hatch within 40-60 days and alevin (yolk-sac fry) remain in the gravel beds for an additional 4–6 weeks. As their yolk-sacs become depleted, fry begin to emerge from the gravel and start exogenous feeding in their natal stream, typically in late July to early August and continuing through October (Fisher 1994).

3. Juvenile/Outmigration

Juvenile winter-run have been found to exhibit variability in their life history dependent on emergence timing and growth rates (Beckman *et al.* 2007). Following spawning, egg incubation, and fry emergence from the gravel, juveniles begin to emigrate in the fall. Some juvenile winter-run migrate to sea after only 4 to 7 months of river life, while others hold and rear upstream and spend 9 to 10 months in freshwater. Emigration of juvenile winter-run fry and pre-smolts past RBDD (RM 242) may begin as early as mid-July, but typically peaks at the end of September (Table 5), and can continue through March in dry years (Vogel and Marine 1991, NMFS 1997).

4. Estuarine/Delta Rearing

Juvenile winter-run emigration into the estuary/Delta occurs primarily from November through early May based on data collected from trawls in the Sacramento River at Sherwood Harbor (West Sacramento), RM 57 (USFWS 2001). The timing of emigration may vary somewhat due to changes in river flows, Shasta Dam operations, and water year type, but has been correlated with the first storm event when flows exceed 14,000 cfs at Knights Landing, RM 90, which trigger abrupt emigration towards the Delta (del Rosario *et al.* 2013). Residence time in the Delta for juvenile winter-run averages approximately 3 months based on median seasonal catch between Knights Landing and Chipps Island. In general, the earlier juvenile winter-run arrive in the Delta, the longer they stay and rear, as peak departure at Chipps Island regularly occurs in March (del Rosario *et al.* 2013). The Delta serves as an important rearing and transition zone for juvenile winter-run as they feed and physiologically adapt to marine waters (smoltification). The majority of juvenile winter-run in the Delta are 104 to 128 millimeters (mm) in size based on USFWS trawl data (1995-2012), and from 5 to 10 months of age, by the time they depart the Delta (Fisher 1994, Myers *et al.* 1998).

5. Ocean Rearing

Winter-run smolts enter the Pacific Ocean mainly in spring (March–April), and grow rapidly on a diet of small fishes, crustaceans, and squid. Salmon runs that migrate to sea at a larger size tend to have higher marine survival rates (Quinn 2005). The diet composition of Chinook salmon from California consist of anchovy, rockfish, herring, and other invertebrates (in order of preference, Healey 1991). Most Chinook from the Central Valley move northward into Oregon and Washington, where herring make up the majority of their diet. However winter-run, upon entering the ocean, tend to stay near the California coast and distribute from Point Arena southward to Monterey Bay. Winter-run have high metabolic rates, feed heavily, and grow fast, compared to other fishes in their range. They can double their length and increase their weight more than ten-fold in the first summer at sea (Quinn 2005). Mortality is typically highest in the first summer at sea, but can depend on ocean conditions. Winter-run abundance has been correlated with ocean conditions, such as periods of strong up-welling, cooler temperatures, and El Nino events (Lindley *et al.* 2009). Winter-run spend approximately 1-2 years rearing in the ocean before returning to the Sacramento River as 2-3 year old adults. Very few winter-run Chinook salmon reach age 4. Once they reach age 3, they are large enough to become vulnerable to commercial and sport fisheries.

Description of Viable Salmonid Population (VSP) Parameters

1. Abundance

Historically, winter-run population estimates were as high as 120,000 fish in the 1960s, but declined to less than 200 fish by the 1990s (NMFS 2011). In recent years, since carcass surveys began in 2001 (Figure 3), the highest adult escapement occurred in 2005 and 2006 with 15,839 and 17,296, respectively. However, from 2007 to 2012, the population has shown a precipitous decline, averaging 2,486 during this period, with a low of 827 adults in 2011 (Figure 3). This recent declining trend is likely due to a combination of factors such as poor ocean productivity (Lindley *et al.* 2009), drought conditions from 2007-2009, and low in-river survival (NMFS 2011a). In 2013, the population increased to 6,075 adults, well above the 2007–2012 average, but below the high for the last ten years.

Although impacts from hatchery fish (*i.e.*, reduced fitness, weaker genetics, smaller size, less ability to avoid predators) are often cited as having deleterious impacts on natural in-river populations (Matala *et al.* 2012), the winter-run conservation program at LSNFH is strictly controlled by the USFWS to reduce such impacts. The average annual hatchery production at LSNFH is approximately 176,348 per year (2001–2010 average) compared to the estimated natural production that passes RBDD, approximately 4.7 million (2002–2010 average, Poytress and Carrillo 2011). Therefore, hatchery production typically represents approximately 3-4 percent of the total in-river juvenile production in any given year.

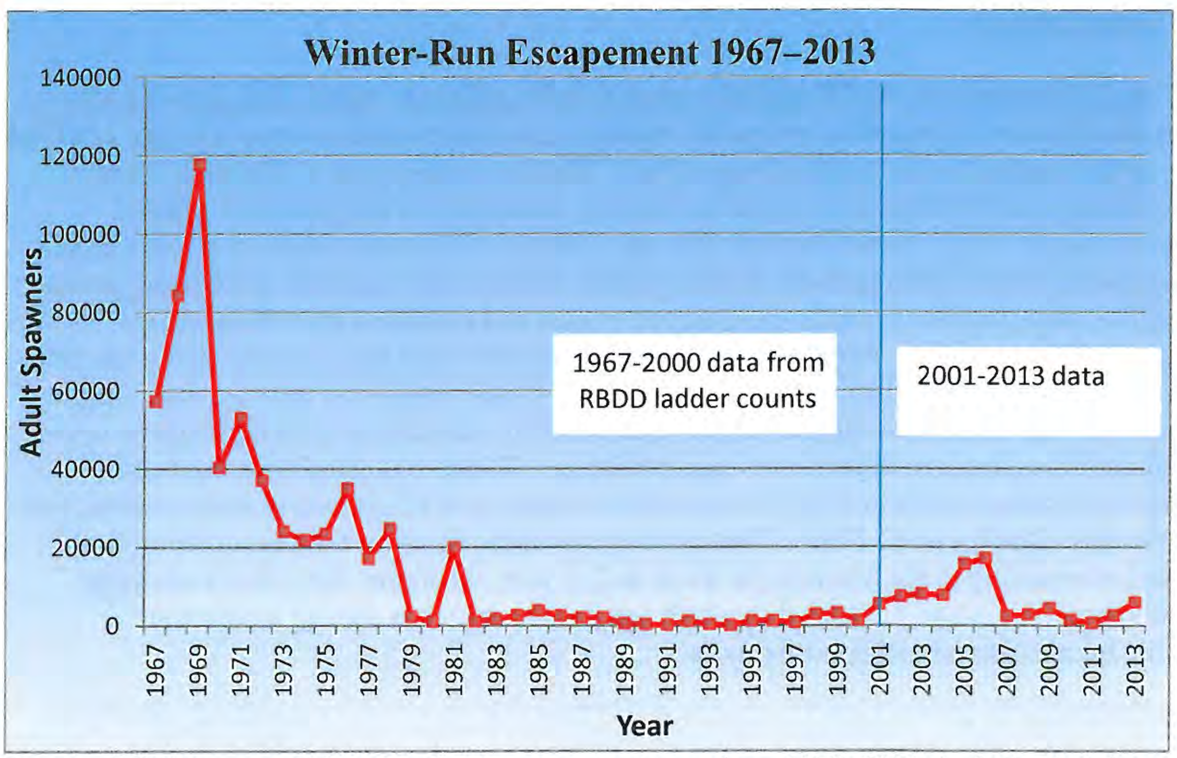


Figure 3. Winter-run Chinook salmon escapement numbers 1970-2013, includes hatchery broodstock and tributaries, but excludes sport catch. RBDD ladder counts used pre-2000, carcass surveys post 2001 (3).

2. Productivity

ESU productivity was positive over the period 1998–2006, and adult escapement and juvenile production had been increasing annually until 2007, when productivity became negative (Figure 4) with declining escapement estimates. The long-term trend for the ESU, therefore, remains negative, as the productivity is subject to impacts from environmental and artificial conditions. The population growth rate based on cohort replacement rate (CRR) for the period 2007–2012 suggests a reduction in productivity (Figure 4), and indicates that the winter-run population is not replacing itself. In 2013, winter-run experienced a positive CRR, possibly due to favorable in-river conditions in 2011 (a wet year), which increased juvenile survival to the ocean.

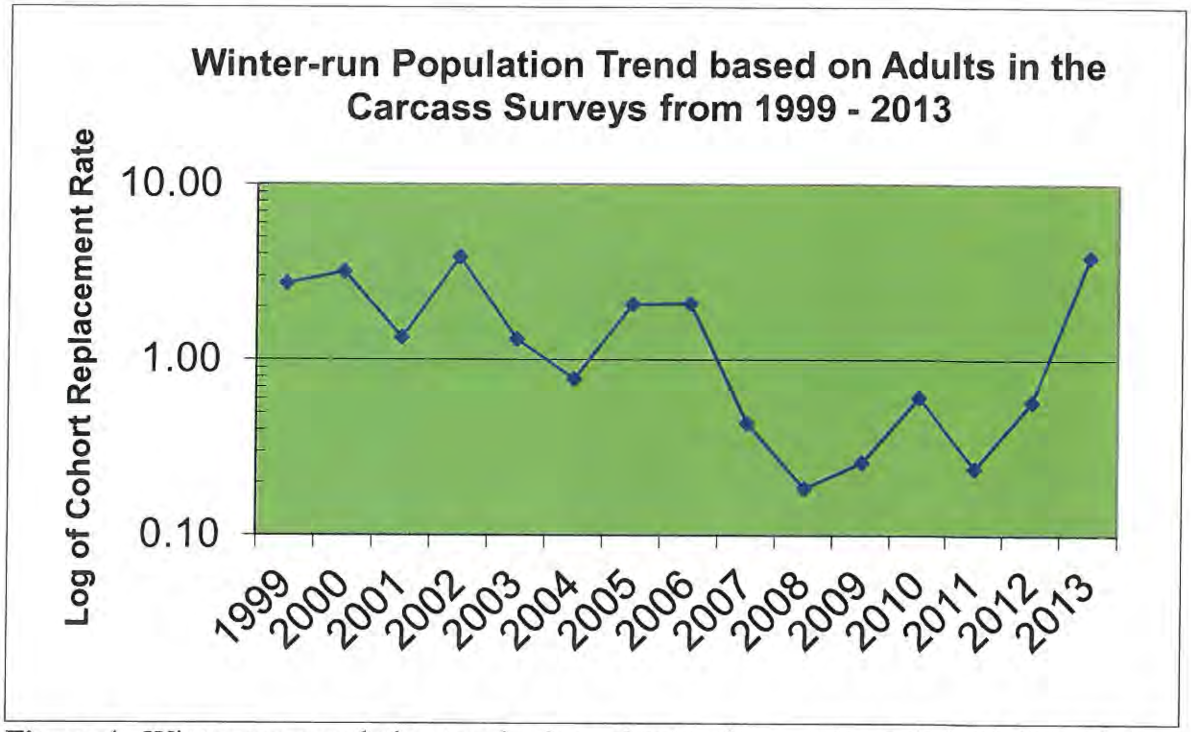


Figure 4. Winter-run population trend using cohort replacement rate derived from adult escapement, including hatchery fish, 1986–2013.

An age-structured density-independent model of spawning escapement by Botsford and Brittnacher (1998) assessing the viability of winter-run found the species was certain to fall below the quasi-extinction threshold of three consecutive spawning runs with fewer than 50 females (Good *et al.* 2005). Lindley and Mohr (2003) assessed the viability of the population using a Bayesian model based on spawning escapement that allowed for density dependence and a change in population growth rate in response to conservation measures found a biologically significant expected quasi-extinction probability of 28 percent. Although the growth rate for the winter-run population improved up until 2006, it exhibits the typical variability found in most endangered species populations. The fact that there is only one population, dependent upon cold-water releases from Shasta Dam, makes it vulnerable to periods of prolonged drought (NMFS 2011). Productivity, as measured by the number of juveniles entering the Delta, or juvenile production estimate (JPE), has declined in recent years from a high of 3.8 million in 2007 to 1.1 million in 2013 (Table 6). Due to uncertainties in the various factors, the JPE was updated in

2010 with the addition of confidence intervals (Cramer Fish Sciences model), and again in 2013 with a change in survival based on acoustic tag data (NMFS 2014). However, juvenile winter-run productivity is still much lower than other Chinook salmon runs in the Central Valley and in the Pacific Northwest (Michel 2010).

Table 6. Winter-run adult and juvenile population estimates based on RBDD counts (1986–2001) and carcass counts (2001–2013), with corresponding 3-year-cohort replacement rates.

Return Year	Adult Population Estimate[a]	Cohort Replacement Rate[b]	NMFS-calculated Juvenile Production
1986	2596		
1987	2185		
1988	2878		
1989	696	0.27	
1990	430	0.20	
1991	211	0.07	
1992	1240	1.78	40,100
1993	387	0.90	273,100
1994	186	0.88	90,500
1995	1297	1.05	74,500
1996	1337	3.45	338,107
1997	880	4.73	165,069
1998	2992	2.31	138,316
1999	3288	2.46	454,792
2000	1352	1.54	289,724
2001	8224	2.75	370,221
2002	7441	2.26	1,864,802
2003	8218	6.08	2,136,747
2004	7869	0.96	1,896,649
2005	15839	2.13	881,719
2006	17296	2.10	3,556,995
2007	2542	0.32	3,890,534
2008	2830	0.18	1,100,067
2009	4537	0.26	1,152,043
2010	1,596	0.63	1,144,860
2011	827	0.29	332,012
2012	2,674	0.59	162,051
2013	6,075	3.88	1,196,387
median	2,542	0.95	412,507

[a] Population estimates include adults taken into the hatchery and were based on ladder counts at RBDD until 2001, after which the methodology changed to carcass surveys (CDFG 2012).

[b] Assumes all adults return after three years. NMFS calculated a CRR using the adult spawning population, divided by the spawning population three years prior. Two year old returns were not used.

[c] JPE estimates include survival estimates from the spawning gravel to the point where they enter the Delta (Sacramento I St Bridge), but does not include through-Delta survival.

3. Spatial Structure

The distribution of winter-run spawning and initial rearing historically was limited to the upper Sacramento River (upstream of Shasta Dam), McCloud River, Pitt River, and Battle Creek, where springs provided cold water throughout the summer, allowing for spawning, egg incubation, and rearing during the mid-summer period (Slater 1963 *op. cit.* Yoshiyama et al. 1998). The construction of Shasta Dam in 1943 blocked access to all of these waters except Battle Creek, which currently has its own impediments to upstream migration (*i.e.*, a number of small hydroelectric dams situated upstream of the Coleman Fish Hatchery weir). The Battle Creek Salmon and Steelhead Restoration Project (BCSSRP) is currently removing these impediments, which should restore spawning and rearing habitat for winter-run in the future. Approximately 299 miles of former tributary spawning habitat upstream of Shasta Dam is inaccessible to winter-run. Yoshiyama *et al.* (2001) estimated that in 1938, the upper Sacramento River had a "potential spawning capacity" of approximately 14,000 redds equal to 28,000 spawners. Since 2001, the majority of winter-run redds have occurred in the first 10 miles downstream of Keswick Dam. Most components of the winter-run life history (*e.g.*, spawning, incubation, freshwater rearing) have been compromised by the construction of Shasta Dam.

The greatest risk factor for winter-run lies within its spatial structure (NMFS 2011). The remnant and remaining population cannot access 95% of their historical spawning habitat, and must therefore be artificially maintained in the Sacramento River by: (1) spawning gravel augmentation, (2) hatchery supplementation, and, (3) regulating the finite cold-water pool behind Shasta Dam to reduce water temperatures. Winter-run require cold water temperatures in the summer that simulate their upper basin habitat, and they are more likely to be exposed to the impacts of drought in a lower basin environment. Battle Creek is currently the most feasible opportunity for the ESU to expand its spatial structure, but restoration is not scheduled to be completed until 2017 (BCSSRP). The draft CV Salmon and Steelhead Recovery Plan includes criteria for recovering the winter-run Chinook salmon ESU, including re-establishing a population into historical habitats upstream of Shasta Dam (NMFS 2009b). Additionally, NMFS (2009a) included a requirement for a pilot fish passage program upstream of Shasta Dam.

4. Diversity

The current winter-run population is the result of the introgression of several stocks (*e.g.*, spring-run and fall-run Chinook) that occurred when Shasta Dam blocked access to the upper watershed. A second genetic bottleneck occurred with the construction of Keswick Dam which blocked access and did not allow spatial separation of the different runs (Good *et al.* 2005). Lindley *et al.* (2007) recommended reclassifying the winter-run population extinction risk from low to moderate, if the proportion of hatchery origin fish from the LSNFH exceeded 15 percent due to the impacts of hatchery fish over multiple generations of spawners. Since 2005, the percentage of hatchery winter-run recovered in the Sacramento River has only been above 15 percent in two years, 2005 and 2012 (Figure 5).

Concern over genetic introgression within the winter-run population led to a conservation program at LSNFH that encompasses best management practices such as: (1) genetic confirmation of each adult prior to spawning, (2) a limited number of spawners based on the effective population size, and (3) use of only natural-origin spawners since 2009. These practices reduce the risk of hatchery impacts on the wild population. Hatchery-origin winter-run have made up more than 5 percent of the natural spawning run in recent years and in 2012, it exceeded 30 percent of the natural run (Figure 5). However, the average over the last 16 years (approximately 5 generations) has been 8 percent, still below the low-risk threshold (15%) used for hatchery influence (Lindley *et al.* 2007).

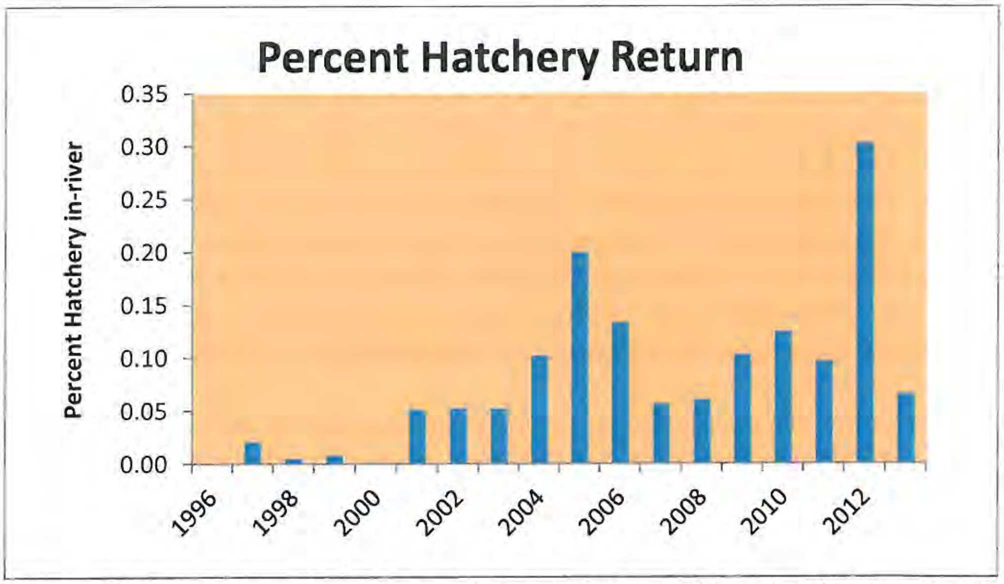


Figure 5. Percentage of hatchery-origin winter-run Chinook salmon naturally spawning in the Sacramento River (1996–2013). Source: CDFW carcass surveys, 2013.

Summary of Sacramento River Winter-run Chinook Salomon ESU Viability

There are several criteria (only one is required) that would qualify the winter-run ESU at moderate risk of extinction, and since there is still only one population that spawns downstream of Keswick Dam, that population would be at high risk of extinction in the long-term according the criteria in Lindley *et al.* (2007). Recent trends in those criteria are: (1) continued low abundance (Figure 3) ; (2) a negative growth rate over 6 years (2006–2012), which is two complete generations (Figure 4); (3) a significant rate of decline since 2006; and (4) increased risk of catastrophe from oil spills, wild fires, or extended drought (climate change). The most recent 5-year status review (NMFS 2011) on winter-run concluded that the ESU had increased to a high risk of extinction. In summary, the most recent biological information suggests that the extinction risk for the winter-run ESU has increased from moderate risk to high risk of extinction since 2005 (last review), and that several listing factors have contributed to the recent decline, including drought and poor ocean conditions (NMFS 2011).

Critical Habitat: Essential Features for Sacramento River Winter-run Chinook Salmon

NMFS designated critical habitat for winter-run Chinook salmon on June 16, 1993 (58 FR 33212). Critical habitat was delineated as the Sacramento River from Keswick Dam at river mile (RM) 302 to Chipps Island, RM 0, at the westward margin of the Sacramento-San Joaquin Delta (Delta), including Kimball Island, Winter Island, and Brown's Island; 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. In the Sacramento River, critical habitat includes the river water, river bottom, and the adjacent riparian zone.

Critical habitat for winter-run is defined as specific areas (listed below) that contain the physical and biological features considered essential to the conservation of the species. This designation includes the river water, river bottom (including those areas and associated gravel used by winter-run as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing (June 16, 1993, 58 FR 33212). NMFS limits "adjacent riparian zones" to only those areas above a stream bank that provide cover and shade to the near shore aquatic areas. Although the bypasses (*e.g.,* Yolo, Sutter, and Colusa) are not currently designated critical habitat for winter-run, NMFS recognizes that they may be utilized when inundated with Sacramento River flood flows and are important rearing habitats for juvenile winter-run. Also, juvenile winter-run may use tributaries of the Sacramento River for non-natal rearing. Critical habitat also includes the estuarine water column and essential foraging habitat and food resources used by winter-run as part of their juvenile outmigration or adult spawning migration.

The following is the status of the physical and biological habitat features that are considered to be essential for the conservation of winter-run (June 16, 1993, 58 FR 33212):

1. <u>Access from the Pacific Ocean to Appropriate Spawning Areas</u>

Adult migration corridors should provide satisfactory water quality, water quantity, water temperature, water velocity, cover, shelter and safe passage conditions in order for adults to reach spawning areas. Adult winter-run generally migrate to spawning areas during the winter and spring. At that time of year, the migration route is accessible to the appropriate spawning grounds on the upper 60 miles of the Sacramento River, however much of this migratory habitat is degraded and they must pass through a fish ladder at the Anderson-Cottonwood Irrigation Dam (ACID). In addition, the many flood bypasses are known to strand adults in agricultural drains due to inadequate screening (Vincik and Johnson 2013). Since the primary migration corridors are essential for connecting early rearing habitat with the ocean, even the degraded reaches are considered to have a high intrinsic conservation value to the species.

2. <u>The Availability of Clean Gravel for Spawning Substrate</u>

Suitable spawning habitat for winter-run exists in the upper 60 miles of the Sacramento River between Keswick Dam and Red Bluff Diversion Dam (RBDD). However, the majority of spawning habitat currently being used occurs in the first 10 miles downstream of Keswick Dam.

The available spawning habit is completely outside the historical range utilized by winter-run upstream of Keswick Dam. Because Shasta and Keswick dams block gravel recruitment, the U.S. Bureau of Reclamation (Reclamation) annually injects spawning gravel into various areas of the upper Sacramento River. With the supplemented gravel injections, the upper Sacramento River reach continues to support a small naturally-spawning winter-run Chinook salmon population. Even in degraded reaches, spawning habitat has a high conservation value as its function directly affects the spawning success and reproductive potential of listed salmonids.

3. Adequate River Flows for Successful Spawning, Incubation of Eggs, Fry Development and Emergence, and Downstream Transport of Juveniles

An April 5, 1960, Memorandum of Agreement between Reclamation and the CDFW originally established flow objectives in the Sacramento River for the protection and preservation of fish and wildlife resources. In addition, Reclamation complies with the 1990 flow releases required in State Water Resource Control Board (SWRCB) Water Rights Order (WRO) 90-05 for the protection of Chinook salmon. This order includes a minimum flow release of 3,250 cubic feet per second (cfs) from Keswick Dam downstream to RBDD from September through February during all water year types, except critically dry.

4. Water Temperatures at 5.8–14.1°C (42.5–57.5°F) for Successful Spawning, Egg Incubation, and Fry Development

Summer flow releases from Shasta Reservoir for agriculture and other consumptive uses drive operations of Shasta and Keswick dam water releases during the period of winter-run migration, spawning, egg incubation, fry development, and emergence. This pattern, the opposite of the pre-dam hydrograph, benefits winter-run by providing cold water for miles downstream during the hottest part of the year. The extent to which winter-run habitat needs are met depends on Reclamation's other operational commitments, including those to water contractors, Delta requirements pursuant to State Water Rights Decision 1641 (D-1641), and Shasta Reservoir end of September storage levels required in the NMFS 2009 biological opinion on the long-term operations of the CV Project and State Water Project (CVP/SWP, NMFS 2009a). WRO 90-05 and 91-1 require Reclamation to operate Shasta, Keswick, and Spring Creek Powerhouse to meet a daily average water temperature of 13.3°C (56°F) at RBDD. They also provide the exception that the water temperature compliance point (TCP) may be modified when the objective cannot be met at RBDD. Based on these requirements, Reclamation models monthly forecasts and determines how far downstream 13.3°C (56°F) can be maintained throughout the winter-run spawning, egg incubation, and fry development stages.

In every year since WRO 90-05 and 91-1were issued, operation plans have included modifying the TCP to make the best use of the cold water available based on water temperature modeling and current spawning distribution. Once a TCP has been identified and established in May, it generally does not change, and therefore, water temperatures are typically adequate through the summer for successful winter-run egg incubation and fry development for those redds constructed upstream of the TCP (except for in some critically dry and drought years). However, by continually moving the TCP upstream, the value of that habitat is degraded by reducing the spawning area in size and imprinting upon the next generation to return further upstream.

5. Habitat and Adequate Prey Free of Contaminants

Water quality conditions have improved since the 1980s due to stricter standards and Environmental Protection Agency (EPA) Superfund site cleanups (see Iron Mountain Mine remediation under Factors). No longer are there fish kills in the Sacramento River caused by the heavy metals (*e.g.*, lead, zinc and copper) found in the Spring Creek runoff. However, legacy contaminants such as mercury (and methyl mercury), polychlorinated biphenyls (PCB), heavy metals and persistent organochlorine pesticides continue to be found in watersheds throughout the CV. In 2010, the EPA, listed the Sacramento River as impaired under the Clean Water Act, section 303(d), due to high levels of pesticides, herbicides, and heavy metals (http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/category5_report.shtml). Although most of these contaminants are at low concentrations in the food chain, they continue to work their way into the base of the food web, particularly when sediments are disturbed and previously entombed compounds are released into the water column.

Adequate prey for juvenile salmon to survive and grow consists of abundant aquatic and terrestrial invertebrates that make up the majority of their diet before entering the ocean. Exposure to these contaminated food sources such as invertebrates may create delayed sublethal effects that reduce fitness and survival (Laetz *et al.* 2009). Contaminants are typically associated with areas of urban development, agriculture, or other anthropogenic activities (*e.g.*, mercury contamination as a result of gold mining or processing). Areas with low human impacts frequently have low contaminant burdens, and therefore lower levels of potentially harmful toxicants in the aquatic system. Freshwater rearing habitat has a high intrinsic conservation value even if the current conditions are significantly degraded from their natural state.

6. Riparian and Floodplain Habitat that Provides for Successful Juvenile Development and Survival

The channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento River system typically have low habitat complexity, low abundance of food organisms, and offer little protection from predators. Juvenile life stages of salmonids are dependent on the natural functioning of this habitat for successful survival and recruitment. Ideal habitat contains natural cover, such as riparian canopy structure, submerged and overhanging large woody material (LWM), aquatic vegetation, large rocks and boulders, side channels, and undercut banks which augment juvenile and adult mobility, survival, and food supply. Riparian recruitment is prevented from becoming established due to the reversed hydrology (*i.e.*, high summer time flows and low winter flows prevent tree seedlings from establishing). However, there are some complex, productive habitats within historical floodplains [*e.g.*, Sacramento River reaches with setback levees (*i.e.*, primarily located upstream of the City of Colusa)] and flood bypasses (*i.e.*, fish in Yolo and Sutter bypasses experience rapid growth and higher survival due to abundant food resources) seasonally available that remain in the system. Nevertheless, the current condition of degraded riparian habitat along the mainstem Sacramento River restricts juvenile growth and survival (Michel 2010, Michel *et al.* 2012).

7. Access Downstream so that Juveniles Can Migrate from the Spawning Grounds to San Francisco Bay and the Pacific Ocean

Freshwater emigration corridors should be free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. Migratory corridors are downstream of the Keswick Dam spawning areas and include the mainstem of the Sacramento River to the Delta, as well as non-natal rearing areas near the confluence of some tributary streams.

Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. Unscreened diversions that entrain juvenile salmonids are prevalent throughout the mainstem Sacramento River and in the Delta. Predators such as striped bass (*Morone saxatilis*) and Sacramento pikeminnow (*Ptychocheilus grandis*) tend to concentrate immediately downstream of diversions, resulting in increased mortality of juvenile Chinook salmon.

Water pumping at the CVP/SWP export facilities in the South Delta at times causes the flow in the river to move back upstream (reverse flow), further disrupting the emigration of juvenile winter-run by attracting and diverting them to the interior Delta, where they are exposed to increased rates of predation, other stressors in the Delta, and entrainment at pumping stations. NMFS' biological opinion on the long-term operations of the CVP/SWP (NMFS 2009a) sets limits to the strength of reverse flows in the Old and Middle Rivers, thereby keeping salmon away from areas of highest mortality. Regardless of the condition, the remaining estuarine areas are of high conservation value because they provide factors which function to as rearing habitat and as an area of transition to the ocean environment.

2.2.2 Central Valley Spring-run Chinook salmon

In August 2011, NMFS completed an updated status review of five Pacific Salmon ESUs, including CV spring-run Chinook salmon, and concluded that the species' status should remain as previously listed (76 FR 50447). The 2011 Status Review (NMFS 2011b) additionally stated that although the listings will remain unchanged since the 2005 review, and the original 1999 listing (64 FR 50394), the status of these populations have worsened over the past five years and recommended that the status be reassessed in two to three years as opposed to waiting another five years.

CV spring-run Chinook salmon were listed as threatened on September 16, 1999, (64 FR 50394). This ESU consists of spring-run Chinook salmon occurring in the Sacramento River basin. The Feather River Fish Hatchery (FRFH) spring-run Chinook salmon population has been included as part of the CV spring-run Chinook salmon ESU in the most recent modification of the CV spring-run Chinook salmon listing status (70 FR 37160). Critical habitat was designated for CV spring-run Chinook salmon on September 2, 2005, (70 FR 52488), and includes the action area for the Proposed Action. It includes stream reaches of the Feather and Yuba rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the main stem of the Sacramento River from Keswick Dam through the Delta; and portions of the network of channels in the northern Delta.

Historically spring-run Chinook salmon were the second most abundant salmon run in the CV and one of the largest on the west coast (CDFG 1990, 1998). These fish occupied the upper and middle reaches (1,000 to 6,000 feet elevation) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1874, Rutter 1904, Clark 1929). The CV Technical Review Team (TRT) estimated that historically there were 18 or 19 independent populations of CV spring-run Chinook salmon, along with a number of dependent populations, all within four distinct geographic regions (diversity groups) (Lindley *et al.* 2004). Of these 18 populations, only 3 extant populations currently exist (Mill, Deer, and Butte creeks on the upper Sacramento River) and they represent only the northern Sierra Nevada diversity group. All populations in the basalt and porous lava diversity group and the southern Sierra Nevada diversity group have been extirpated. The northwestern California diversity group did not historically contain independent populations, and currently contains two or three populations that are likely dependent on the northern Sierra Nevada diversity group populations for their continued existence.

Construction of low elevation dams in the foothills of the Sierras on the Mokelumne, Stanislaus, Tuolumne, and Merced rivers, was thought to have extirpated CV spring-run Chinook salmon from these watersheds of the San Joaquin River, as well as on the American and Yuba rivers of the Sacramento River basin. However, observations in the last decade suggest that perhaps a naturally occurring population may still persist in the Stanislaus and Tuolumne rivers (Franks, personal communication, 2012), as well as in the Yuba River. Documented naturally-spawning populations of CV spring-run Chinook salmon are currently restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and the Yuba River (CDFG 1998).

Life History

Adult CV spring-run Chinook salmon leave the ocean to begin their upstream migration in late January and early February (CDFG 1998) and enter the Sacramento River beginning in March (Yoshiyama 1998). Spring-run Chinook salmon move into tributaries of the Sacramento River (*e.g.* Butte, Mill, Deer creeks) beginning as early as February in Butte Creek and typically mid-March in Mill and Deer creeks (Lindley *et al.* 2004). Adult migration peaks around mid-April in Butte Creek, and mid-to end of May in Mill and Deer creeks, and is complete by the end of July in all three tributaries (Lindley *et al.* 2004) (Table 7). Typically, spring-run Chinook salmon utilize mid- to high-elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering while conserving energy and allowing their gonadal tissue to mature (Yoshiyama *et al.* 1998).

Spring-run Chinook salmon spawning occurs between September and October (Moyle 2002). Between 56 and 87 percent of adult spring-run Chinook salmon that enter the Sacramento River basin to spawn are 3 years old (Calkins *et al.* 1940, Fisher 1994).

Spring-run Chinook salmon fry emerge from the gravel from November to March (Moyle 2002) and the emigration timing is highly variable, as they may migrate downstream as young-of-the-year or as juveniles or yearlings. The model size of fry migrants at approximately 40 millimeters (mm) between December and April in Mill, Butte, and Deer creeks reflects a prolonged emergence of fry from the gravel (Lindley *et al.* 2004). Studies in Butte Creek, (Ward *et al.* 2003, McReynolds *et al.* 2007) found the majority of CV spring-run Chinook salmon migrants to be fry, which occurred primarily during December, January, and February; and that these movements appeared to be influenced by increased flow. Small numbers of CV spring-run Chinook salmon were observed to remain in Butte Creek to rear and migrated as yearlings later in the spring. Juvenile emigration patterns in Mill and Deer creeks are very similar to patterns observed in Butte Creek, with the exception that Mill and Deer creek juveniles typically exhibit a later young-of-the-year migration and an earlier yearling migration (Lindley *et al.* 2004). CDFW (CDFG 1998) observed the emigration period for spring-run Chinook salmon extending from November to early May, with up to 69 percent of the young-of-the-year fish outmigrating through the lower Sacramento River and Delta during this period. Peak movement of juvenile CV spring-run Chinook salmon in the Sacramento River at Knights Landing occurs in December, and again in March and April. However, juveniles also are observed between November and the end of May (Snider and Titus 2000).

Once juveniles emerge from the gravel they initially seek areas of shallow water and low velocities while they finish absorbing the yolk sac and transition to exogenous feeding (Moyle 2002). Many also would disperse downstream during high-flow events. As is the case in other salmonids, there is a shift in microhabitat use by juveniles to deeper faster water as they grow larger. Microhabitat use can be influenced by the presence of predators which can force fish to select areas of heavy cover and suppress foraging in open areas (Moyle 2002).

Table 7. The temporal occurrence of adult (a) and juvenile (b) CV spring-run Chinook salmon in the Sacramento River. Darker shades indicate months of greatest relative abundance.

(a) Adult migration												
Location	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Sac.River basin[a,b]			Medium	Medium	High	High	Medium	Medium	Medium	Low		
Sac. River mainstem[c]	–/Low	Low	Medium	Medium	Medium	Medium	Medium	Low				
Mill Creek[d]			Low	Medium/High	High	High/Medium	Medium/Low	Low/–				
Deer Creek[d]			Low	Medium/High	High	High/Medium	Medium/–					
Butte Creek[d]		Medium	Medium	Medium/High	High	High/Medium	Low/–					
(b) Adult Holding		Medium	Medium	Medium/High	High	High	High	High	High/Medium	Medium/Low		
(c) Adult Spawning								Low/Medium	High	Medium/Low		
(d) Juvenile migration												
Location	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Sac. River Tribs[e]	Medium	Medium	Medium							Medium	High	High
Upper Butte Creek[f]	High	High	Medium	Medium	Medium	Low				Low	Low	High
Mill, Deer, Butte Creeks[d]	High	High	Medium	Medium	Medium	Low/–				Low	Low	Low
Sac. River at RBDD[c]	High	Low	Low	Low	Low/–						High	High
Sac. River at KL[g]	Medium	Medium	High	High	Medium						Medium	High

Relative Abundance: = High; = Medium; = Low

Note: Yearling spring-run Chinook salmon rear in their natal streams through the first summer following their birth. Downstream emigration generally occurs the following fall and winter. Most young of the year spring-run Chinook salmon emigrate during the first spring after they hatch.

Sources: [a]Yoshiyama *et al.* (1998); [b]Moyle (2002); [c]Myers *et al.* (1998); [d]Lindley *et al.* (2004); [e]CDFG (1998); [f]McReynolds *et al.* (2007); Ward *et al.* (2003); [g]Snider and Titus (2000)

Description of VSP Parameters

Like the winter-run Chinook salmon population, the CV spring-run Chinook salmon population fails to meet the "representation and redundancy rule" since there are only one demonstrably viable populations in one diversity group (northern Sierra Nevada) out of the three diversity groups that historically contained them. Over the long term, these remaining populations are considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of the spring-run Chinook salmon populations in these three watersheds due to their close proximity to each other.

1. Abundance

The CV drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). The San Joaquin River historically supported large runs of spring-run Chinook salmon, suggested to be one of the largest runs of any Chinook salmon on the West Coast with estimates averaging 200,000 – 500,000 adults returning annually (CDFG 1990). Construction of Friant Dam began in 1939 and was completed in 1942, which blocked access to upstream habitat.

The FRFH spring-run Chinook salmon population has been included in the ESU based on its genetic linkage to the natural population and the potential development of a conservation strategy for the hatchery program. On the Feather River, significant numbers of spring-run Chinook salmon, as identified by run timing, return to the FRFH. Since 1954, spawning escapement has been estimated using combinations of in-river estimates and hatchery counts, with estimates ranging from 2,908 in 1964 to 2 fish in 1978 (DWR 2001). Spring-run estimates after 1981 have been based solely on salmon entering the hatchery during the month of September. The 5-year moving averages from 1997 to 2006 had been more than 4,000 fish, but from 2007 to 2011, the 5-year moving averages have declined each year to a low of 1,783 fish in 2011 (CDFG 2012). However, coded wire tag (CWT) information from these hatchery returns has indicated that fall-run and spring-run Chinook salmon have overlap (DWR 2001). In addition, genetic testing has indicated substantial introgression has occurred between fall-run and spring-run Chinook salmon populations within the Feather River system due to temporal overlap and hatchery practices (DWR 2001). Because Chinook salmon have not always been spatially separated in the FRFH, spring-run and fall-run Chinook salmon have been spawned together, thus compromising the genetic integrity of the spring-run Chinook salmon stock (Good *et al.* 2005; DWR draft Hatchery Genetic Management Plan 2010). For the reasons discussed above, the Feather River spring-run Chinook salmon population numbers are not included in the following discussion of ESU abundance.

In addition, monitoring of the Sacramento River mainstem during spring-run Chinook salmon spawning timing indicates some spawning occurs in the river. Here, the lack of physical separation of spring-run Chinook salmon from fall-run Chinook salmon is complicated by overlapping migration and spawning periods. Significant hybridization with fall-run Chinook salmon has made identification of spring-run Chinook salmon in the mainstem very difficult to determine, and there is speculation as to whether a true spring-run Chinook salmon population still exists downstream of Keswick Dam. Although the physical habitat conditions downstream of Keswick Dam are capable of supporting spring-run Chinook salmon, higher than normal water temperatures in some years have led to substantial levels of egg mortality. Less than 15 redds per year were observed in the Sacramento River from 1989 to 1993, during September aerial redd counts (USFWS 2003). Redd surveys conducted in September between 2001 and 2011 have observed an average of 36 salmon redds from Keswick Dam downstream to the RBDD, ranging from three to 105 redds (CDFG, unpublished data, 2011). Therefore, even though physical habitat conditions may be suitable for spawning and incubation, spring-run Chinook salmon depend on spatial segregation and geographic isolation from fall-run Chinook salmon to maintain genetic diversity. With the onset of fall-run Chinook salmon spawning occurring in the same time and place as potential spring-run Chinook salmon spawning, it is likely to have caused extensive introgression between the populations (CDFG 1998). For these reasons, Sacramento River mainstem spring-run Chinook salmon are not included in the following discussion of ESU abundance trends.

Sacramento River tributary populations in Mill, Deer, and Butte creeks are likely the best trend indicators for the CV spring-run Chinook salmon ESU as a whole because these streams contain the primary independent populations within the ESU. Generally, these streams have shown a positive escapement trend since 1991, displaying broad fluctuations in adult abundance, ranging from 1,013 in 1993 to 23,788 in 1998. Tributary numbers during 2005 to 2011 showed a downturn; however, 2012 and 2013 showed an increase to 10,810 and 18,499 fish, respectively. Escapement numbers for 2013 increased in most tributary populations, which resulted in the second highest number of spring-run Chinook salmon returning to the tributaries since 1960. Escapement numbers are dominated by Butte Creek returns, which have averaged over 7,000 fish from 1995 to 2005. During this same period, adult returns on Mill and Deer creeks have averaged 780 fish, and 1,464 fish respectively. From 2001 to 2005, the CV spring-run Chinook salmon ESU has experienced a trend of increasing abundance in some natural populations, most dramatically in the Butte Creek population (Good *et al.* 2005). Although trends were generally positive during this time, annual abundance estimates display a high level of fluctuation, and the overall number of CV spring-run Chinook salmon remains well below estimates of historic abundance.

In 2002 and 2003, mean water temperatures in Butte Creek exceeded 21°C for 10 or more days in July (Williams 2006). These persistent high water temperatures, coupled with high fish densities, precipitated an outbreak of Columnaris Disease (*Flexibacter columnaris*) and Ichthyophthiriasis (*Ichthyophthirius multifiis*) in the adult spring-run Chinook salmon over-summering in Butte Creek. In 2002, this contributed to the pre-spawning mortality of approximately 20 to 30 percent of the adults. In 2003, approximately 65 percent of the adults succumbed, resulting in a loss of an estimated 11,231 adult spring-run Chinook salmon in Butte Creek due to the disease. Since 2005, abundance numbers in most of the tributaries have declined. From 2006 to 2009, adult returns indicate that population abundance is declining from the peaks seen in the 5 years prior for the entire Sacramento River basin.

For Mill Creek the 2009, return of 220 spring-run Chinook salmon was the lowest return since 1997. Assuming the 2012, spring-run Chinook salmon return was primarily of three year old fish, then those 768 Chinook salmon represent a significant increase over the 2009, parent year. The 2013 estimate was 644, which was an increase from 2010 estimate of 482. The Mill Creek population of spring-run Chinook salmon is currently at a moderate risk of extinction, due to the significant decline in abundance from prior to 2008 through 2011. However, with the increase in abundance in 2012 and 2013, this trend may be improving. The Deer Creek abundance of spring-run Chinook salmon experienced a significant decline starting in 2008, with an increase in 2012 and 2013.

The abundance of spring-run Chinook salmon in Clear Creek was lower in 2010, 2011, and from 2005 through 2011, abundance numbers in most of the tributaries declined. Adult returns from 2006 to 2009, indicate that population abundance for the entire Sacramento River basin was declining from the peaks seen in the five years prior to 2006. Declines in abundance from 2005 to 2011, placed the Mill Creek and Deer Creek populations in the high extinction risk category due to the rates of decline, and in the case of Deer Creek, also the level of escapement (NMFS 2011). Butte Creek had sufficient abundance to retain its low extinction risk classification, but the rate of population decline in years 2006 through 2011 was nearly sufficient to classify it as a high extinction risk based on this criteria. Nonetheless, the watersheds identified as having the highest likelihood of success for achieving viability/low risk of extinction include, Butte, Deer and Mill creeks (NMFS 2011). Some other tributaries to the Sacramento River, such as Clear Creek and Battle Creek have seen population gains in the years from 2001 to 2009, but the overall abundance numbers have remained low. Year 2012 appeared to be a good return year for most of the tributaries with some, such as Battle Creek, having the highest return on record (799). Additionally, 2013 adult escapement numbers combined for Butte, Mill and Deer creeks increased (over 17,000), which resulted in the second highest number of spring-run Chinook salmon returning to the tributaries since 1998. 2014 adult escapement was lower than 2013 to be lower, with an adult escapement of just over 5,000 fish, which indicates a highly fluctuating and unstable ESU.

1. Productivity

The 5-year geometric mean for the extant Butte, Deer, and Mill creek spring-run Chinook salmon populations ranged from 491 to 4,513 fish, indicating increasing productivity over the short-term and was projected to likely continue into the future (Good *et al.* 2005). However, as mentioned in the previous paragraph, the next five years of adult escapement to these tributaries has seen a cumulative decline in fish numbers and the CRR has declined in concert with the population declines. The productivity of the Feather River and Yuba River populations and contribution to the CV spring-run ESU currently is unknown.

2. Spatial Structure

With only one of four diversity groups currently containing viable populations, the spatial structure of CV spring-run Chinook salmon is severely reduced. Butte Creek spring-run Chinook salmon cohorts have recently utilized all currently available habitat in the creek; and it is unknown if individuals have opportunistically migrated to other systems. The persistent populations in Clear Creek and Battle Creek, with habitat restoration completed and underway are anticipated to add to the spatial structure of the CV spring-run Chinook salmon ESU if they can reach viable status in the basalt and porous lava and northwestern California diversity group areas. The spatial structure of the spring-run Chinook salmon ESU would still be lacking with the extirpation of all San Joaquin River basin spring-run Chinook salmon populations. Plans are underway to re-establish a spring-run Chinook salmon experimental population downstream of Friant Dam in the San Joaquin River, as part of the San Joaquin River Settlement Agreement. This would be done with Feather River Hatchery stock. Interim flows for this began in 2009.. Its long-term contribution to the CV spring-run Chinook salmon ESU is uncertain. It is clear that further efforts would need to involve more than restoration of currently accessible watersheds to make the ESU viable. The draft CV Recovery Plan calls for reestablishing populations into historical habitats currently blocked by large dams, such as a population upstream of Shasta Dam. It also calls to facilitate passage of fish upstream and downstream of Englebright Dam on the Yuba River (NMFS 2009b).

3. Diversity

The CV spring-run Chinook salmon ESU is comprised of two genetic complexes. Analysis of natural and hatchery spring-run Chinook salmon stocks in the CV indicates that the northern Sierra Nevada diversity group spring-run Chinook salmon populations in Mill, Deer, and Butte creeks retains genetic integrity as opposed to the genetic integrity of the Feather River population, which has been somewhat compromised. The Feather River spring-run Chinook salmon have introgressed with the fall-run Chinook salmon, and it appears that the Yuba River population may have been impacted by FRFH fish straying into the Yuba River. Additionally, the diversity of the spring-run Chinook salmon ESU has been further reduced with the loss of the majority, if not all, of the San Joaquin River basin spring-run Chinook salmon populations. Efforts underway, like the San Joaquin Restoration Project, are needed to improve the diversity of the CV spring-run Chinook salmon ESU.

Summary of CV Spring-run Chinook salmon DPS Viability

Lindley et al. (2007) indicated that the spring-run Chinook salmon populations in the CV had a low risk of extinction in Butte and Deer creeks, according to their population viability analysis (PVA) model and other population viability criteria (i.e., population size, population decline, catastrophic events, and hatchery influence, which correlate with VSP parameters abundance, productivity, spatial structure, and diversity). The Mill Creek population of spring-run Chinook salmon was at moderate extinction risk according to the PVA model, but appeared to satisfy the other viability criteria for low-risk status. However, the CV spring-run Chinook salmon population failed to meet the "representation and redundancy rule" since there are only demonstrably viable populations in one diversity group (northern Sierra Nevada) out of the three diversity groups that historically contained them. Over the long term, these remaining populations are considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of the spring-run Chinook salmon populations in these three watersheds due to their close proximity to each other. One large event could eliminate all three populations.

In the 2011 California CV status review for spring-run Chinook salmon, NMFS identified the status of CV spring-run Chinook salmon ESU as having probably deteriorated since the 2005 status review and Lindley et al.'s (2007) assessment, with two of the three extant independent populations (Deer and Mill creeks) of spring-run Chinook salmon slipping from low or moderate extinction risk to high extinction risk. Since the abundance of some populations is improving, though this is based on only two years (2012 and 2013), the extinction risk of Sacramento tributary populations generally has improved from high to moderate.

Critical Habitat and Primary Constituent Elements for CV Spring-Run Chinook Salmon

Critical habitat was designated for CV spring-run Chinook salmon on 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 line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation (defined as the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a recurrence interval of one to two years on the annual flood series) (Bain and Stevenson 1999; 70 FR 52488). Critical habitat for CV spring-run Chinook salmon is defined as specific areas that contain the primary constituent elements (PCEs) essential to the conservation of the species. Following are the inland habitat types used as PCEs for CV spring-run Chinook salmon.

1. Spawning Habitat

Freshwater spawning sites are those with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. Most spawning habitat in the CV for Chinook salmon is located in areas directly downstream of dams containing suitable environmental conditions for spawning and incubation. Spawning habitat for CV spring-run Chinook salmon occurs on the mainstem Sacramento River between RBDD and Keswick Dam and in tributaries such as Mill, Deer, and Butte creeks; as well as the Feather and Yuba rivers, Big Chico, Battle, Antelope, and Clear creeks. However, little spawning activity has been recorded in recent years on the Sacramento River mainstem for spring-run Chinook salmon. Even in degraded reaches, spawning habitat has a high conservation value as its function directly affects the spawning success and reproductive potential of listed salmonids.

2. Freshwater Rearing Habitat

Freshwater rearing sites are those with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile salmonid development; and natural cover such as shade, submerged and overhanging large woody material, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and the presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system (*e.g.*, the lower Cosumnes River, Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]) and flood bypasses (*i.e.*, Yolo and Sutter bypasses). However, the channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from piscivorous fish and birds. Freshwater rearing habitat also has a high intrinsic conservation value even if the current conditions are significantly degraded from their natural state. Juvenile life stages of salmonids are dependent on the function of this habitat for successful survival and recruitment.

3. Freshwater Migration Corridors

Ideal freshwater migration corridors are free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. They contain natural cover such as riparian canopy structure, submerged and overhanging large woody objects, aquatic vegetation, large rocks, and boulders, side channels, and undercut banks which augment juvenile and adult mobility, survival, and food supply. Migratory corridors are downstream of the spawning areas and include the lower mainstems of the Sacramento and San Joaquin rivers and the Delta. These corridors allow the upstream passage of adults, and the downstream emigration of juveniles. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. For adults, upstream passage through the Delta and much of the Sacramento River is not a problem, yet a number of challenges exist on many tributary streams. For juveniles, unscreened or inadequately screened water diversions throughout their migration corridors and a scarcity of complex in-river cover have degraded this PCE. However, since the primary migration corridors are used by numerous populations, and are essential for connecting early rearing habitat with the ocean, even the degraded reaches are considered to have a high intrinsic conservation value to the species.

4. Estuarine Areas

Estuarine areas free of migratory obstructions with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water are included as a PCE. Natural cover such as submerged and overhanging large woody material, aquatic vegetation, and side channels, are suitable for juvenile and adult foraging.

The remaining estuarine habitat for these species is severely degraded by altered hydrologic regimes, poor water quality, reductions in habitat complexity, and competition for food and space with exotic species. Regardless of the condition, the remaining estuarine areas are of high conservation value because they provide factors which function to provide predator avoidance, as rearing habitat and as an area of transition to the ocean environment.

2.2.3 California Central Valley steelhead

CCV steelhead were listed as threatened on March 19, 1998, (63 FR 13347). Following a new status review (Good *et al.* 2005) and after application of the agency's hatchery listing policy, the NMFS reaffirmed its status as threatened and also listed several hatchery stocks as part of the DPS in 2006 (71 FR 834). In June 2004, after a complete status review of 27 west coast salmonid ESUs, the NMFS proposed that CCV steelhead remain listed as threatened (69 FR 33102). On January 5, 2006, NMFS reaffirmed the threatened status of the CCV steelhead and applied the DPS policy to the listed steelhead ESUs because the resident and anadromous life forms of *O.*

mykiss remain "markedly separated" as a consequence of physical, ecological and behavioral factors, and therefore warranted delineation as a separate DPS (71 FR 834). On August 15, 2011, the NMFS completed another 5-year status review of CCV steelhead and recommended that the CCV steelhead DPS remain classified as a threatened species (NMFS 2011a).

Critical habitat was designated for CCV steelhead on September 2, 2005, (70 FR 52488). Critical habitat includes the stream channels to the ordinary high water line within designated stream reaches such as those of the American, Feather, and Yuba rivers, and Deer, Mill, Battle, Antelope, and Clear creeks in the Sacramento River basin; the Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers in the San Joaquin River basin; and the Sacramento and San Joaquin rivers and Delta. Currently the CCV steelhead DPS and its designated critical habitat extends up the San Joaquin River upstream to the confluence with the Merced River.

Life History

1. Migratory Forms Present in CV

Steelhead in the CV historically consisted of both summer-run and winter-run migratory forms, based on their state of sexual maturity at the time of river entry and the duration of their time in freshwater before spawning. Between 1944 and 1947, annual counts of summer-run steelhead passing through the Old Folsom Dam fish ladder during May, June, and July ranged from 400 to 1,246 fish (Gerstung 1971). After 1950, when the fish ladder at Old Folsom Dam was destroyed by flood flows, summer-run steelhead were no longer able to access their historic spawning areas, and either perished in the warm water downstream of Old Folsom Dam or hybridized with winter-run steelhead. Only winter-run (ocean maturing) steelhead currently are found in California CV rivers and streams (Moyle 2002; McEwan and Jackson 1996). Summer-run steelhead have been extirpated due to a lack of access to suitable holding and staging habitat, such as coldwater pools in the headwaters of CV streams, presently located upstream of impassible dams (Lindley *et al.* 2006).

2. Age Structure

Juvenile steelhead (parr) rear in freshwater for one to three years before outmigrating to the ocean as smolts (Moyle 2002). The time that parr spend in freshwater is related to their growth rate, with larger, faster-growing members of a cohort smolting at an earlier age (Peven *et al.* 1994; Seelbach 1993). Hallock *et al.* (1961) aged 100 adult steelhead caught in the Sacramento River upstream of the Feather River confluence in 1954, and found that 70 had smolted at age-2, 29 at age-1, and one at age-3. Seventeen of the adults were repeat spawners, with three fish on their third spawning migration, and one on its fifth. Age at first maturity varies among populations. In the CV, most steelhead return to their natal streams as adults at a total age of two to four years (Hallock 1961, McEwan and Jackson 1996).

3. Egg to Parr Stages

Steelhead eggs hatch in three to four weeks at 10°C to 15°C (Moyle 2002). The length of time it takes for eggs to hatch depends mostly on water temperature. After hatching, alevins remain in the gravel for an additional two to five weeks while absorbing their yolk sacs, and emerge in spring or early summer (Barnhart 1986). Fry emerge from the gravel usually about four to six weeks after hatching, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Upon emergence, fry inhale air at the stream surface to fill their air bladders, absorb the remains of their yolks in the course of a few days, and start to feed actively, often in schools (Barnhart 1986; NMFS 1996).

The newly emerged juveniles move to shallow, protected areas associated within the stream margin (McEwan and Jackson 1996). As steelhead parr increase in size and their swimming abilities improve, they increasingly exhibit a preference for higher velocity and deeper mid-channel areas (Hartman 1965; Everest and Chapman 1972; Fontaine 1988).

4. Preferred Juvenile Habitat

Productive juvenile rearing habitat is characterized by complexity, primarily in the form of cover, which can be deep pools, woody debris, aquatic vegetation, or bolders. Cover is an important habitat component for juvenile steelhead both as velocity refugia and as a means of avoiding predation (Meehan and Bjornn 1991). Optimal water temperatures for growth range from 15°C to 20°C (McCullough *et al.* 2001, Spina 2006).

5. Smolt Migration

Juvenile steelhead will often migrate downstream as parr in the summer or fall of their first year of life (USFWS 2002), but this is not a true smolt migration (Loch *et al.* 1988). Smolt migrations occur in the late winter through spring, when juveniles have undergone a physiological transformation to survive in the ocean, and become slender in shape, bright silvery in coloration, with no visible parr marks. Emigrating steelhead smolts use the lower reaches of the Sacramento River and the Delta primarily as a migration corridor to the ocean. There is little evidence that they rear in the Delta or on floodplains, though there are few behavioral studies of this life-stage in the CV.

6. Ocean Behavior

Unlike Pacific salmon, steelhead do not appear to form schools in the ocean (Behnke 1992). Steelhead in the southern part of their range appear to migrate close to the continental shelf, while more northern populations may migrate throughout the northern Pacific Ocean (Barnhart 1986).

7. Adult Run-Timing and Spawning Habitat

CCV steelhead generally leave the ocean from August through April (Busby *et al.* 1996), enter freshwater from August to November with a peak in September (Hallock 1961), and spawn from December to April, with a peak in January through March, in rivers and streams where cold, well oxygenated water is available (Table 8; Williams 2006; Hallock *et al.* 1961; McEwan and Jackson 1996). Timing of upstream migration is correlated with higher flow events, such as freshets, and the associated change in water temperatures (Workman *et al.* 2002). Adults typically spend a few months in freshwater before spawning (Williams 2006). Female steelhead construct redds in suitable gravel and cobble substrate, primarily in pool tailouts and heads of riffles.

8. Fecundity

The number of eggs laid per female is highly correlated with adult size, though the strain of the fish can also play a role. Adult steelhead size depends on the duration of and growth rate during their ocean residency (Meehan and Bjornn 1991). CCV steelhead generally return to freshwater after one to two years at sea (Hallock *et al.* 1961), and adults typically range in size from two to twelve pounds (Reynolds *et al.* 1993). Steelhead about 55 cm long may have fewer than 2,000 eggs, whereas steelhead 85 cm long can have 5,000 to 10,000 eggs, depending on the stock (Meehan and Bjornn 1991). The average for Coleman National Fish Hatchery (CNFH) since 1999 is about 3,900 eggs per female (USFWS 2011).

9. Iteroparity

Unlike Pacific salmon, steelhead are iteroparous, meaning they are capable of spawning multiple times before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; and repeat spawners tend to be biased towards females (Busby *et al.* 1996). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996). Although one-time spawners are the great majority, Shapolov and Taft (1954) reported that repeat spawners were relatively numerous (17.2 percent) in Waddell Creek. Null *et al.* (2013) found between 36 percent and 48 percent of kelts released from CNFH in 2005 and 2006 survived to spawn the following spring, which is in sharp contrast to what Hallock (1989) reported for CNFH in the 1971 season, where only 1.1 percent of adults were fish that had been tagged the previous year. Most populations have never been studied to determine the percentage of repeat spawners. Hatchery steelhead are typically less likely than wild fish to survive to spawn a second time (Leider *et al.* 1986).

10. Kelts

Post-spawning steelhead (kelts) may migrate downstream to the ocean immediately after spawning, or they may spend several weeks holding in pools before outmigrating (Shapovalov and Taft 1954). Recent studies have shown that kelts may remain in freshwater for an entire year after spawning (Teo *et al.* 2011), but that most return to the ocean (Null *et al.* 2013).

11. Population Dynamics

Historic CCV steelhead run sizes are difficult to estimate given the paucity of data, but may have approached one to two million adults annually (McEwan 2001). By the early 1960s the steelhead run size had declined to about 40,000 adults (McEwan 2001). Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River upstream of the Feather River. Steelhead counts at the RBDD declined from an average of 11,187 for the period from 1967 to 1977, to an average of approximately 2,000 through the early 1990's, with an estimated total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan and Jackson 1996, McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 due to changes in dam operations.

About 80 percent of the historical spawning and rearing habitat once used by anadromous *O. mykiss* in the CV is now upstream of impassible dams (Lindley *et al.* 2006). The extent of habitat loss for steelhead most likely was much higher than that for salmon because steelhead were undoubtedly more extensively distributed. Due to their superior jumping ability, the timing of their upstream migration which coincided with the winter rainy season, and their less restrictive preferences for spawning gravels, steelhead could have utilized at least hundreds of miles of smaller tributaries not accessible to the earlier-spawning salmon (Yoshiyama *et al.* 1996). Many historical populations of CCV steelhead are entirely upstream of impassable barriers and may persist as resident or adfluvial rainbow trout, although they are presently not considered part of the DPS. Steelhead were found as far south as the Kings River (and possibly Kern river systems in wet years) (McEwan 2001). Native American groups such as the Chunut people have had accounts of steelhead in the Tulare Basin (Latta 1977).

Nobriga and Cadrett (2003) compared CWT and untagged (wild) steelhead smolt catch ratios at Chipps Island trawl from 1998 through 2001 to estimate that about 100,000 to 300,000 steelhead smolts are produced naturally each year in the CV. Good *et al.* (2005) made the following conclusion based on the Chipps Island data:

> *"If we make the fairly generous assumptions (in the sense of generating large estimates of spawners) that average fecundity is 5,000 eggs per female, 1 percent of eggs survive to reach Chipps Island, and 181,000 smolts are produced (the 1998-2000 average), about 3,628 female steelhead spawn naturally in the entire CV. This can be compared with McEwan's (2001) estimate of 1 million to 2 million spawners before 1850, and 40,000 spawners in the 1960s."*

Existing naturally produced steelhead stocks in the CV are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill creeks and the Yuba River. Populations may exist in Big Chico and Butte creeks and a few wild steelhead are produced in the American and Feather rivers (McEwan and Jackson 1996). Clear Creek steelhead spawner abundance has not been estimated.

Until recently, CCV steelhead were thought to be extirpated from the San Joaquin River system. Monitoring has detected small numbers of steelhead in the Stanislaus, Mokelumne, and Calaveras rivers, and other streams previously thought to be devoid of steelhead (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995. A counting weir has been in place in the Stanislaus River since 2002 and in the Tuolumne River since 2009 to detect adult salmon, and have also detected *O. mykiss* passage. In 2012, 15 adult *O. mykiss* were detected passing the Tuolumne River weir and 82 adult *O. mykiss* were detected at the Stanislaus River weir (FishBio 2012a,b). In addition, rotary screw trap sampling has occurred since 1995 in the Tuolumne River, but only one juvenile *O. mykiss* was caught during the 2012 season (FishBio 2012b). Rotary screw traps are well known to be very inefficient at catching steelhead smolts, so the actual numbers of smolts could be much higher. Rotary screw trapping on the Merced River has occurred since 1999. A fish counting weir was installed on this river in 2012. Since installation, one adult *O. mykiss* has been reported passing the weir. Juvenile *O. mykiss* were not reported captured in the rotary screw traps on the Merced River until 2012, when a total of 381 were caught (FishBio 2013). The unusually high number of *O. mykiss* captured may be attributed to a flashy storm event that rapidly increased flows over a 24 hour period. Zimmerman *et al.* (2009) has documented CCV steelhead in the Stanislaus, Tuolumne, and Merced rivers based on otolith microchemistry.

CDFW conducts annual Kodiak trawl sampling on the San Joaquin River near Mossdale. Based on these catches, as well as rotary screw trap efforts in all three tributaries, Marston (2004) stated that it is "clear from this data that *O. mykiss* do occur in all the tributaries as migrants and that the vast majority of them occur on the Stanislaus River." Mossdale Kodiak trawl catches continue to occur and are still being conducted by CDFW. The low adult returns to these tributaries and the low numbers of juvenile emigrants captured suggest that existing populations of CCV steelhead on the Tuolumne, Merced, and lower San Joaquin rivers are severely depressed. The loss of these populations would severely impact CCV steelhead spatial structure and further challenge the viability of the CCV steelhead DPS.

In the Mokelumne River, East Bay Municipal Utilities District has included steelhead in their redd surveys on the Lower Mokelumne River since the 1999-2000 spawning season (NMFS 2011a). Based on data from these surveys, the overall trend suggests that redd numbers have slightly increased over the years (2000-2010). However, according to Satterthwaite *et al.* (2010), it is likely that most of the *O. mykiss* spawning in the Mokelumne River are non-anadromous (or resident) fish rather than steelhead. The Mokelumne River steelhead population is supplemented by Mokelumne River Hatchery production. In the past, this hatchery received fish imported from the Feather River and Nimbus hatcheries (Merz 2002). However, this practice was discontinued 11 years ago for Nimbus stock, and 3 years ago for Feather River stock. Recent results show that the Mokelumne River Hatchery steelhead are closely related to Feather River fish, suggesting that there has been little carry-over of genes from the Nimbus stock.

Although there have been recent restoration efforts in the San Joaquin River tributaries, CCV steelhead populations in the San Joaquin Basin continue to show a decline, an overall low abundance, and fluctuating return rates. Lindley *et al.* (2007) developed viability criteria for CV salmonids. Using data through 2005, Lindley *et al.* (2007) found that data were insufficient to determine the status of any of the naturally-spawning populations of CCV steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas.

The most recent status review of the CCV steelhead DPS (NMFS 2011a) found that the status of the population appears to have worsened since the 2005 status review (Good *et al.* 2005), when it was considered to be in danger of extinction. Analysis of data from the Chipps Island monitoring program indicates that natural steelhead production has continued to decline and that hatchery origin fish represent an increasing fraction of the juvenile production in the CV. Since 1998, all hatchery produced steelhead in the CV have been adipose fin clipped (ad-clipped). Since that time, the trawl data indicates that the proportion of ad-clip steelhead juveniles captured in the Chipps Island monitoring trawls has increased relative to wild juveniles, indicating a decline in natural production of juvenile steelhead. In recent years, the proportion of hatchery produced juvenile steelhead in the catch has exceeded 90 percent and in 2010 was 95 percent of the catch. Because hatchery releases have been fairly consistent through the years, this data suggests that the natural production of steelhead has been declining in the CV.

Salvage of juvenile steelhead at the CVP and SWP fish collection facilities has also shown a shift towards reduced natural production. In the past decade, there has been a decline in the percentage of salvaged juvenile steelhead that are naturally produced from 55 percent in 1998 down to 22 percent in 2010 (NMFS 2011a).

In contrast to the data from Chipps Island and the CVP and SWP fish collection facilities, some populations of wild CCV steelhead appear to be improving (Clear Creek) while others (Battle Creek) appear to be better able to tolerate the recent poor ocean conditions and dry hydrology in the CV compared to hatchery produced fish (NMFS 2011a). Since 2003, fish returning to the CNFH have been identified as wild (adipose fin intact) or hatchery produced (Ad-clipped). Returns of wild fish to the hatchery have remained fairly steady at 200-300 fish per year, but represent a small fraction of the overall hatchery returns. Numbers of hatchery origin fish returning to the hatchery have fluctuated much more widely; ranging from 624 to 2,968 fish per year. The returns of wild fish remained steady, even during the recent poor ocean conditions and the 3-year drought in the CV, while hatchery produced fish showed a decline in the numbers returning to the hatchery (NMFS 2011a). Furthermore, the continuing widespread distribution of wild steelhead in the CV provides the spatial distribution necessary for the DPS to survive and avoid localized catastrophes. However, these populations are frequently very small, and lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change (NMFS 2011a).

Table 8. The temporal occurrence of (a) adult and (b) juvenile CCV steelhead at locations in the CV. Darker shades indicate months of greatest relative abundance.

(a) Adult migration and holding

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[1,3]Sac. River	Low	Low	Low				Low	Low/Medium	Medium/High	High/Medium	Low	Low
[2,3]Sac R at Red Bluff	Low	Low	Low	Low	Low	Low	Low	Low	Medium	High/Medium	Low	Low
[4]Mill, Deer Creeks	Medium	High/Medium	Medium/Low	Low	Low	Low				Medium/High	High/Low	Low
[6]Sac R. at Fremont Weir	Low	Low						Medium	High	Medium	Low	Low
[6]Sac R. at Fremont Weir	Low	Low						Medium	High	Medium	Low	Low
[7]San Joaquin River	High	Medium	Low				Low	Low	Medium	Medium	Medium	High

(b) Juvenile migration

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[1,2]Sacramento River	Low	Low	Medium	Medium	Medium	Medium	Low	Low	Low	Medium	Medium	Low
[2,8]Sac. R at KL	Low	Low	High	Low	Low							Low
[9]Sac. River @ KL	Medium	Medium	High	High	Medium						Low	Low
[10]Chipps Island (wild)	Low	Low	High	High	Medium	Medium				Low	Low	Low
[8]Mossdale			Low	High	High	Low	Low					
[11]Woodbridge Dam	Medium	Medium	Medium	Medium	Medium	Medium	Medium					
[12]Stan R. at Caswell	Low	Medium	High	Medium	Medium	Medium/Low						
[13]Sac R. at Hood	Low	High	High	High	High	High					Low	Low

Relative Abundance: ■ = High ■ = Medium □ = Low

Sources: [1]Hallock 1961; [2]McEwan 2001;[3]USFWS unpublished data; [4]CDFG 1995; [5]Hallock *et al.* 1957; [6]Bailey 1954; [7]CDFG Steelhead Report Card Data 2007;[8]CDFG unpublished data; [9]Snider and Titus 2000; [10]Nobriga and Cadrett 2003; [11]Jones and Stokes Associates, Inc., 2002; [12]S.P. Cramer and Associates Inc. 2000 and 2001; [13]Schaffter 1980, 1997.

Description of VSP Parameters

1. Abundance

All indications are that natural CCV steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good *et al.* 2005; NMFS 2011a); the long-term trend remains negative. Comprehensive steelhead population monitoring has not taken place in the CV, despite 100 percent marking of hatchery steelhead since 1998. Efforts are underway to improve this deficiency, and a long term adult escapement monitoring plan is being considered (Eilers *et al.* 2010). Hatchery production and returns are dominant over natural fish and include significant numbers of non-DPS-origin Eel/Mad River steelhead stock. Continued decline in the ratio between naturally produced juvenile steelhead to hatchery juvenile steelhead in fish monitoring efforts indicates that the wild population abundance is declining. Hatchery releases (100 percent adipose fin clipped fish since 1998) have remained relatively constant over the past decade, yet the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts has steadily increased over the past several years.

2. Productivity

An estimated 100,000 to 300,000 naturally produced juvenile steelhead are estimated to leave the CV annually, based on rough calculations from sporadic catches in trawl gear (Good *et al.* 2005). The Mossdale trawls on the San Joaquin River conducted annually by CDFW and USFWS capture steelhead smolts, although usually in very small numbers. These steelhead recoveries which represent migrants from the Stanislaus, Tuolumne, and Merced rivers suggest that existing populations of CCV steelhead on these tributaries are severely depressed. In addition, the Chipps Island midwater trawl dataset from the USFWS provides information on the trend (Williams *et al.* 2011).

3. Spatial Structure

Steelhead appear to be well-distributed throughout the CV (Good *et al.* 2005; NMFS 2011a). In the San Joaquin River Basin, steelhead have been confirmed in all of the tributaries: Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers. Zimmerman *et al.* (2009) used otolith microchemistry to show that *O. mykiss* of anadromous parentage occur in all three major San Joaquin River tributaries, but at low levels, and that these tributaries have a higher percentage of resident *O. mykiss* compared to the Sacramento River and its tributaries. The efforts to provide passage of salmonids over impassable dams may increase the spatial diversity of CCV steelhead populations if the passage programs are implemented for steelhead. In addition, the San Joaquin River Restoration Program (SJRRP) calls for a combination of channel and structural modifications along the San Joaquin River downstream of Friant Dam, releases of water from Friant Dam to the confluence of the Merced River, and the reintroduction of spring-run and fall-run Chinook salmon. If the SJRRP is successful, habitat improved for spring-run Chinook salmon could also benefit CCV steelhead (NMFS 2011a).

4. Diversity

CCV steelhead abundance and growth rate continue to decline, largely the result of a significant reduction in the diversity of habitats available to CCV steelhead (Lindley *et al.* 2006). Recent reductions in population size are also supported by genetic analysis (Nielsen *et al.* 2003). Garza and Pearse (2008) analyzed the genetic relationships among CCV steelhead populations and found that unlike the situation in coastal California watersheds, fish downstream of barriers in the CV were more closely related to downstream of barrier fish from other watersheds than to *O. mykiss* upstream of barriers in the same watershed. This pattern suggests the ancestral genetic structure is still relatively intact upstream of barriers, but may have been altered below barriers by stock transfers. The genetic diversity of CCV steelhead is also compromised by hatchery origin fish, which likely comprise the majority of the spawning run, placing the natural population at a high risk of extinction (Lindley *et al.* 2007). There are four hatcheries (CNFH, FRFH, Nimbus Fish Hatchery, and Mokelumne River Fish Hatchery) in the CV which combined release approximately 600,000 yearling steelhead smolts each year. These programs are intended to compensate for the loss of steelhead habitat caused by dam construction, but hatchery origin fish now appear to constitute a major proportion of the total abundance in the DPS. Two of these hatchery stocks (Nimbus and Mokelumne River hatcheries) originated from outside the DPS (from the Eel and Mad rivers) and are not presently considered part of the DPS.

Summary of CCV Steelhead DPS Viability

All indications are that natural CCV steelhead have continued to decrease in abundance over the past 25 years (Good et al. 2005; NMFS 2011a). The long-term trend remains negative. Hatchery production and returns are dominant over natural fish. Continued decline in the ratio between naturally produced juvenile steelhead to hatchery juvenile steelhead in fish monitoring efforts indicates that the wild population abundance is declining. Hatchery releases (100 percent adipose fin clipped fish since 1998) have remained relatively constant over the past decade, yet the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts has steadily increased over the past several years.

Although there have been recent restoration efforts in the San Joaquin River tributaries, CCV steelhead populations in the San Joaquin Basin continue to show a decline, an overall low abundance, and fluctuating return rates. Lindley et al. (2007) developed viability criteria for CV salmonids. Using data through 2005, Lindley et al. (2007) found that data were insufficient to determine the status of any of the naturally-spawning populations of CCV steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas.

The widespread distribution of wild steelhead in the CV provides the spatial distribution necessary for the DPS to survive and avoid localized catastrophes. However, these populations are frequently very small, and lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change (NMFS 2011a). The most recent status review of the CCV steelhead DPS (NMFS 2011a) found that the status of the population appears to have worsened since the 2005 status review (Good et al. 2005), when it was considered to be in danger of extinction.

Critical Habitat and Primary Constituent Elements for CCV Steelhead

Critical habitat was designated for CCV steelhead on September 2, 2005 (70 FR 52488). Critical habitat for CCV steelhead includes stream reaches such as those of the Sacramento, Feather, and Yuba Rivers, and Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries, and the waterways of the 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 bankfull elevation (defined as the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series) (Bain and Stevenson 1999; 70 FR

52488). Critical habitat for CCV steelhead is defined as specific areas that contain the PCE and physical habitat elements essential to the conservation of the species. Following are the inland habitat types used as PCEs for CCV steelhead. PCEs for CCV steelhead include:

1. Freshwater Spawning Habitat

Freshwater spawning sites are those with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. Most of the available spawning habitat for steelhead in the CV is located in areas directly downstream of dams due to inaccessibility to historical spawning areas upstream and the fact that dams are typically built at high gradient locations. These reaches are often impacted by the upstream impoundments, particularly over the summer months, when high temperatures can have adverse effects upon salmonids spawning and rearing downstream of the dams. Even in degraded reaches, spawning habitat has a high conservation value as its function directly affects the spawning success and reproductive potential of listed salmonids.

2. Freshwater Rearing Habitat

Freshwater rearing sites are those with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and survival; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging LWM, log jams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and the presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system (*e.g.*, the lower Cosumnes River, Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]) and flood bypasses (*i.e.*, Yolo and Sutter bypasses). However, the channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators. Freshwater rearing habitat also has a high conservation value even if the current conditions are significantly degraded from their natural state. Juvenile life stages of salmonids are dependent on the function of this habitat for successful survival and recruitment.

3. Freshwater Migration Corridors

Ideal freshwater migration corridors are free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. They contain natural cover such as riparian canopy structure, submerged and overhanging large woody objects, aquatic vegetation, large rocks, and boulders, side channels, and undercut banks which augment juvenile and adult mobility, survival, and food supply. Migratory corridors are downstream of the spawning areas and include the lower mainstems of the Sacramento and San Joaquin rivers and the Delta. These corridors allow the upstream and downstream passage of adults, and the emigration of smolts. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. For this reason, freshwater migration corridors are considered to have a high conservation value even if the migration corridors are significantly degraded compared to their natural state.

4. Estuarine Areas

Estuarine areas free of migratory obstructions with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water are included as a PCE. Natural cover such as submerged and overhanging LWM, aquatic vegetation, and side channels, are suitable for juvenile and adult foraging. Estuarine areas are considered to have a high conservation value as they provide factors which function to provide predator avoidance and as a transitional zone to the ocean environment.

2.2.4 Southern DPS of North American Green Sturgeon

The following section entails the status of the species for the Southern distinct population segment of North American green sturgeon (sDPS green sturgeon). This section establishes the life history and viability for sDPS green sturgeon, and discusses their critical habitat. The critical habitat analysis is approached by examining the PCEs of that critical habitat, and this analysis considers separately freshwater and estuarine environments. Throughout this analysis of life history, viability, and critical habitat, the focus is upon the CV of California. Therefore, not all aspects of sDPS green sturgeon are presented; for example, the PCEs for the critical habitat in the marine environment are not included.

1. Listed as threatened on June 6, 2006 (71 FR 17757)
2. Critical habitat designated October 9, 2009 (74 FR 52300)

Life History

Our understanding of the biology of the sDPS of green sturgeon is evolving. In areas where information is lacking, inferences are sometimes made from what is known about the Northern distinct population segment (nDPS) green sturgeon and, to a lesser extent, from other sturgeon species, especially the sympatric white sturgeon (*Acipenser transmontanus*). Green sturgeon are long lived, iteroperous, anadromous fish. They may live up to 60-70 years; green sturgeon captured in Oregon have been age-estimated using a fin-spine analysis up to 52 years (Farr and Kern 2005). The green sturgeon sDPS includes those that spawn south of the Eel River. Until recently, it was believed that the green sturgeon sDPS was composed of a single spawning population on the Sacramento River. However, recent research conducted by DWR has revealed spawning activity in the Feather River. Additionally, there is some evidence of spawning in the Yuba River downstream of Daguerre Point Dam (Cramer Fish Sciences 2013).

Laboratory studies have provided some important information about about larval sturgeon diet and habitat use. Green sturgeon larvae hatch from fertilized eggs after approximately 169 hours at a water temperature of 15° C (59° F) (Van Eenennaam *et al.* 2001, Deng *et al.* 2002). Studies conducted at the University of California, Davis by Van Eenennaam *et al.* (2005) using nDPS juveniles indicated that an optimum range of water temperature for egg development ranged between 14° C (57.2°F) and 17° C (62.6°F). Temperatures over 23 °C (73.4°F) resulted in 100 percent mortality of fertilized eggs before hatching. Eggs incubated at water temperatures between 17.5° C (63.5°F) and 22° C (71.6°F) resulted in elevated mortalities and an increased occurrence of morphological abnormalities in those eggs that did hatch. At incubation temperatures below 14° C (57.2°F), hatching mortality also increased significantly, and morphological abnormalities increased slightly, but not statistically so (Van Eenennaam *et al.* 2005).

Young green sturgeon appear to rear for the first one to two months in the Sacramento River between Keswick Dam and Hamilton City (CDFG 2002). Juvenile green sturgeon first appear in USFWS sampling efforts at RBDD in June and July at lengths ranging from 24 to 31 mm fork length, indicating they are approximately two weeks old (CDFG 2002, USFWS 2002). Growth is rapid as juveniles reach up to 300 mm the first year and over 600 mm in the first 2 to 3 years (Nakamoto *et al.* 1995). Juvenile green sturgeon have been salvaged at the Federal and State pumping facilities (which are located in the southern region of the Delta), and sampled in trawling studies by the CDFW during all months of the year (CDFG 2002). The majority of these fish that were captured in the Delta were between 200 and 500 mm indicating they were from 2 to 3 years of age, based on Klamath River age distribution work by Nakamoto *et al.* (1995). The lack of a significant proportion of juveniles smaller than approximately 200 mm in Delta captures indicates juvenile sDPS green sturgeon likely hold in the mainstem Sacramento River for up to 10 months, as suggested by Kynard *et al.* (2005). Both nDPS and sDPS green sturgeon juveniles tested under laboratory conditions, with either full or reduced rations, had optimal bioenergetic performance (*i.e.,* growth, food conversion, swimming ability) between 15°C (59° F) and 19° C (66.2° F), thus providing a temperature related habitat target for conservation of this rare species (Mayfield and Cech 2004). This temperature range overlaps the egg incubation temperature range for peak hatching success previously discussed.

Radtke (1966) inspected the stomach contents of juvenile green sturgeon in the Delta and found food items to include a mysid shrimp (*Neomysis awatschensis)*, amphipods (*Corophium* spp.*)*, and other unidentified shrimp. No additional information is available regarding the diet of sDPS green sturgeon in the wild, but they are presumed to be generalist, opportunistic benthic feeders.

There is a fair amount of variability (1.5 – 4 years) in the estimates of the time spent by juvenile green sturgeon in freshwater before making their first migration to sea. Nakamoto *et al.* (1995) found that nDPS green sturgeon on the Klamath River migrated to sea, on average by age three and no later than by age four. Moyle (2002) suggests juveniles migrate out to sea before the end of their second year, and perhaps as yearlings. Laboratory experiments indicate that both nDPS and sDPS green sturgeon juveniles may occupy fresh to brackish water at any age, but they are physiologically able to completely transition to saltwater at around 1.5 years in age (Allen and Cech 2007). In studying nDPS green sturgeon on the Klamath River, Allen *et al.* (2009) devised a technique to estimate the timing of transition from fresh water to brackish water to seawater by taking a bone sample from the leading edge of the pectoral fin and anlyzing the ratios of stontium and barium to calcium. The results of this study indicate that green sturgeon move from freshwater to brackish water (such as the estuary) at ages 0.5–1.5 years and then move into seawater at ages 2.5-3.5 years. Table 9 shows the migration timing of various life stages throughout the CV, Delta, San Francisco Bay, and into the Pacific Ocean.

In the summer months, multiple rivers and estuaries throughout the sDPS range are visited by dense aggregations of green sturgeon (Moser and Lindley 2007, Lindley *et al.* 2011). Capture of green sturgeon as well as tag detections in tagging studies have shown that green sturgeon are present in San Pablo Bay and San Francisco Bay at all months of the year (Kelly *et al.* 2007, Heublein *et al.* 2009, Lindley *et al.* 2011). An increasing amount of information is becoming available regarding green sturgeon habitat use in estuaries and coastal ocean, and why they aggregate episodically (Lindley *et al.* 2008, Lindley *et al.* 2011). Genetic studies on green sturgeon stocks indicate that almost all of the green sturgeon in the San Francisco Bay ecosystem belong to the sDPS (Israel and Klimley 2008).

Green sturgeon do not mature until they are at least 15–17 years of age (Beamesderfer *et al.* 2007). Therefore, it would not be expected that a green sturgeon returning to freshwater would be younger than this. However, once mature, green sturgeon appear to make spawning runs once every few years. Erickson and Hightower (2007) found that nDPS green sturgeon returned to the Rogue River 2–4 years after leaving; it is presumed that sDPS green sturgeon display similar behavior and return to the Sacramento River or Feather River system to spawn every 2–5 years. Adult sDPS green sturgeon begin their upstream spawning migrations into freshwater as early as late February with spawning occuring between March and July (CDFG 2002, Heublein 2006, Heublein *et al.* 2009, Vogel 2008). Peak spawning is believed to occur between April and June in deep, turbulent, mainstem channels over large cobble and rocky substrates featuring crevices and interstices (Van Eenennaam *et al.* 2001). Poytress *et al.* (2012) conducted spawning site and larval sampling in the upper Sacramento River from 2008–2012 and has identified a number of confirmed spawning locations (Figure 6). Green sturgeon fecundity is approximately 50,000 to 80,000 eggs per adult female (Van Eenennaam *et al.* 2001). They have the largest egg size of any sturgeon. The outside of the eggs are mildly adhesive, and are more dense than than those of white sturgeon (Kynard *et al.* 2005, Van Eenennaam *et al.* 2009).

Post spawning, green sturgeon may exhibit a variety of behaviors. Ultimately they will return to the ocean, but how long they take to do this and what they do along the way are open questions. Illustrating the spectrum of behavioral choices, Benson *et al.* (2007) conducted a study in which 49 nDPS green sturgeon were tagged with radio and/or sonic telemetry tags and tracked manually or with receiver arrays from 2002 to 2004. Tagged individuals exhibited four movement patterns: upstream spawning migration, spring outmigration to the ocean, or summer holding, and outmigration after summer holding.

Table 9. The temporal occurrence of (a) adult, (b) larval (c) juvenile and (d) subadult coastal migrant sDPS of green sturgeon. Locations emphasize the CV of California. Darker shades indicate months of greatest relative abundance.

(a) Adult-sexually mature (≥145 – 205 cm TL for females and ≥ 120 – 185 cm TL old for males)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Upper Sac. River[a,b,c,i]	Low	Low	Medium	Medium / High	High	High / Medium	Medium	Medium	Medium	Low	Low	Low
SF Bay Estuary[d,h,i]	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Low

(b) Larval and juvenile (≤10 months old)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RBDD, Sac River[e]					Medium	High	High	Medium				
GCID, Sac River[e]					Medium	High	High	Medium	Low	Low		

(c) Older Juvenile (> 10 months old and ≤3 years old)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
South Delta*[f]	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Sac-SJ Delta[f]	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Sac-SJ Delta[e]				Medium	Medium	Medium	Medium	Medium	Medium	Medium		
Suisun Bay[e]	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium

(d) Sub-Adult/non-sexually mature (approx. 75 cm to 145 cm for females and 75 to 120 cm for males)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pacific Coast[c,g]	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium

Relative Abundance: ■ = High ■ = Medium □ = Low

* Fish Facility salvage operations

Sources: [a]USFWS (2002); [b]Moyle *et al.* (1992); [c]Adams *et al.* (2002) and NMFS (2005); [d]Kelly *et al.* (2007); [e]CDFG (2002); [f]IEP Relational Database, fall midwater trawl green sturgeon captures from 1969 to 2003; [g]Nakamoto *et al.* (1995); [h]Heublein (2006); [i]CDFG Draft Sturgeon Report Card (2007)

Description of Viability Parameters for sDPS Green Sturgeon

As an approach to determining the conservation status of salmonids, NMFS has developed a framework for identifying attributes of a VSP. The intent of this framework is to provide parties with the ability to assess the effects of management and conservation actions and ensure their actions promote the listed species' survival and recovery. This framework is known as the VSP concept (McElhany *et al.* 2000). The VSP concept measures population performance in term of four key parameters: abundance, population growth rate, spatial structure, and diversity. Although the VSP concept was developed for Pacific salmonids, the underlying parameters are general principles of conservation biology and can therefore be applied more broadly; here we adopt the VSP concept for sPDS green sturgeon.

1. Abundance

Abundance is one of the most basic principles of conservation biology, and from this measurement other parameters can be related. In applying the VSP concept, abundance is examined at the population level, and therefore population size is perhaps a more appropriate term. Population estimates of the green sturgeon sDPS are in development. A decrease in sDPS green sturgeon abundance has been inferred from the amount of take observed at the south Delta pumping facilities; the Skinner Delta Fish Protection Facility (SDFPF) and the Tracy Fish Collection Facility (TFCF) (Figure 7).

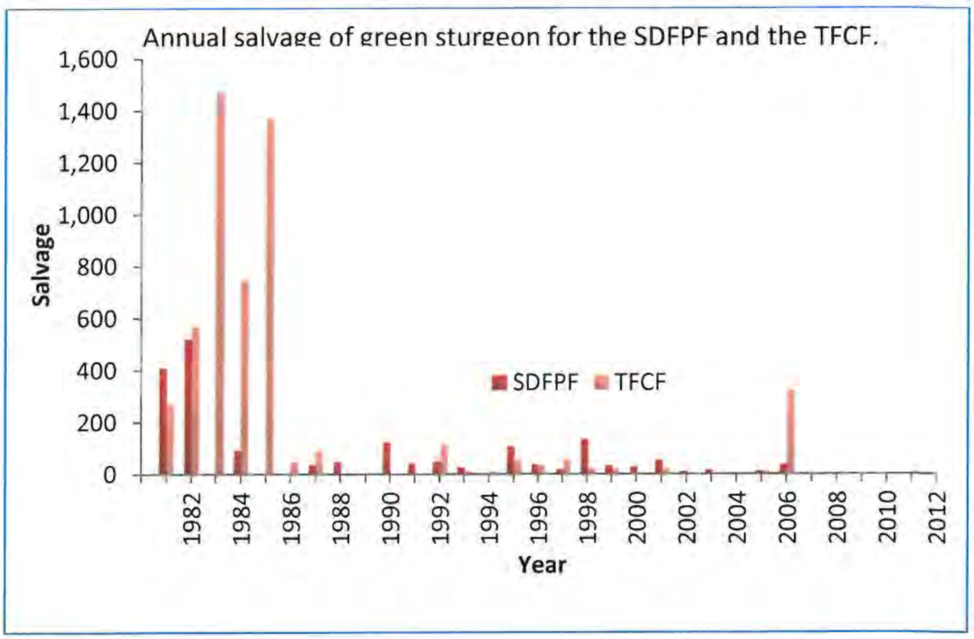


Figure 7. Annual salvage of green sturgeon for the SDFPF and the TFCF from 1981 to 2012. Data source: ftp://ftp.delta.dfg.ca.gov/salvage

Adult spawning population estimates in the upper Sacramento River, using sibling based genetics, indicates 10-28 spawners per year between 2002-2006 (Israel and May 2010). Fish monitoring efforts at RBDD and Glen Colusa Irrigation District (GCID) on the upper Sacramento River have captured anywhere between 0 and 2,068 juvenile green sturgeon per year, between 1986 and 2000 (Adams *et al.* 2002).

In determining the conservation status of sDPS green sturgeon, a few notes with regards to population size are crucial. Population(s) should be large enough to survive environmental variations, catastrophes, and anthropogenic perturbations. Also, the population(s) should be sufficiently large to maintain long term genetic diversity (McElhany *et al.* 2000). Our understanding of the status of sDPS green sturgeon towards these concerns is developing.

2. Productivity

Productivity and recruitment information for sDPS green sturgeon is an area that requires additional research; existing data is too limited to be presented as robust estimates. Incidental catches of larval green sturgeon in the mainstem Sacramento River and of juvenile green sturgeon at the south Delta pumping facilities suggest that green sturgeon are successful at spawning, but that annual year class strength may be highly variable (Beamesderfer *et al.* 2007, Lindley *et al.* 2007). In general, sturgeon year class strength appears to be episodic with overall abundance dependent upon a few successful spawning events (NMFS 2010). It is unclear if the population is able to consistently replace itself. This is significant because the VSP concept requires that a population meeting or exceeding the abundance criteria for viability should, on average, be able to replace itself (McElhany *et al.* 2000). More research is needed to establish green sturgeon sDPS productivity.

3. Spatial Structure

Green sturgeon, as a species, are known to range from Baja California to the Bering Sea along the North American continental shelf. During the late summer and early fall, subadults and nonspawning adult green sturgeon frequently can be found aggregating in estuaries along the Pacific coast (Emmett 1991, Moser and Lindley 2007). Based on genetic analyses and spawning site fidelity (Adams *et al.* 2002, Israel *et al.* 2004), green sturgeon are comprised of at least two DPSs.

1. A nDPS consisting of populations originating from coastal watersheds northward of and including the Eel River (*i.e.* Klamath, Rogue, and Umpqua rivers), and
2. A sDPS consisting of populations originating from coastal watersheds south of the Eel River.

Throughout much of their range, sDPS and nDPS green sturgeon are known to co-occur, especially in northern estuaries and over-wintering grounds. However, those green sturgeon that are found within the inland waters of California are almost entirely sDPS green sturgeon (Israel and Klimley 2008).

Adams *et al.* (2007) summarizes information that suggests green sturgeon may have been distributed upstream of the locations of present-day dams on the Sacramento and Feather rivers. In the California CV, sDPS green sturgeon are known to range from the Delta to the Sacramento River up to Keswick Dam, the Feather River up to the fish barrier structure downstream of Oroville Dam, and the Yuba River up to Daguerre Point Dam. Additional habitat may have historically existed in the San Joaquin River basin. Anecdotal evidence from anglers suggest sDPS green sturgeon presence in the San Joaquin River. Since implementation of the Sturgeon Report Card in 2007, anglers have reported catching 169 white sturgeon and six green sturgeon on the San Joaquin River upstream from Stockton (Gleason *et al.* 2008; DuBois *et al.* 2009, 2010, 2011, 2012).

In applying the VSP concept to sDPS green sturgeon, it is important to look at the within-population spatial diversity. Ongoing research is being conducted to determine if the green sturgeon sDPS is composed of a single population, or perhaps several populations. It is known that sDPS green sturgeon spawn in the mainstem Sacramento River, the Feather River, and the Yuba River; but it is not yet known if these spawning areas represent individual populations, sub-populations, or if they are all part of one single population. However, it is encouraging to note that at least this level of spatial diversity exists; when sDPS green sturgeon were originally listed as threatened under the ESA, the only known spawning locations at the time were those on the mainstem Sacramento River.

4. Diversity

The VSP concept identifies a variety of traits that exhibit diversity within and among populations, and this variation has important effects on population viability (McElhany *et al.* 2000). For sDPS green sturgeon, such traits include, but are not limited to fecundity, age at maturity, physiology, and genetic characteristics. On a species-wide scale, studies have examined the genetic differentiation between sDPS and nDPS green sturgeon (Israel *et al.* 2004).

Although the population structure of sDPS green sturgeon is still being refined, it may be the case that only a single population exists. This may have the effect of providing for lower diversity than if two or more populations existed. Lindley *et al.* (2007), in discussing winter-run Chinook salmon, states that an ESU represented by a single population at moderate risk of extinction is at high risk of extinction over the long run. This concern applies to any DPS or ESU represented by a single population.

Summary of sDPS Green Sturgeon Viability

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The risk of extinction is believed to be moderate because, although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices (NMFS 2010a). Viability is defined 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 (McElhany et al. 2000). The best available scientific information does not indicate that the extinction risk facing sDPS green sturgeon is negligible over a long term (~100 year) time horizon; therefore the sDPS is not believed to be viable. To support this statement, the population viability analysis (PVA) that was done for sDPS green sturgeon in relation to stranding events (Thomas et al. 2013) may provide some insight. While this PVA model made many assumptions that need to be verified as new information becomes available, it was alarming to note that over a 50-year time period the DPS declined under all scenarios where stranding events were recurrent over the lifespan of a green sturgeon.

Although the population structure of sDPS green sturgeon is still being refined, it is currently believed that only one population of sDPS green sturgeon exists. Lindley et al. (2007), in discussing winter-run Chinook salmon, states that an ESU represented by a single population at moderate risk of extinction is at high risk of extinction over the long run. This concern applies to any DPS or ESU represented by a single population, and if this were to be applied to sDPS green sturgeon directly, it could be said that sDPS green sturgeon face a high extinction risk. However, the position of NMFS, upon weighing all available information (and lack of information) has stated the extinction risk to be moderate (NMFS 2010a).

There is a strong need for additional information about sDPS green sturgeon, especially with regards to a robust abundance estimate, a greater understanding of their biology, and further information about their habitat needs.

Southern DPS of North American Green Sturgeon Critical Habitat

Critical habitat was designated for the sDPS green sturgeon on October 9, 2009 (74 FR 52300). A full and exact description of all sDPS green sturgeon critical habitat, including excluded areas, can be found at 50 CFR 226.219. 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, and the Feather River upstream to the fish barrier dam adjacent to the Feather River Fish Hatchery. 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 also included as critical habitat for sDPS green sturgeon.

Critical habitat for sDPS green sturgeon includes principal biological or physical constituent elements within the defined area that are essential to the conservation of the species. PCEs for sDPS green sturgeon have been designated for freshwater riverine systems, estuarine habitats, and nearshore coastal areas. In keeping with the focus on the California CV, we will limit our discussion to freshwater riverine systems and estuarine habitats.

Freshwater Riverine Systems

1. <u>Food Resources</u>

Abundant food items for larval, juvenile, subadult, and adult life stages for sDPS green sturgeon should be present in sufficient amounts to sustain growth, development, and support basic metabolism. Although specific information on food resources for green sturgeon within freshwater riverine systems is lacking, they are presumed to be generalists and opportunists that feed on similar prey as other sturgeons (Israel and Klimley 2008). Seasonally abundant drifting and benthic invertebrates have been shown to be the major food items of shovelnose and pallid sturgeon in the Missouri River (Wanner *et al.* 2007), lake sturgeon in the St. Lawrence River (Nilo *et al.* 2006), and white sturgeon in the lower Columbia River (Muir *et al.* 2000). As sturgeons grow, they begin to feed on oligochaetes, amphipods, smaller fish, and fish eggs as represented in the diets of lake sturgeon (Nilo *et al.* 2006), pallid sturgeon (Gerrity *et al.* 2006), and white sturgeon (Muir *et al.* 2000).

2. Substrate Type or Size

Critical habitat in the freshwater riverine system should include substrate suitable for egg deposition and development, larval development, subadults, and adult life stages. For example, spawning is believed to occur over substrates ranging from clean sand to bedrock, with preferences for cobble (Emmett *et al.* 1991, Moyle *et al.* 1995). Eggs are likely to adhere to substrates, or settle into crevices between substrates (Van Eenennaam *et al.* 2001, Deng *et al.* 2002). Larvae exhibited a preference for benthic structure during laboratory studies (Van Eenennaam *et al.* 2001, Deng *et al.* 2002, Kynard *et al.* 2005), and may seek refuge within crevices, but use flat-surfaced substrates for foraging (Nguyen and Crocker 2006).

3. Water Flow

An adequate flow regime is necessary for normal behavior, growth, and survival of all life stages in the upper Sacramento River. Such a flow regime should include stable and sufficient water flow rates in spawning and rearing reaches to maintain water temperatures within the optimal range for egg, larval, and juvenile survival and development (11°C - 19°C) (Mayfield and Cech 2004, Van Eenennaam *et al.* 2005, Allen *et al.* 2006). Sufficient flow is also needed to reduce the incidence of fungal infestations of the eggs, and to flush silt and debris from cobble, gravel, and other substrate surfaces to prevent crevices from being filled in and to maintain surfaces for feeding. Successful migration of adult green sturgeon to and from spawning grounds is also dependent on sufficient water flow. Spawning in the Sacramento River is believed to be triggered by increases in water flow to about 14,000 cfs [average daily water flow during spawning months: 6,900 – 10,800 cfs; Brown (2007)]. In Oregon's Rogue River, nDPS green sturgeon have been shown to emigrate to sea during the autumn and winter when water temperatures dropped below 10° C and flows increased (Erickson *et al.* 2002). On the Klamath River, the fall outmigration of nDPS green sturgeon has been shown to coincide with a significant increase in discharge resulting from the onset of the rainy season (Benson *et al* 2007). On the Sacramento River, flow regimes are largely dependent on releases from Shasta Dam, thus the operation of this dam could have profound effects upon sDPS green sturgeon habitat.

4. Water Quality

Adequate water quality, including temperature, salinity, oxygen content, and other chemical characteristics are necessary for normal behavior, growth, and viability of all life stages. Suitable water temperatures would include: stable water temperatures within spawning reaches; temperatures within 11°C - 17°C (optimal range = 14°C - 16°C) in spawning reaches for egg incubation (March-August) (Van Eenennaam *et al.* 2005); temperatures below 20°C for larval development (Werner *et al.* 2007); and temperatures below 24°C for juveniles (Mayfield and Cech 2004, Allen *et al.* 2006). Suitable salinity levels range from fresh water (< 3 ppt) for larvae and early juveniles to brackish water (10 ppt) for juveniles prior to their transition to salt water. Prolonged exposure to higher salinities may result in decreased growth and activity levels and even mortality (Allen and Cech 2007). Adequate levels of dissolved oxygen (DO) are needed to support oxygen consumption by early life stages (ranging from 61.78 to 76.06 mg O_2 hr^{-1} kg^{-1} for juveniles, Allen and Cech (2007). Suitable water quality would also include water free of contaminants (*i.e.*, pesticides, organochlorines, selenium, elevated levels of heavy metals, *etc.*) that may disrupt normal development of embryonic, larval, and juvenile stages of green sturgeon. Poor water quality can have adverse effects on growth, reproductive development, and reproductive success. Studies on effect of water contaminants upon green sturgeon are needed; studies performed upon white sturgeon have clearly demonstrated the negative impacts contaminants can have upon white sturgeon biology (Foster *et al.* 2001a, 2001b, Feist *et al.* 2005, Fairey *et al.* 1997, Kruse and Scarnecchia 2002). Legacy contaminants such as mercury still persist in the watershed and pulses of pesticides have been identified in winter storm discharges throughout the Sacramento River basin, and the CV and Delta.

5. Migratory Corridor

Safe and unobstructed migratory pathways are necessary for adult green sturgeon to migrate to and from spawning habitats, and for larval and juvenile green sturgeon to migrate downstream from spawning and rearing habitats within freshwater rivers to rearing habitats within the estuaries. Unobstructed passage throughout the Sacramento River up to Keswick Dam (RM 302) is important, because optimal spawning habitats for green sturgeon are believed to be located upstream of the RBDD (RM 242).

6. Depth

Deep pools of ≥ 5 m depth are critical for adult green sturgeon spawning and for summer holding within the Sacramento River. Summer aggregations of green sturgeon are observed in these pools in the upper Sacramento River upstream of GCID. The significance and purpose of these aggregations are unknown at the present time, but may be a behavioral characteristic of green sturgeon. Adult green sturgeon in the Klamath and Rogue rivers also occupy deep holding pools for extended periods of time, presumably for feeding, energy conservation, and/or refuge from high water temperatures (Erickson *et al.* 2002, Benson *et al.* 2007). As described above approximately 54 pools with adequate depth have been identified in the Sacramento River upstream of the GCID location.

7. Sediment Quality

Sediment should be of the appropriate quality and characteristics necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of contaminants [*e.g.*, elevated levels of heavy metals (*e.g.*, mercury, copper, zinc, cadmium, and chromium), polycyclic aromatic hydrocarbons (PAHs), and organochlorine pesticides] that can result in negative effects on any life stage of green sturgeon or their prey. Based on studies of white sturgeon, bioaccumulation of contaminants from feeding on benthic species may negatively affect the growth, reproductive development, and reproductive success of green sturgeon. The Sacramento River and its tributaries have a long history of contaminant exposure from abandoned mines, separation of gold ore from mine tailings using mercury, and agricultural practices with pesticides and fertilizers which result in deposition of these materials in the sediment horizons in the river channel. The San Joaquin River is a source for many of these same contaminants, although pollution and runoff from agriculture are the predominant driving force. Disturbance of these sediment horizons by natural or anthropogenic actions can liberate he sequestered contaminants into the river. This is a continuing concern throughout the watershed.

For Estuarine Habitats

1. Food Resources

Abundant food items within estuarine habitats and substrates for juvenile, subadult, and adult life stages are required for the proper functioning of this PCE for green sturgeon. Green sturgeon primarily on worms, mollusks, and crustaceans (Moyle 2002). Radtke (1966) studied the diet of juvenile sDPS green sturgeon and found their stomach contents to include a mysid shrimp, amphipods, and other unidentified shrimp. These prey species are critical for the rearing, foraging, growth, and development of juvenile, subadult, and adult green sturgeon within the bays and estuaries. Currently, the estuary provides these food resources, although annual fluctuations in the population levels of these food resources may diminish the contribution of one group to the diet of green sturgeon relative to another food source.

Invasive species are a concern because they may replace the natural food items consumed by green sturgeon. The Asian overbite clam (*Corbula amurensis*) is one example of a prolific invasive clam species in the Delta. It has been observed to pass through white sturgeon undigested (Kogut 2008).

2. Water Flow

Within bays and estuaries adjacent to the Sacramento River (*i.e.*, the Delta and the Suisun, San Pablo, and San Francisco bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds is required. Sufficient flows are needed to attract adult green sturgeon to the Sacramento River from the bay and to initiate the upstream spawning migration into the upper river. The specific quantity of flow required is a topic of ongoing research.

3. Water Quality

Adequate water quality, including temperature, salinity, oxygen content, and other chemical characteristics, is necessary for normal behavior, growth and viability of all life stages. Suitable water temperatures for juvenile green sturgeon should be below 24°C (75°F). At temperatures above 24°C, juvenile green sturgeon exhibit decreased swimming performance (Mayfield and Cech 2004) and increased cellular stress (Allen *et al.* 2006). Suitable salinities in the estuary range from brackish water (10 ppt) to salt water (33 ppt). Juveniles transitioning from brackish to salt water can tolerate prolonged exposure to salt water salinities, but may exhibit decreased growth and activity levels (Allen and Cech 2007), whereas subadults and adults tolerate a wide range of salinities (Kelly *et al.* 2007). Subadult and adult green sturgeon occupy a wide range of DO levels, but may need a minimum DO level of at least 6.54 mg O_2/l (Kelly *et al.* 2007, Moser and Lindley 2007).

Suitable water quality also includes water free of contaminants (*e.g.*, pesticides, organochlorines, elevated levels of heavy metals) that may disrupt the normal development of juvenile life stages, or the growth, survival, or reproduction of subadult or adult stages. In general, water quality in the Delta and estuary meets these criteria, but local areas of the Delta and downstream bays have been identified as having deficiencies. Discharges of agricultural drain water have also been implicated in local elevations of pesticides and other related agricultural compounds within the Delta and the tributaries and sloughs feeding into the Delta. Discharges from petroleum refineries in Suisun and San Pablo bay have been identified as sources of selenium to the local aquatic ecosystem (Linville *et al.* 2002).

4. Migratory Corridor

Safe and unobstructed migratory pathways are necessary for timely passage of adult, sub-adult, and juvenile fish within the region's different estuarine habitats and between the upstream riverine habitat and the marine habitats. Within the waterways comprising the Delta, and bays downstream of the Sacramento River, safe and unobstructed passage is needed for juvenile green sturgeon during the rearing phase of their life cycle. Passage within the bays and the Delta is also critical for adults and subadults for feeding and summer holding, as well as to access the Sacramento River for their upstream spawning migrations and to make their outmigration back into the ocean. Within bays and estuaries outside of the Delta and the areas comprised by Suisun, San Pablo, and San Francisco bays, safe and unobstructed passage is necessary for adult and subadult green sturgeon to access feeding areas, holding areas, and thermal refugia, and to ensure passage back out into the ocean. Currently, safe and unobstructed passage has been diminished by human actions in the Delta and bays. The CVP and SWP, responsible for large volumes of water diversions, alter flow patterns in the Delta due to export pumping and create entrainment issues in the Delta at the pumping and Fish Facilities. Power generation facilities in Suisun Bay create risks of entrainment and thermal barriers through their operations of cooling water diversions and discharges. Installation of seasonal barriers in the South Delta and operations of the radial gates in the Delta Cross Channel (DCC) facilities alter migration corridors available to green sturgeon. Actions such as the hydraulic dredging of ship channels and operations of large ocean going vessels create additional sources of risk to green sturgeon within the estuary. Commercial shipping traffic can result in the loss of fish, particularly adult fish, through ship and propeller strikes.

5. Water Depth

A diversity of depths is necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages. Subadult and adult green sturgeon occupy deep (≥ 5 m) holding pools within bays, estuaries, and freshwater rivers. These deep holding pools may be important for feeding and energy conservation, or may serve as thermal refugia (Benson *et al.* 2007). Tagged adults and subadults within the San Francisco Bay estuary primarily occupied waters with depths of less than 10 meters, either swimming near the surface or foraging along the bottom (Kelly *et al.* 2007). In a study of juvenile green sturgeon in the Delta, relatively large numbers of juveniles were captured primarily in shallow waters from 3 – 8 feet deep, indicating juveniles may require shallower depths for rearing and foraging (Radtke 1966).

Currently, there is a diversity of water depths found throughout the San Francisco Bay estuary and Delta waterways. Most of the deeper waters, however, are comprised of artificially maintained shipping channels, which do not migrate or fluctuate in response to the hydrology in the estuary in a natural manner. Shallow waters occur throughout the Delta and San Francisco Bay. Extensive "flats" occur in the lower reaches of the Sacramento and San Joaquin river systems as they leave the Delta region and are even more extensive in Suisun and San Pablo bays. In most of the region, variations in water depth in these shallow water areas occur due to natural processes, with only localized navigation channels being dredged (*e.g.*, the Napa River and Petaluma River channels in San Pablo Bay).

6. Sediment Quality

Sediment quality (*i.e.*, chemical characteristics) is necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of contaminants (*e.g.*, elevated levels of selenium, PAHs, and organochlorine pesticides) that can cause negative effects on all life stages of green sturgeon (see description of *sediment quality* for riverine habitats above).

Summary of the Conservation Value of Green Sturgeon Critical Habitat

The current condition of critical habitat for the green sturgeon sDPS is degraded over its historical conditions. It does not provide the full extent of conservation values necessary for the survival and recovery of the species, especially in the upstream riverine habitat. In particular, passage and water flow PCEs have been impacted by human actions, substantially altering the historical river characteristics in which the green sturgeon sDPS evolved. The habitat values proposed for green sturgeon critical habitat have suffered similar types of degradation as described for winter-run Chinook salmon critical habitat. In addition, the alterations to the Delta may have a particularly strong impact on the survival and recruitment of juvenile green sturgeon due to the protracted rearing time in the delta and estuary. Loss of individuals during this phase of the life history of green sturgeon represents losses to multiple year classes, which can ultimately impact the potential population structure for decades.

2.3 Environmental Baseline

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 (50 CFR 402.02).

The environmental baseline describes the status of listed species and critical habitat in the action area, to which we add the effects of the cumulative effects in the action area and the proporsed action, to consider the effects of the proposed Federal actions within the context of other factors that affect the listed species and their critical habitat. The effects of the proposed Federal action are evaluated in the context of the aggregate effects of all factors that have contributed to the status of listed species and, for non-Federal activities in the action area, those actions that are likely to affect listed species in the future, to determine if implementation of the Southport EIP is likely to cause an appreciable reduction in the likelihood of both survival and recovery or result in destruction or adverse modification of critical habitat.

The action area historically provided both shallow and deeper water habitat. Channel confining levees and upstream reservoirs that maintain year-round outflow have eliminated much of the adjacent shallow water floodplain habitat. Many native fish species are adapted to rear in flooded, shallow water areas that provide abundant cover and prey. As a consequence of habitat alterations, and the introduction of non-native species and pollutants, some native fish species are now extinct while most others are reduced in numbers (Moyle 2002).

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.

The natural banks and adjacent floodplains of the Sacramento River 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 river, 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).

Riparian forest typically has a dominant overstory of cottonwood, California sycamore, or valley oak. Species found in the scrub-shrub will make up the sub canopy and could also include white alder 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 are also found in riparian communities.

The herbaceous ruderal habitat 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, 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 project area.

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.

Within Southport area, bank erosion, and lateral migration of the channel is generally limited to a distance of 50 to 100 feet between the levee and river bank. These areas may be occupied by a narrow strip of riparian forest or riparian scrub/shrub. Based on aerial photo-interpretation of 1-foot resolution Digital Globe imagery (2008), many areas between the channel edge and closely set levees support either very little vegetation or a low density cover of weedy herbaceous plants. The majority of revetments present at the erosion sites and along the banks without erosion sites is >20 inches rock. The presence of levees and bank revetments and the loss of wide expanses of riparian forest currently limit IWM recruitment, bank erosion, and point bar formation, which in turn limit habitat diversity that will normally result from such natural processes.

Quantification of existing SRA cover nearshore and floodplain habitat conditions in the Southport EIP were measured by the SAM, is described in Appendix C of the 2014 Corps BA.

2.3.1 Status of the Species in the Action Area

The action area, which encompasses portions of the lower Sacramento River and associated riparian areas at and adjacent to the proposed construction site functions as a migratory corridor for CV spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, CCV steelhead, and sDPS of North American green sturgeon. The action area is also used for rearing and adult feeding.

1. <u>Presence of CCV Steelhead in the Action Area</u>

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 and San Joaquin rivers and their tributaries. FRFH steelhead are also included in this designation. All adult CCV 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 CCV 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 CCV steelhead DPS occurs in both the Sacramento River and the San Joaquin River watersheds. However the spawning population of fish is much greater in the Sacramento River watershed and accounts for nearly all of the DPS' population.

CCV steelhead smolts will first start to appear in the action area in November. This is based on the records from the CVP and SWP fish salvage facilities, as well as the fish monitoring program in the northern and central Delta. Their presence increases through December and January, peaks in February and March, and declines in April. By June, the emigration has essentially ended, with only a small number of fish being salvaged through the summer at the CVP and SWP. Adult steelhead are expected to move through the action area throughout the year with the peak of upriver immigration expected to occur August through November. There is potential exposure to adult steelhead moving back downstream in a post-spawn condition (kelts) through the action area during the February to May period. It is expected that more kelts will be observed earlier in the period (February) due to the timing of spawning in the Sacramento River basin.

Based on the temporal presence of adult and juvenile steelhead in the lower Sacramento River, the timing of the proposed project, and the location of the action area, it is likely that adult steelhead will be using the action area as a migration corridor during construction. Additionally, it is likely that juvenile steelhead may be emigrating through the action area during construction.

A similar application of the CVP and SWP salvage records and the northern and Central Delta fish monitoring data to the presence of CV spring-run Chinook salmon indicates 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 comprised 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.

2. <u>Presence of Sacramento River winter-run Chinook salmon in the Action Area</u>

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 actions 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. 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.

Based on the temporal presence of Sacramento River winter-run Chinook salmon in the lower Sacramento River, the timing of the proposed project, and the location of the action area, it is likely that adult and juvenile Sacramento River winter-run Chinook salmon will be using the action area.

3. Presence of North American green sturgeon in the Action Area

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.

Juvenile green sturgeon from the sDPS are routinely collected at the SWP and CVP salvage facilities throughout the year. However, numbers are considerably lower than for other species of fish monitored at the facilities. 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. The action area is located on the main migratory route that juvenile green sturgeon will utilize to enter the Delta from their natal areas upstream on the upper Sacramento River. The fact that juvenile green sturgeon are captured at the CVP and SWP facilities will indicate that green sturgeon are more likely to be present in the action area during the proposed project, and in higher densities, than are observed at the fish collection facilities. Likewise, since the action area is on the main migratory route utilized by adult green sturgeon to access the spawning grounds in the upper Sacramento River, it is likely that adult green sturgeon will be present in the action area. 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.

2.3.2 Status of Critical Habitat within the Action Area

The action area occurs within the CALWATER Hydrologic Unit (HU) for the Sacramento Delta Subbasin, designated HU 5510. Designated critical habitat for Sacramento River winter-run Chinook salmon (June 16, 1993, 58 FR 33212), CV spring-run Chinook salmon (September 2, 2005, 70 FR 52488), CCV steelhead (September 2, 2005, 70 FR 52488) and the sDPS of green sturgeon (October 9, 2009, 74 FR 52300) occur in this hydrologic unit. The HU includes portions of the Sacramento River and the DWSC. The critical habitat analytical review team (CHART) concluded that it contained one or more PCEs for both the CCV steelhead DPS and CV spring-run Chinook salmon ESU (NMFS 2005). The PCEs for steelhead and spring-run Chinook salmon habitat within the action area include freshwater rearing habitat and freshwater migration corridors. The features of the PCEs included essential to the conservation of the CCV steelhead DPS and CV spring-run Chinook salmon 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, 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 CCV steelhead and CV spring-run Chinook salmon juveniles and smolts and for adult freshwater migration. No spawning of CCV steelhead or CV spring-run Chinook salmon occurs within the action area.

Critical habitat for winter-run Chinook salmon includes the Sacramento River reach within the action area. Critical habitat elements include the river water, river bottom, and adjacent riparian zone used by fry and juveniles for rearing. Downstream migration of juveniles and upstream migration of adults should not be impeded or blocked. Adequate forage base is required to provide food for emigrating juvenile winter-run.

In regards to the designated critical habitat for the sDPS of green sturgeon, the action area includes PCEs concerned with: 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 present in the estuary; and sediment with sufficiently low contaminant burdens to allow for normal physiological and behavioral responses to the environment.

The general condition and function of the aquatic habitat has already been described in the *Status of the Species and Critical Habitat* section of this BO. The substantial degradation over time of several of the essential critical elements has diminished the function and condition of the freshwater rearing and migration habitats in the action area. It has only rudimentary functions compared to its historical status. The channels of the lower Sacramento River have been riprapped with coarse stone slope protection on artificial levee banks and these channels have been straightened 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 farming.

Even though the habitat has been substantially altered and its quality diminished through years of human actions, its conservation value remains high for Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. All juvenile winter-run and spring-run Chinook salmon, sDPS green sturgeon, as well as those CCV steelhead smolts originating in the Sacramento River basin must pass into and through the Sacramento Delta HU to reach the lower Delta and the ocean. A large fraction of these fish will likely pass downstream through the action area within the Sacramento River channel. Likewise, adults migrating upstream to spawn must pass through Sacramento Delta HU to reach their upstream spawning areas on the tributary watersheds or main stem Sacramento River. A large proportion of the population is expected to move through the action area within the main channel of the Sacramento River. Therefore, it is of critical importance to the long-term viability of the Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon ESUs, the sDPS of green sturgeon, and the Sacramento River basin portion of the CCV steelhead DPS to maintain a functional migratory corridor and freshwater rearing habitat through the action area and the Sacramento Delta subbasin HU in general.

2.3.4 Factors Affecting the Species and Habitat in the Action Area

The action area encompasses a small portion of the area utilized by the Sacramento River winter-run and CV spring-run Chinook salmon ESUs, and the CCV steelhead DPS as well as the sDPS of North American 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 will focus on the specific factors in the action area that are most relevant to the proposed project.

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 main stem of the river often truncate the peak of the flood hydrograph and extended 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 72°F (22.2°C), and create a thermal barrier to the migration of adult and juvenile salmonids (Kjelson *et al.* 1982). In addition, water diversions at the dams (*i.e.* Friant, Goodwin, La Grange, Folsom, Nimbus, and other dams) 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 juvenile salmonids in these tailwater sections (Reynolds *et al.* 1993). The elevated water temperatures compel many salmon juveniles to migrate out of the valley floor systems before summer heat makes the tailwaters 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 shaded riverine aquatic (SRA) cover. Individual bank protection sites typically range from a few hundred to a few thousand linear feet 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 accumulative 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 controlling riparian vegetation. Reach-level impacts which cause significant impacts to fish are reductions in new habitats of various kinds, changes to sediment and organic material storage and transport, reductions of lower food-chain production, and reduction in large woody debris

(LWD).

The use of rock armoring limits recruitment of LWD (*i.e.*, from non-riprapped areas), and greatly reduces, if not eliminates, the retention of LWD once it enters the river channel. Riprapping creates a relatively clean, smooth surface which diminishes the ability of LWD to become securely snagged and anchored by sediment. LWD 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 to fish and wildlife. Recruitment of LWD 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, and general lack of connectedness of remaining near shore 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 (*e.g.* green sturgeon, Klimley 2002). Organic contaminants from agricultural drain water, urban and agricultural runoff from storm events, and high trace element (*i.e.* 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, such as migration barriers, water conveyance factors, water quality, NIS, *etc.*, are discussed in the *Rangewide Status of the Species and Critical Habitat* section.

As previously stated in the *Rangewide Status of the Species and Critical Habitat* section, the transformation of the Sacramento River from a meandering waterway lined with a dense riparian corridor, to a highly leveed system under varying degrees of control over riverine erosional processes resulted in homogenization of the river, including effects to the rivers sinuosity. These impacts likely included the removal of valuable pools and holding habitat for North American green sturgeon. In addition, the change in the ecosystem as a result of the removal of riparian vegetation and LWD likely reduduced access to floodplain and offchannel rearing habitat, reduced the quantity and quality of benthic habitat and reduced the abundance prey items rearing, foraging and holding habitat.

2.4 Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

To evaluate the effects of the Southport EIP, NMFS examined the potential proposed actions in the designated action areas. We analyzed construction-related impacts and the expected short- and long-term fish response to habitat modifications using the SAM. We also reviewed and considered the Corps proposed conservation measures. This assessment relied heavily on the information from the Corps BA developed for the West Sacramento General Revaluation Report, supplemental SAM modeling reports and summaries, and available monitoring data from other CV fish studies.

The Southport EIP is a blend of flood risk reduction measures selected based on their effectiveness in addressing deficiencies, compatibility with land uses, minimization of real estate acquisition, avoidance of adverse effects, and cost. The proposed action includes a combination of setback levees, cutoff walls, and seepage berms (along with other measures). WSAFCA is proposing the Southport EIP to implement flood risk reduction measures along the Sacramento River South Levee in order to provide 200-year level of performance consistent with the state goal for urbanized areas, as well as to provide opportunities for ecosystem restoration and public recreation. The overall project involves the following elements.

1. Construction of flood risk reduction measures, including seepage berms, slurry cutoff walls, setback levees, rock and biotechnical slope protection, and encroachment removal.
2. Partial degrade of the existing levee, forming a "remnant levee."
3. Construction of offset areas using setback levees.
4. Construction of breaches in the remnant levee to open up the offset areas to Sacramento River flows.
5. Offset area restoration.
6. Road construction.
7. Drainage system modifications.
8. Utility line relocations.

The continued existence of any new or improved flood management structures, associated critical habitat disturbance, vegetation removal, and operational aspects may adversely affect several life stages of CV spring-run Chinook salmon, CCV steelhead, Sacramento River winter-run Chinook salmon, and the sDPS of North American green sturgeon in the action area. The assessment will consider the nature, duration, and extent of the potential actions relative to the migration timing, behavior, and habitat requirements of federally listed CV spring-run Chinook salmon, CCV steelhead, Sacramento River winter-run Chinook salmon, and sDPS of North American green sturgeon. Specifically, this assessment will consider the potential impacts resulting from the construction and subsequent O&M activites. Effects of the Southport EIP on aquatic resources include both short- and long-term impacts. Short-term effects, which are related primarily to construction activities (*i.e.*, increased suspended sediment and turbidity), may last several hours to several weeks. Long-term impacts may last months or years and generally involve physical alteration of the river bank and riparian vegetation adjacent to the water's edge.

The Southport EIP construction activities may increase noise, turbidity, suspended sediment, and sediment deposition that may disrupt feeding or temporarily displace fish from preferred habitat or impair normal behavior. Construction activities will also introduce rip rap material into the water column that may injure, harm, or kill listed fish. Some of these effects may occur downstream of the construction activities because noise and sediment may be propagated downstream. Substantial increases in suspended sediment could temporarily bury substrates and submerged aquatic vegetation that supports invertebrates for feeding juvenile fish. The Southport EIP will be implemented in increments and is described earlier in this BO. Some of the project increments will be of varying length, thereby impacting the subsequent analysis.

Post-construction, the only permanent facilities will be the slurry cutoff wall and an aggregate base, levee-top patrol road for the purpose of levee inspection and emergency vehicle access, and the levee O&M corridors. Typical levee O&M in the Southport EIP area currently includes the following actions.

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

This setback levee is a new section of levee constructed at some distance behind the landside of the existing levee. The existing levee will remain in place or be removed or breached, depending on the location. The new section of levee will be tied into the existing levee and then become the Federal project levee. The Southport EIP's new levee section will be constructed to meet current design standards, including height and slope requirements. The remnant levee sites will no longer be part of the Federal project levee thus not subject to the ETL.

Site repairs on the remnant levee will be designed both to control erosion and to maintain existing vegetation and IWM. This will be accomplished by incorporating rock benches that serve as buffers against erosion while providing space for planting riparian vegetation and creating a platform to support aquatic habitat features. IWM will be anchored along the remnant levee erosion sites to achieve at least 40 percent shoreline coverage, and will be placed between 1 and 3 feet below the elevation of the average annual low water surface. Existing vegetation and riprap at the erosion site will be retained. Post-construction, there will be no continued maintenance of the remnant levee. However, the remnant levee will be monitored periodically to ensure that future erosion does not jeopardize the flood risk–reduction measures. The landside toe O&M corridor will provide access for inspection and erosion repair, if needed. Portions of the remnant levee will be breached to allow Sacramento River flows into two separate offset areas during high flow events.

The new setback levees will be designed to be compliant with the ETL. Any vegetation removed as part of direct construction activities will not be replaced at that location, but may require offsite, in-kind habitat offsets, to be determined in consultation with the appropriate resource agencies.

The offset floodplain area refers to the two expanded floodways located between the proposed Southport setback levee and the remnant levee that will be created when portions of the existing levee are breached to allow Sacramento River water to flow into the offset area. Project activities in this area will include floodplain and habitat restoration and borrow excavation. The offset areas will be planted to provide habitat benefits to offset loss of vegetation removed as part of construction. The target plant communities in the offset floodplain area will include emergent marsh, riparian willow scrub, riparian cottonwood forest, mixed riparian woodland, elderberry shrubs and associated plants for valley elderberry longhorn beetle habitat, and grassland. Botanical and tree surveys conducted within the project area provided guidance on plant material selection for the newly created habitat as part of the Southport EIP. Revegetation of the offset areas and remnant levee is proposed as a means to compensate for construction impacts. The plants selected for the riparian willow scrub planting are intended to establish a self-sustaining mix of riparian scrub dominated by four species of willows. The areas within the offset area will be seeded, and the areas on the remnant levee with established herbaceous cover will not be seeded.

2.4.1 Construction Impact Analysis for Southport EIP

Implementation of the Southport EIP is presently expected to result in some direct adverse effects as well as the creation of habitat conditions that will provide significant benefits to federally listed fish and their habitat, as characterized below.

Species Affected	Impact Area	Habitat Creation
-Winter-run Chinook salmon -Spring-run Chinook salmon -Steelhead -Green sturgeon	-Permanent loss of 2,904 linear feet of SRA cover. -Loss of 0.04 acre of shallow water habitat.	-Creation of approximately 6,150 linear feet of SRA cover. -Creation of approximately 118.81 acres of seasonal shallow water habitat. -Erosion site repair design would provide an additional 0.23 acre of shallow water habitat along the Sacramento River.

NMFS expects that adult and juvenile CCV steelhead, adult winter-run Chinook salmon, adult spring-run Chinook salmon, and adult and juvenile green sturgeon may be present in the action area during construction activities. Only those fish that are holding adjacent to or migrating past the Southport EIP sites will be directly exposed or affected by construction activities. Those fish that are exposed to the effects of construction activities will encounter short-term (*i.e.*, minutes to hours) construction-related noise, physical disturbance, and water quality changes that may cause injury or harm by increasing the susceptibility of some individuals to predation by temporarily disrupting normal behaviors, and affecting sheltering abilities. If an adult salmonid were to enter the action area, they will likely exhibit avoidance behavior in response to construction and associated activities.

Larger fish will likely respond to construction activities by quickly swimming away from the construction sites, and will escape injury. Toxic substances used at construction sites, including gasoline, lubricants, and other petroleum-based products could enter the waterway as a result of spills or leakage from machinery and injure listed salmonids, and green sturgeon. Petroleum products also tend to form oily films on the water surface that can reduce DO levels available to aquatic organisms. NMFS expects that adherence to BMPs that dictate the use, containment, and cleanup of contaminants will minimize the risk of introducing such products to the waterway.

Green sturgeon move to estuaries and the lower reaches of rivers between late winter and early summer, and ascend rivers to spawn in the spring and early summer. Adult green sturgeon leave the rivers soon after spawning (Environmental Protection Information Center *et al.* 2001). Movement and foraging during downstream migration occurs at night for both larvae (approximately 10 days post-hatch) and juveniles (73 FR 52084; Cech *et al.* 2000, as cited in Reclamation 2008). Juvenile emigration reportedly occurs from May through September. Juvenile will experience the greatest exposure to construction activities.

Direct effects are defined as "the direct or immediate effects of the Proposed Action on the species or its habitat" (USFWS and NMFS, March 1998). Direct effects associated with in-river construction work will involve equipment and activities that will produce pressure waves, and create underwater noise and vibration, thereby temporarily altering in-river conditions.

Any increases in turbidity will most likely disrupt feeding and migratory behavior activities of juvenile salmonids (though they are not likely to be present). Turbidity and sedimentation events are not expected to affect visual feeding success of green sturgeon, as they are not believed to utilize visual cues (Sillman *et al.* 2005). Green sturgeon, which can occupy waters containing variable levels of suspended sediment and thus turbidity, are not expected to be impacted by the slight increase in the turbidity levels anticipated from the pile driving action as explained above. The construction activities are unlikely to impact any deepwater areas where the species spawn and hold.

NMFS expects that actual physical damage or harassment to listed fish species will be low relative to the overall population abundance during the months of construction. Adults will not sustain any physical damage due to construction because their size, preference for deep water, and their crepuscular migratory behavior will enable them to avoid most temporary, nearshore disturbance that occurs during typical daylight construction hours.

2.4.2 Standard Assessment Methodology Analysis

The Southport EIP impacts were analyzed using SAM. The Corps provided the background data, assumptions, analyses, and assessment of habitat compensation requirements for the federally protected fish species relevant to this consultation.
The following data sources were used to characterize SAM habitat conditions (as defined by bank slope, floodplain availability, substrate size, instream structure, aquatic vegetation, and overhanging shade) within the Southport EIP area under baseline conditions:

1. The Corps' Sacramento River revetment database.
2. Aerial images of the Southport EIP reach (Google™ Earth).

3. Southport EIP Revetment Condition Assessment – This report presents the results of a recent assessment of existing revetment conditions within the project reach, including extent of riprap cover, particle size distribution, bank profile, presence of vegetation, and photographs of representative sites (cbec 2012).
4. Southport Sacramento River EIP 65 percent Design Submittal Design Documentation Report –This report includes topographic profiles and photographs of the existing erosion sites that were used to characterize bank slope, substrate, and cover characteristics of specific subsegments within the Southport project area.
5. Tree locations and canopy diameters delineated during tree surveys conducted in 2012-2014.

The Southport EIP SAM employs these six habitat variables to characterize near-shore and floodplain habitats of listed fish species. The following describes how input values for each of these attributes were derived for existing conditions in the SAM assessment.

1. **Bank Slope:** Existing bank slopes were obtained from levee profiles drawn from topographic data collected at 18 riprap evaluation transects and 13 erosion study transects on the waterside slope of the Southport levee. Transect locations were imported into the GIS base map to determine the applicability of individual or multiple transects to specific subsegments. Additional levee profiles were obtained as needed from a CAD-based topographic surface of the existing project levee. Within each subsegment, the average slopes of the levee within the 3-foot depth zone below the average annual low and high water surface elevations (WSEs) were used to characterize the availability of shallow water habitat under average summer-fall and winter-spring inundation conditions.

2. **Floodplain Availability:** The SAM attribute of floodplain inundation ratio, which represents floodplain availability, was assumed to have a value of 1, reflecting the absence of significant floodplain habitat above the winter-spring shoreline under existing conditions.

3. **Bank Substrate Size:** The median substrate size along the summer-fall and winter-spring shorelines of the project reach was determined using a combination of particle size data collected at revetment transects (cbec 2012), photographs taken at revetment and erosion site transects (cbec 2012), aerial photography (Google Inc. 2010), and the revetment data (USACE 2008). For revetted sites, it was evident that the USACE database consistently overestimated the median particle sizes at individual revetment sites based on comparison of these values with the values generated from Wolman pebble counts at representative transects. Because of the higher level of accuracy associated with pebble counts, median particle sizes from pebble count data were used to characterize substrate conditions at existing revetment sites. Where data were lacking, the average of 6 inches from the pebble count data was applied to existing revetment sites.

4. **Instream Structure:** The extent of IWM along the average summer-fall and winter-spring shorelines of the Southport project reach could not be reliably quantified except at several subsegments where aerial and ground-based photography provided reasonable coverage. Therefore, the USACE's revetment database was used as the primary source

for these values. The revetment database uses four classes of instream structure, based on ranges of percent shoreline having IWM.

5. **Overhanging Shade:** The extent of overhanging shade along the summer-fall and winter-spring shorelines of the project reach was determined using a combination of tree survey data and aerial photography of the project reach taken in October 2010 (Google Inc. 2010). Polygons denoting the canopy coverage of each surveyed tree were imported into the GIS base map. The percent of the average summer-fall shoreline covered by shade was estimated within each segment based on the intersection of canopy cover with the apparent shoreline in the photograph (average Sacramento River flow at Freeport in October 2010 was approximately 12,000 cfs which is typical of fall flows in the Action Area). The percent of the average winter-spring shoreline covered by shade was estimated by shifting the shoreline position approximately 15 feet landward (based on an average slope of 3:1 for the project reach) and examining each sub-segment for any significant changes in the extent of overhanging canopy cover.

With-project conditions were characterized using the 90 percent design plans and specifications, including representative cross-sections of the proposed erosion repair sites, levee breaches, and levee setback areas, and assumptions related to the density and growth of planted vegetation within these project features. With-project conditions on the waterside levee slope were characterized by four major bank treatment types: erosion repair site, levee breach (including shoulder rock), and planted remnant levee. Existing conditions were assumed to persist throughout the 50-year project period for segments where no treatment was proposed. However, winter-spring floodplain inundation ratios for these segments were modified depending on the presence of a setback levee and the ratio of the distance of the new levee from the centerline of the river to the distance of the existing levee from the centerline of the river. Assumptions regarding the extent of shoreline cover (aquatic vegetation and overhanging shade) provided by planted vegetation are based on planting densities and canopy growth rates of trees and shrubs for similar bank protection designs.

Through iteration of the SAM, it was found that 1,000-1,500 linear feet of revegetated remnant levee (depending on existing SRA cover values) will be required to achieve full onsite compensation of SRA cover impacts along the summer-fall shoreline.

The following describes how input values for each of the SAM habitat attributes were derived for with-project conditions:

1. **Bank Slope:** For the erosion repair sites, a bank slope of 10:1 was assumed in winter and spring and 2:1 in summer and fall based on the design slopes and elevation of the constructed bench relative to the average seasonal water surface elevations. These changes will take effect in year two of the construction period based on the proposed construction schedule. For the levee breaches, a bank slope of 10:1 was assumed in winter and spring based on the design slope and elevation of the breaches relative to the average winter-spring water surface elevation. No change in levee slope was assumed for the toe of the levee breaches (below the summer-fall shoreline) or for the toe and upper slopes of the levee breach shoulders (above and below the summer-fall shoreline); if

needed, rock placed on these zones will match the contours of the existing levee slope. No changes in levee profile or slope were assumed for the planted remnant levee.

2. **Floodplain Availability:** For the Southport EIP site, the distance from the centerline of the Sacramento River to the centerline of the existing levee and the distance from the centerline of the river to the centerline of the proposed setback levee (perpendicular and through the center of each subsegment) were measured in GIS to calculate the floodplain inundation ratio for each sub-segment. Sub-segments without landward setback levees were assumed to retain a floodplain inundation ratio of 1:1. All summer-fall floodplain inundation ratios were assumed to be 1:1.

3. **Bank Substrate Size:** All bank treatments involving the placement of rock, it was assumed that the median size of rock will be 10 inches in diameter based on previous SAM assessments (*e.g.,* Jones and Stokes 2006). Although natural processes are expected to result in the deposition of fine sediment on the rock bench, 10-inch diameter rock was assumed to be the dominant substrate type along the winter/spring shoreline throughout the 50-year evaluation period because of uncertainties related to the timing and extent of sediment deposition. Where soil and/or coir fabric will be placed on top of the constructed bench, levee slope, or levee beach to create a planting surface, the median substrate size was assumed to be 0.25 inches. Based on the proposed construction schedule, changes in bank substrate size will take effect in year 2 or year 3 depending on the site. With-project conditions also include the temporary effects of culvert installation on existing habitat values within the footprints of the remaining levee breach sites. These effects include the replacement of existing substrate with 10-inch diameter rock along approximately 600 feet (200 feet per breach) of the existing levee in year 3. These culverts and associated rock revetment will be removed in year 5 to create the remaining levee breaches.

4. **Instream Structure:** For the Southport EIP site there will be an effort preserve existing IWM within the proposed levee breaches and erosion repair sites; however, it was assumed that all existing IWM will be eliminated from the summer-fall and winter-spring shorelines during construction. All erosion repair site designs include the installation of onsite and imported IWM that will be anchored on the waterside face of the constructed bench to enhance nearshore habitat values within the average summer-fall inundation zone (below 7-foot elevation). It was assumed that IWM will cover approximately 40 percent of the shoreline of each erosion repair site and will persist throughout the 50-year assessment period. With-project conditions also include the temporary effects of culvert installation on existing habitat values within the footprints of the remaining levee breach sites. These effects include the removal of existing vegetation along approximately 600 feet (200 feet per breach) of the existing levee in year 3.

5. **Aquatic Vegetation:** For the Southport EIP site, at the erosion repair sites, all existing riparian and aquatic vegetation below elevation 12 feet will be removed in year 2, resulting in the loss of instream cover primarily within the winter-spring inundation zone. In the same year, woody riparian vegetation will be planted on the constructed bench and adjacent slope, resulting in 20 percent cover along the winter-spring shoreline. At all

sites, it was assumed that planted vegetation will provide 20 percent shoreline cover through year 5, 50 percent by year 15, and 75 percent by year 25. An average of 75 percent shoreline cover is assumed to be maintained through year 50.

At the levee breach sites, degradation of the levee will result in the removal of all existing levee vegetation. This will occur in year 3 at the initial levee breach sites and year 5 at the remaining levee breach sites. In these years, woody riparian vegetation will be planted within the levee breach, resulting in 20 percent cover within the winter-spring inundation zone.

Within the levee breaches, it was assumed that planted vegetation will provide 20 percent cover through year 5, 50 percent by year 15, and 75 percent by year 25. An average of 75 percent shoreline cover is assumed to be maintained through year 50. It was assumed that the levee breach shoulders will be maintained free of vegetation throughout the 50-year assessment period.

With-project conditions also include the temporary effects of culvert installation on existing habitat values within the footprints of the remaining levee breach sites. These effects include the removal of existing vegetation along approximately 600 feet (200 feet per breach) of the existing levee in year 3. The same assumptions regarding the extent of cover provided by planted vegetation at the erosion repair sites will be applied to the remnant levee planting sites.

Overhanging Shade: At the erosion repair sites, the removal of all existing vegetation below elevation 12 feet will eliminate all canopy (shade) cover along the average summer-fall shoreline, while retention of upslope vegetation will preserve the shade along the average winter-spring shoreline. With the construction of the bench and planting of riparian vegetation on the bench and adjacent slope in year 2, it was assumed that planted vegetation will contribute 10 percent canopy cover through year 5, 25 percent canopy cover by year 15, and a maximum of 50 percent cover by year 25 over the average winter/spring shoreline. Based on projected canopy growth rates and the average width of the benches, these plantings are expected to provide 10 percent canopy cover by year 15 and a maximum of 20 percent by year 25 over the average summer-fall shoreline.

Degradation of the levee to create the levee breaches will result in the removal of all existing vegetation and canopy cover in year 3 at the initial levee breach sites and year 5 at the remaining levee breach sites. Similar to the erosion repair sites, woody riparian vegetation planted within the levee breach in these years is expected to result in 10 percent canopy cover within the winter-spring inundation zone. However, because of periodic coppicing of vegetation on the levee breach to minimize scour damage, it is assumed that canopy cover will be limited to a maximum of 25 percent (10 percent cover through year 5 and 25 percent between years 15 and 50).

Because of unrestricted growing conditions and the proximity of vegetation to the average winter/spring and summer-fall shorelines on remnant levees, it was assumed that planted vegetation on remnant levees will achieve greater canopy coverage and natural

IWM recruitment than that projected for the erosion repair sites. Accordingly, it was assumed that planted vegetation on remnant levees will provide 1) 10 percent canopy cover through year 5, 30 percent by year 15, and a maximum of 60 percent by year 25 over the average winter-spring shoreline, 2) 15 percent canopy cover by year 15 and a maximum of 40 percent by year 25 over the average summer-fall shoreline; 3) 10 percent instream structure (IWM) between years 15 and 50 within the average winter-spring inundation zone; and 4) 5 percent instream structure between years 15 and 50 within the average summer-fall inundation zone.

These values are comparable to those observed in areas of high riparian tree density on the existing project levee. With-project conditions also include the temporary effects of culvert installation on existing habitat values within the footprints of the remaining levee breach sites. These effects include the removal of existing vegetation and overhead canopy along approximately 600 feet (200 feet per breach) of the existing levee in year 3.

2.4.3 SAM Results

The Southport EIP will include the construction of a setback levee that will increase accessibility to historic floodplain habitat and result in positive growth and survival of Chinook salmon, steelhead and green sturgeon juvenile rearing and migration. The benefits are illustrated below in figure 8-12. These figures demonstrates that available linear feet of juvenile rearing Chinook salmon habitat will increase in the spring and winter and index a corresponding increase of fish growth and survival.

Although the Southport EIP is expected to be largely beneficial for salmon, steelhead and green sturgeon rearing and smolt migration, there are some adverse effects expected, though minor, compared the benefits. The adverse effects are related to temporary loss of riparian vegetation, IWM and an increase in new rock revetment along the remnant levee, levee breaches and breach stabilization measures, and installation of new revetment where the new setback levee will tie into the existing Federal levee. There will be an initial decrease in SAM modeled values, and index reduced growth and survival but the deficits are relatively small, and of short duration. The adverse and beneficial effects are illustrated in figures 8-12, below and summarized in table 11. Table 11 shows Southport EIP maximum SAM deficits, duration of deficits, and maximum SAM benefits by species, life-stage, and season.

Summary of CV spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, CCV steelhead and sDPS green sturgeon effects by water surface elevation:

At fall water surface elevations:

Reduced growth and survival of fry and juvenile rearing CV spring-run Chinook salmon, winter-run Chinook salmon, and CCV steelhead for 50+ years after construction activities associated with the Southport EIP due to impacts to riparian habitat, IWM, and bank substrate size. The amount and extent of this adverse effect is summarized in Table 11 of this BO. The amount and the effect is greatest in years 5 and 15 for each species at -16 ft, -16 ft, and -31 ft WRI respectively, and is reduced to -6 WRI, -6, and -11, respectively, by year 50. Following year 15, some recovery of values is expected. At year 50, the SAM modeled habitat conditions are still in the negative, but the values are minimal and the extent of adverse effects are negligible.

The SAM modeled green sturgeon response show no change for fry and juvenile rearing from baseline conditions for the first two years after construction. By year 5, values exceed baseline conditions and improved survival and growth is expected. At year 5, the WRI is 174 and reaches 258 by year 50. SAM values for juvenile migration do not change from baseline. Effects to other life stages were not modeled and are not expected because they are not present in the action area during this season.

At winter water surface elevations:

Reduced survival of adult migrating CV spring-run Chinook salmon, winter-run Chinook salmon, and CCV steelhead for up to 15 years after project construction due to impacts to riparian habitat, IWM, and bank substrate size. The amount and extent of this effect is quantified and summarized in Table 11 of this BO. The amount and extent the effect is greatest in year 5 for each species at -67 -67, and -133, respectively. Following year 5, values exceed baseline conditions and improved survival is expected. By year 15, values will increase over baseline to 17 at year 25 and reach 53 at year 50.

Reduced survival of adult residence CCV steelhead after project construction due to impacts to riparian habitat, IWM, and bank substrate size. The amount and extent of this effect is quantified and summarized in Table 11 of this BO. The amount and extent of the effect is greatest in year 5 at -133 WRI. Following year 5, values exceed baseline conditions and improved survival is expected. By year 25, values will increase over baseline to 12 at year 25 and reach 75 at year 50.

The SAM modeling shows no change to adult migrating green sturgeon and thus no adverse response is expected. For fry and juvenile rearing there is no change from baseline conditions for the first two years after construction. By year 5, values exceed baseline conditions and improved survival and growth is expected. At year 5, the WRI is 200 and reaches 506 by year 50.

Reduced growth and survival of adult resident sDPS green sturgeon for at least 50 years after project construction due to impacts to bank substrate size. The amount and extent of this effect is quantified and summarized in Table 11 of this BO. The amount and extent of harm is reaches -211 WRI at year 50 and does not recover over the life of the project.

Fry and juvenile rearing and juvenile migration growth and survival values for Chinook salmon, steelhead and green sturgeon will increase substantially at peak flow elevations, during periods of peak abundance of these life stages. These improved values are illustrated in figures 8-12.

At spring water surface elevations:

Reduced survival of adult migrating CV spring-run Chinook salmon, winter-run Chinook salmon, and CCV steelhead after project construction due to impacts to riparian habitat, IWM, and bank substrate size. The amount and extent of this effect is quantified and summarized in

Table 11 of this BO. The amount and extent of the effect is greatest in year 5 for each species at -67, -67, and -133, respectively. Following year 5, values exceed baseline conditions and improved survival is expected. By year 25, conditions for survival improve to 17 for salmon and 12 for steelhead. After year 25, further improvement in survival above baseline conditions is expected, reaching 53 for salmon and 75 for steelhead at year 50.

Reduced survival of adult residence CCV steelhead after project construction due to impacts to riparian habitat, IWM, and bank substrate size. The amount and extent of this effect is quantified and summarized in Table 11 of this BO. The amount and extent of this effect is greatest in year 5 at -133 WRI. Following year 15, values exceed baseline conditions and improved survival is expected. By year 25, conditions for survival are 12 and 75 by year 50.

The SAM modeling shows no change to adult migrating green sturgeon and thus no adverse response is expected. The model shows no response to spawning sturgeon for the first two years, and a marginal improvement from year 5-50, but spawning does not occur in this reach and thus, no benefits to spawning are expected. For fry and juvenile rearing there is no change from baseline conditions for the first two years after construction. By year 5, values exceed baseline conditions and improved survival and growth is expected. At year 5, the WRI is 200 and reaches 506 by year 50.

Reduced growth and survival of adult resident sDPS green sturgeon for at least 50 years after project construction due to impacts to bank substrate size. The amount and extent of this effect is quantified and summarized in Table 11 of this BO. The amount and extent of this adverse effect reaches -211 WRI at year 15 and does not recover over the life of the project.

Fry and juvenile rearing and juvenile migration growth and survival values for Chinook salmon, steelhead and green sturgeon will increase substantially at spring flow elevations, during periods of peak abundance of these life stages. These improved values are illustrated in figures 8-12.

At summer water surface elevations:

SAM modeled WRI values for winter-run Chinook salmon, CV spring-run Chinook salmon and CCV steelhead juvenile rearing for 50+ years after construction activities associated due to impacts to riparian habitat, IWM, and bank substrate size. The modeled effect is greatest in years 5 and 15 for each species at -16, -16, and -31 WRI respectively, and is reduced to -6 WRI, -6, and -11, respectively, by year 50. At year 50, the SAM modeled habitat conditions are still in the negative, but the values are minimal. Similarly, SAM modeled WRI values for migrating juveniles are negative for the first five years for CV spring-run Chinook salmon species at -9 WRI. Following year 5, values exceed baseline conditions and improved survival would be expected. The SAM modeled habitat conditions reach 15 by year 15 and 89 by year 50. However, even NMFS does not consider these values to be significant enough to reduce the growth or survival of individuals because they are not expected to be present during summer months.

The SAM modeling shows no change to adult migrating green sturgeon and thus no adverse response is expected. The model shows no response to spawning sturgeon for the first two years, and a marginal deficit from year 5-50, but spawning does not occur in this reach and thus, no benefits to spawning are expected. For fry and juvenile rearing there is no change from baseline conditions for the first two years after construction. By year 5, values exceed baseline conditions and improved survival and growth is expected. At year 5, the WRI is 174 and reaches 258 by year 50. The SAM modeling shows no change to juvenile migrating green sturgeon and thus no adverse response is expected. For adult residence, there is no change from baseline conditions for the first two years after construction. By year 5, values exceed baseline conditions to 120 WRI at year 5 and reach 176 by year 50, during which time improved survival and growth is expected.

SAM modeled survival conditions for adult and juvenile Chinook salmon and growth and survival conditions for adult and juvenile CCV steelhead either increase or do not change significantly from baseline. NMFS does not expect this response to be significant due to low abundance of these life stages during summer flow periods.

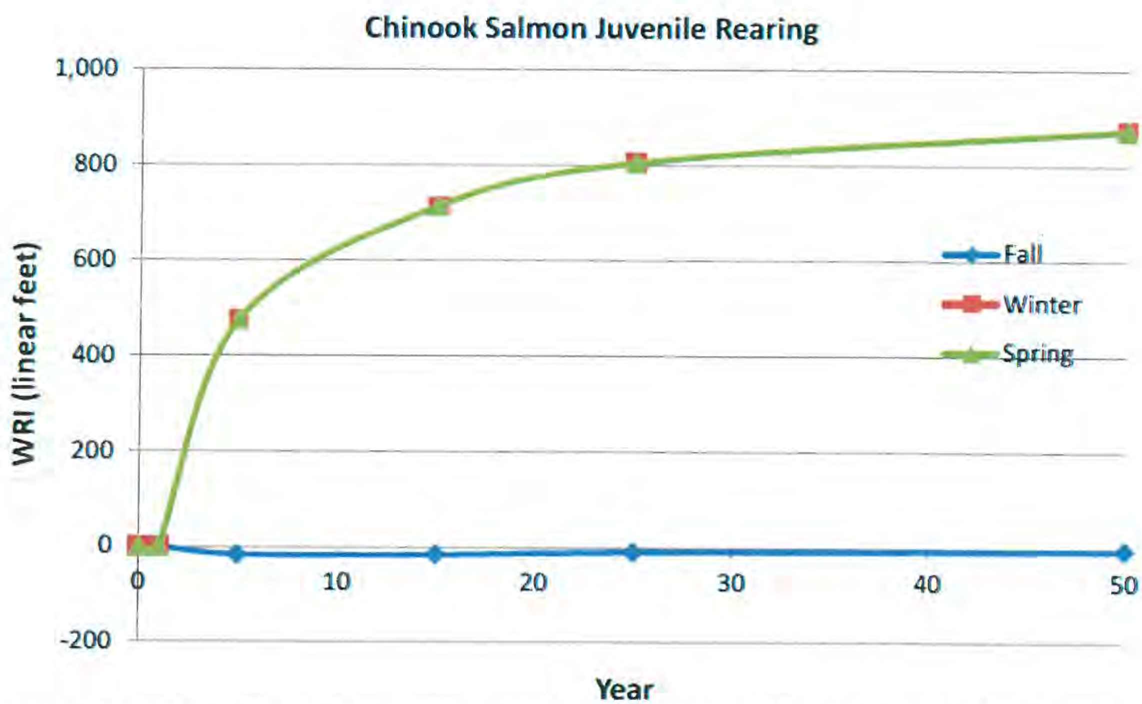


Figure 8. SAM modeled fish growth and survival indices for juvenile Chinook salmon rearing.

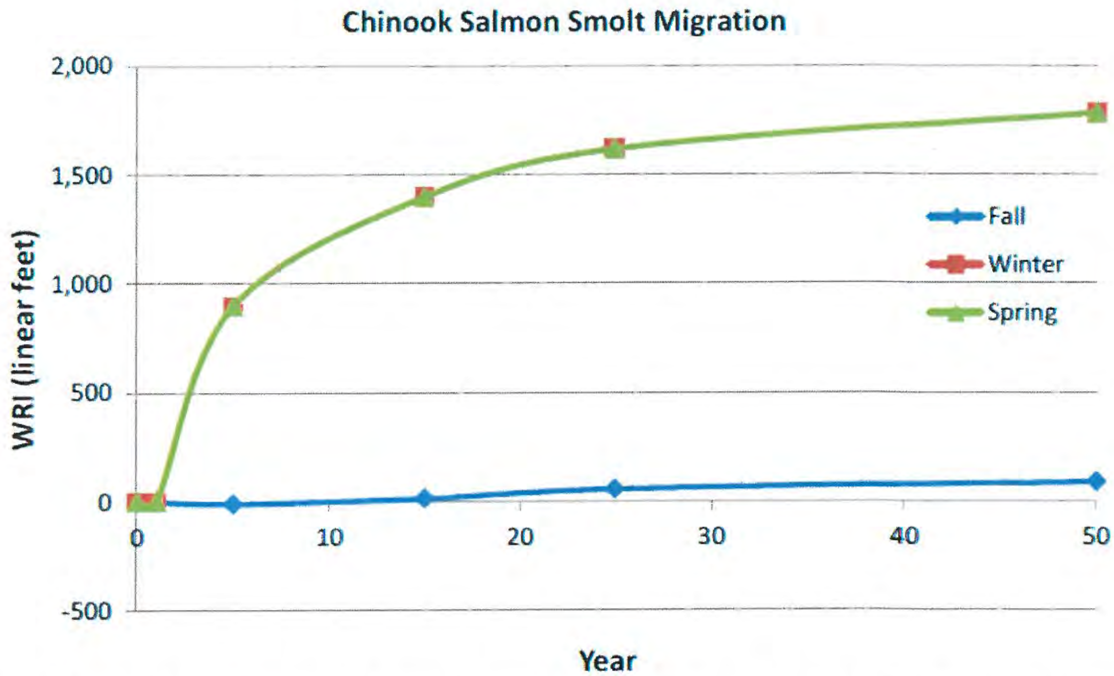


Figure 9. SAM modeled fish growth and survival indices for juvenile Chinook salmon migration.

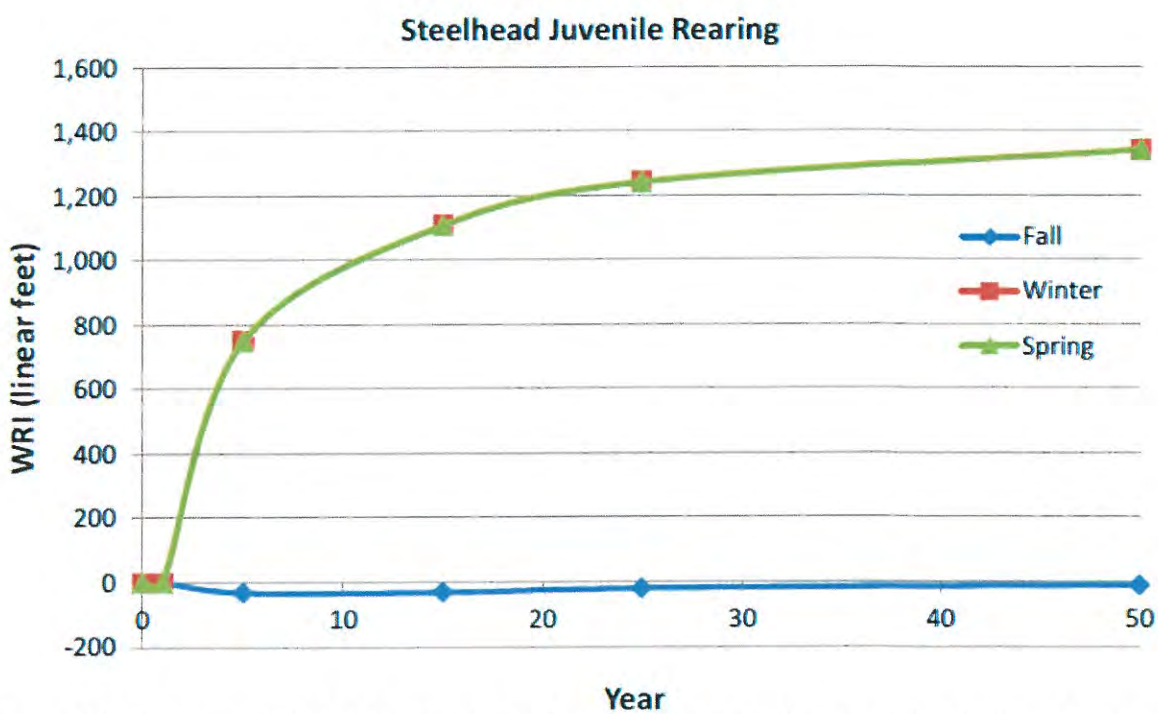


Figure 10. SAM modeled fish growth and survival indices for juvenile steelhead rearing.

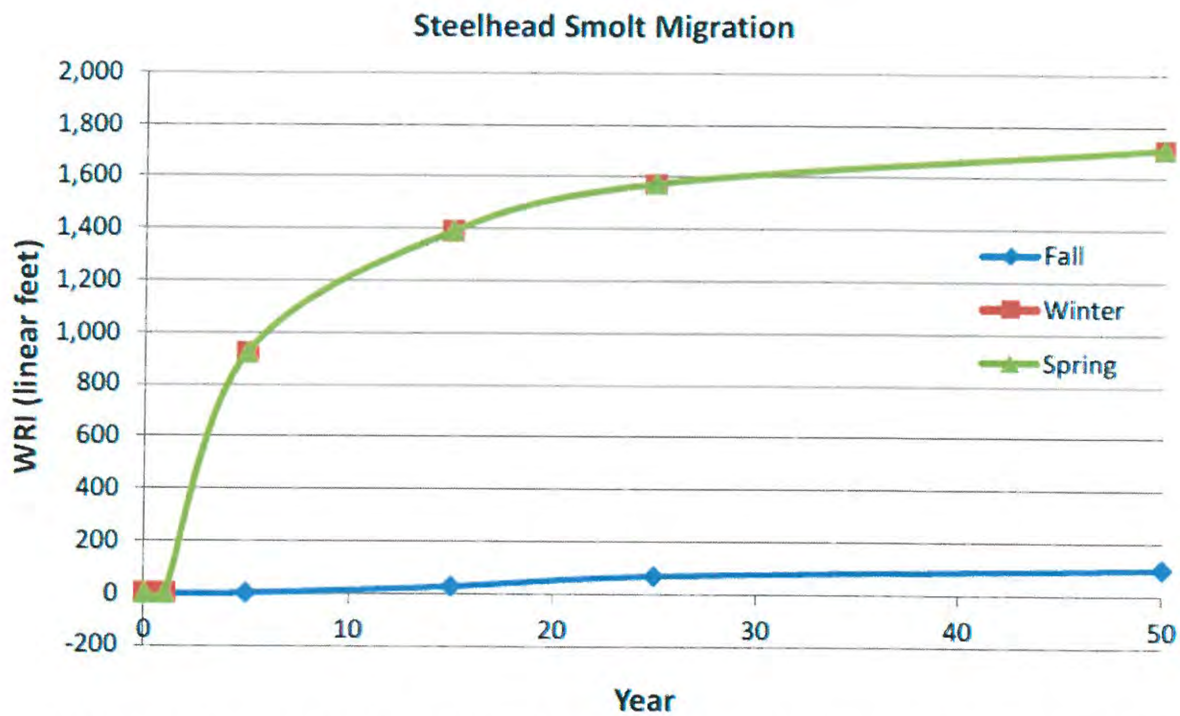


Figure 11. SAM modeled fish growth and survival indices for juvenile steelhead migration.

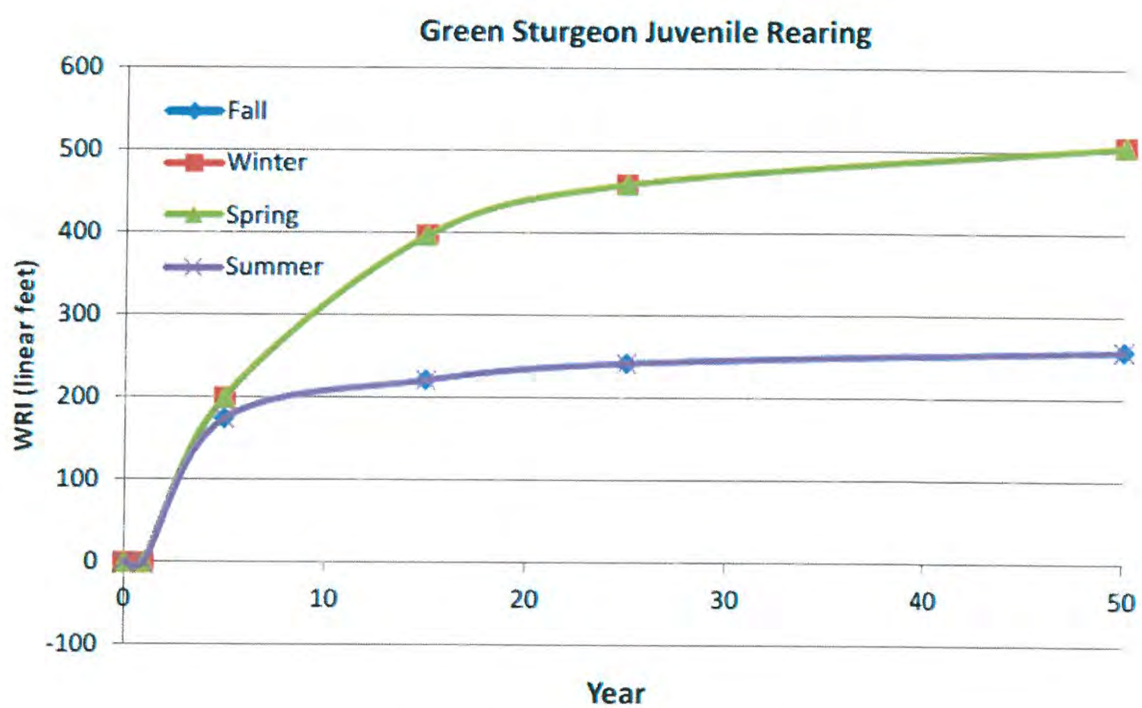


Figure 12. SAM modeled fish growth and survival indices for green sturgeon rearing.

Table 11: Southport EIP Maximum SAM Modeled WRI Deficits Below Baseline, Deficits and Duration of Deficits, and Maximum SAM Modeled WRI Values Above Baseline by Species, Life-Stage, and Season

Season	Life Stage	Maximum WRI Deficits Below Baseline	Duration of Deficit (in years)	Maximum WRI Values Over Baseline
Spring-Run Chinook Salmon				
Fall	Adult Migration	No deficit	NA	110
	Fry and Juvenile Rearing	-16	50+ years	No benefit
	Juvenile Migration	-9	5	89
Winter	Adult Migration	-67	15	53
	Fry and Juvenile Rearing	No deficit	NA	875
	Juvenile Migration	No deficit	NA	1,783
Spring	Adult Migration	-67	15	53
	Fry and Juvenile Rearing	No deficit	NA	875
	Juvenile Migration	No deficit	NA	1,783
Winter-run Chinook Salmon				
Fall	Adult Migration	No deficit	NA	110
	Fry and Juvenile Rearing	-16	50+ years	No benefit
	Juvenile Migration	-9	5	89
Winter	Adult Migration	-67	15	53
	Fry and Juvenile Rearing	No deficit	NA	875
	Juvenile Migration	No deficit	NA	1,783
Spring	Adult Migration	-67	15	53
	Fry and Juvenile Rearing	No deficit	NA	875
	Juvenile Migration	No deficit	NA	1,783

CCV Steelhead				
Fall	Adult Migration	No deficit	NA	218
	Fry and Juvenile Rearing	-31	50+ years	No benefit
	Juvenile Migration	No deficit	NA	100
	Adult Residence	No deficit	NA	218
Winter	Adult Migration	-133	15	75
	Fry and Juvenile Rearing	No deficit	NA	1,341
	Juvenile Migration	No deficit	NA	1,712
	Adult Residence	-133	15	75
Spring	Adult Migration	-133	15	75
	Fry and Juvenile Rearing	No deficit	NA	1,341
	Juvenile Migration	No deficit	NA	1,712
	Adult Residence	-133	15	75
Green Sturgeon				
Fall	Fry and Juvenile Rearing	No deficit	NA	258
	Juvenile Migration	0	NA	0
Winter	Adult Migration	0	NA	0
	Fry and Juvenile Rearing	No deficit	NA	506
	Adult Residence	-211	50+ years	No benefit
Spring	Adult Migration	0	NA	0
	Fry and Juvenile Rearing	No deficit	NA	506
	Juvenile Migration	0	NA	0
	Adult Residence	-211	50+ years	No benefit
Summer	Adult Migration	0	NA	0
	Fry and Juvenile Rearing	No deficit	NA	258
	Juvenile Migration	0	NA	0
	Adult Residence	No deficit	NA	176

2.5 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). 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.

2.5.1 Water Diversions and Agricultural Practices

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found along the West Sacramento GRS action area. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile listed anadromous species. For example, as of 1997, 98.5 percent 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 sDPS green sturgeon reproductive success and survival rates (Dubrovsky *et al.* 1998, 2000; Daughton 2003).

2.5.2 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 habits that have already been permanently lost as a result of dam construction. The loss of this available habitat results 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 fish, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production. Impacts of hatchery fish 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).

2.5.3 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-suspension of 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.

2.5.4 Global Climate Change

The world is about 1.3°F warmer today than a century ago and 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 +2°C and +7°C 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.* Sacramento River winter-run Chinook salmon and CCV steelhead) that must hold and/or rear downstream of the dam over the summer and fall periods.

Within the context of the brief period over which the proposed action is scheduled to be operated, however, the near term effects of global climate change are unlikely to result in any perceptible declines to the overall health or distributions of the listed populations of anadromous fish within the action area that are the subject of this consultation.

2.5.5 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 River watershed. For example, most of the levees have roads on top of the levees which are either maintained by the county, reclamation district, owner, or by the state. Landowners may utilize 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 the West Sacramento Project.

2.6 Integration and Synthesis

The *Integration and Synthesis* section is the final step of NMFS' assessment of the risk posed to species and critical habitat as a result of the proposed action. In this section, NMFS performs two evaluations: whether, given the environmental baseline and status of the species and critical habitat, as well as future cumulative effects, it is reasonable to expect the proposed action is not likely to: (1) reduce the likelihood of both survival and recovery of the species in the wild; and (2) result in the destruction or adverse modification of designated critical habitat (as determined by whether the critical habitat will remain functional to serve the intended conservation role for the listed anadromous species or retain its current ability to establish those features and functions essential to the conservation of the species).

The *Analytical Approach* described the analyses and tools we have used to complete this analysis. This section is based on analyses provided in the *Status of the Species*, the *Environmental Baseline*, and the *Effects of the Proposed Action*.

In our *Status of the Species* section, NMFS summarized the current 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 across their ranges. These factors include past and present human activities and 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* reviewed the status of the species and the factors that are affecting their survival and recovery in the action area. The *Effects of the Proposed Action* reviewed the exposure of the species and critical habitat to the proposed action and interrelated and interdependent actions, cumulative effects. NMFS then evaluated the likely responses of individuals, populations, and critical habitat. The *Integration and Synthesis* will consider all of these factors to determine the proposed action's influence on the likelihood of both the survival and recovery of the species, and on the conservation value of designated critical habitat.

The criteria recommended for low risk of extinction for Pacific salmonids are intended to represent a species and populations that are able to respond to environmental changes and withstand adverse environmental conditions. Thus, when our assessments indicate that a species or population has a moderate or high likelihood of extinction, we also understand that future adverse environmental changes could have significant consequences on the ability of the species to survive and recover. Also, it is important to note that an assessment of a species having a moderate or high likelihood of extinction does not mean that the species has little or no chance to survive and recover, but that the species faces moderate to high risks from various processes that can drive a species to extinction. With this understanding of both the current likelihood of extinction of the species and the potential future consequences for species survival and recovery, NMFS will analyze whether the effects of the proposed action are likely to in some way increase the extinction risk each of the species faces.

In order to estimate the risk to CV spring-run Chinook salmon, CCV steelhead, and green sturgeon as a result of the proposed action, NMFS uses a hierarchical approach. The condition of the ESU or DPS is reiterated from the *Status of the Species* section of this BiOp. We then consider how the status of populations in the action area, as described in the *Environmental Baseline*, is affected by the proposed action. Effects on individuals is summarized, and to the consequence of those effects is applied to establish risk to the diversity group, ESU, or DPS.

In designating critical habitat, NMFS considers the physical and biological features (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.

The basis of the "destruction or adverse modification" analysis is to evaluate whether the proposed action results in negative changes in the function and role of the critical habitat in the conservation of the species. As a result, NMFS bases the critical habitat analysis on the affected areas and functions of critical habitat essential to the conservation of the species, and not on how individuals of the species will respond to changes in habitat quantity and quality.

2.6.1 Status of the CV Spring-Run Chinook Salmon ESU

The CV spring-run Chinook salmon ESU is at moderate risk of extinction (Lindley *et al.* 2007). The most recent viability assessment of CV spring-run Chinook salmon was conducted during NMFS' 2011 status review (NMFS 2011b). This review found that the biological status of the ESU has worsened since the last status review. In the 2011, the ESU as a whole could not be considered viable because there were no extant viable populations in the three other diversity groups. In addition, Mill, Deer, and Butte creeks are close together geographically, decreasing the independence of their extinction risks due to catastrophic disturbance. These and other conditions covered in the 2011 status review have not changed since 2011. While the abundance for some populations appears to be slightly improving, the ESU is still demonstrating a high variability in adult abundance (especially in Butte Creek), we cannot say based on the trend over the past three years that the risk of extinction for the ESU has improved.

2.6.2 Summary of the Status of the CCV Steelhead DPS

All indications are that natural Central Valley steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good et al. 2005; NMFS 2011); the long-term trend remains negative. Hatchery production and returns are dominant over natural fish, and one of the four hatcheries is dominated by Eel/Mad River origin steelhead stock. Continued decline in the ratio between naturally produced juvenile steelhead to hatchery juvenile steelhead in fish monitoring efforts indicates that the wild population abundance is declining.

Hatchery releases (100 percent adipose fin-clipped fish since 1998) have remained relatively constant over the past decade, yet the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts has steadily increased over the past several years.

Although there have been recent restoration efforts in the San Joaquin River tributaries, CCV steelhead populations in the San Joaquin Basin continue to show an overall very low abundance, and fluctuating return rates. Lindley et al. (2007) developed viability criteria for Central Valley salmonids. Using data through 2005, Lindley et al. (2007) found that data were insufficient to determine the status of any of the naturally-spawning populations of CCV steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas.

The widespread distribution of wild steelhead in the Central Valley provides the spatial structure necessary for the DPS to survive and avoid localized catastrophes. However, most wild CCV 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 (NMFS 2011). The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to wild 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 CCV steelhead.

The CCV steelhead DPS is at high risk of extinction (NMFS 2011c), and the extinction risk is increasing. The most recent viability assessment of CCV steelhead was conducted during NMFS' 2011 status review (NMFS 2011c). This review found that the biological status of the ESU has worsened since the last status review recommend that its status be reassessed in two to three years as opposed to waiting another five years, if it does not respond positively to improvements in environmental conditions and management actions.

2.6.3 Summary of the Status of the Green Sturgeon southern DPS

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The risk of extinction is believed to be moderate because, although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices (NMFS 2010a).

Although the population structure of sDPS green sturgeon is still being refined, it is currently believed that only one population of sDPS green sturgeon exists. Lindley et al. (2007), in discussing winter-run Chinook salmon, states that an ESU represented by a single population at moderate risk of extinction is at high risk of extinction over the long run. This concern applies to any DPS or ESU represented by a single population, and if this were to be applied to sDPS green sturgeon directly, it could be said that sDPS green sturgeon face a high extinction risk. However, the position of NMFS, upon weighing all available information (and lack of information) has stated the extinction risk to be moderate (NMFS 2010a).

There is a strong need for additional information about sDPS green sturgeon, especially with regards to a robust abundance estimate, a greater understanding of their biology, and further information about their micro- and macro-habitat ecology.

2.6.4 Summary of Status of the Environmental Baseline and Cumulative Effects in the Action Area

The action area is used by most diversity groups and populations of the salmon, steelhead and green sturgeon ESUs and DPSs that are the subject of this BO. 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 (USFWS 2000). 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 (USFWS 2000). 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 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 describe how continuing or future effects such as non-Federal water diversions, the discharge of point and non-point source chemical contaminant discharges, and climate change 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.

2.6.5 Summary of Project Effects on Sacramento River Winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead and sDPS Green Sturgeon Individuals

1. Construction and O&M-related Effects

During construction and O&M, some injury or death to individual fish could result from rock placement (crushing), or predation related to displacement of individuals away from the shoreline or at the margins or turbidity plumes. These construction type actions will occur during summer and early fall months, when the abundance of individual salmon and steelhead is low and should result in correspondingly low levels of injury or death.

2. Long-term Effects Related to the Presence of Project Features

For juvenile and outmigrating salmon and steelhead, the proposed action will result in short- and long-term adverse effects to individual salmon and steelhead that are exposed to the project features along the Sacramento River. These adverse effects are indexed by SAM model results and expressed as WRI deficits. The long term WRI deficits are highest at fall and summer water surface elevations. We interpret those flow conditions to be consistent with summer and fall months, which are seasons during which individual Sacramento River winter-run, CV spring-run and CCV steelhead is low (fall), or they are absent.

SAM modeled WRI values for adult salmon and steelhead migration and steelhead residence (outmigrating post spawning adults) are deficits at winter, spring and summer water surface elevations. These effects are considered to be insignificant because, although modeled as a result of a reduction in IWM and riparian habitat, the actual survival of adults is unlikely to be affected because there will be no increase in predation, and the upstream migration will not be impeded by any structural features that influence upstream migration.

Although there are some SAM modeled deficits, Figures 8 through 12 clearly show the benefits related to reclamation of the setback area. Approximately 118 acres of historic habitat will be restored and periods of inundation (primarily winter and spring months), juvenile salmon, steelhead and green sturgeon will have access to this habitat and benefits from increased growth and survival.

2.6.6 Summary of Project Effects on Sacramento River Winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead and sDPS Green Sturgeon Critical Habitat

Within the action area, the relevant PCEs of the designated critical habitat for listed salmonids are migratory corridors and rearing habitat, and for green sturgeon the six PCEs include food resources, water flow, water quality, migratory corridors, water depth, and sediment quality.

Based on SAM modeled WRIs, we expect small reductions in the value of PCEs for salmon and steelhead freshwater rearing, but these reductions are at fall and summer water surface elevations and not at water surface elevations when the habitat use is the highest and most significant. There will also be SAM modeled WRI deficits for adult migration-related PCEs for all species. These deficits are also relatively small. Overall, we expect the reclamation of the historic floodplain will significantly contribute to the conservation value of all elements of critical habitat in the action area.

2.6.7 Summary

Although there are some short-term and small SAM modeled WRI deficits, the effects of these deficits, when added to the environmental baseline and cumulative effects in the action area are small, occur during seasons when fish abundance is low or they are not present at all, and is of short duration. In the case of fry and juvenile rearing and migration for all species, the SAM modeled WRI values show significant increases in the growth and survival of individuals, such that the incremental effects of the action are not expected to increase the extinction risk of the Sacramento River winter-run Chinook salmon and CV spring-run Chinook salmon and ESU CCV steelhead and green sturgeon DPS or reduce the conservation value of their designated critical habitat.

Furthermore, the anticipated growth and survival of salmon, steelhead and green sturgeon rearing and juvenile migration are substantially positive and demonstrate how integrating NMFS high priority recovery actions, such as setback levee construction and restoration of floodplain habitat can contribute to an increase in the production and abundance of the Sacramento River winter-run Chinook salmon and CV spring-run Chinook salmon and ESU CCV steelhead and green sturgeon DPS.

2.7 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, any effects of interrelated and interdependent activities, 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, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon or destroy adversely modify their designated critical habitat.

2.8 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.

The measures described below are non-discretionary, and must be undertaken by the Corps so that they become binding conditions of any grant, contract or permit, 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 permittee, contractor, or grantee to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit, contract or grant document, 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 NMFS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

2.8.1 Amount or Extent of Take

NMFS anticipates incidental take of adult and juvenile listed CV spring-run Chinook salmon, CCV steelhead, and juvenile sDPS of North American green sturgeon and juvenile Sacramento River winter-run Chinook salmon in the action area through the implementation of the proposed action.

NMFS anticipates incidental take of adult and juvenile listed Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon, in the action area through the implementation of the Southport EIP

NMFS cannot, using the best available information, quantify the anticipated incidental take of individual Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and the sDPS of North American green sturgeon because of the variability and uncertainty associated with the population size of each species, annual variations in the timing of migration, and uncertainties regarding individual habitat use of the project area. However, it is possible to describe the general programmatic conditions and ecological surrogates using negative SAM WRI values.

Accordingly, NMFS is quantifying take of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and the sDPS of North American green sturgeon incidental to the action resulting from short-term construction impacts, as well as long-term impacts as indexed by the SAM model.

The amount and extent of take described below is in the form of harm due to habitat impacts that will reduce the growth and survival of individuals from predation, or by causing fish to relocate and rear in other locations and reduce the carrying capacity of the existing habitat. This SAM values represent the extent of habitat impacts that will harm fish. As described in the *Analytical Approach* and the *Effects Analysis Sections* of this BO, the SAM values represent an index of fish response to habitat variables to which fish respond including bank slope, bank substrate size, instream structure, overhanging shade, aquatic vegetation and floodplain availability. Positive SAM values represent a positive growth and survival response and negative values index negative growth and survival. There is not a stronger ecological surrogate based on the information available. Due to a lack of site-specific fish data, the exact number of fish that will be affected is not known. The following level of incidental take from program activities is anticipated:

Incidental Take Associated with Construction:

1. Take of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS of North American green sturgeon in the form of injury and death from predation caused by construction-related turbidity that extends up to 100 feet from the shoreline, and 1,000 feet downstream, along all project reaches for levee construction activities.

2. Take of juvenile and smolt Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and the sDPS of North American green sturgeon, in the form of harm or injury of fish from O&M actions is expected from habitat-related disturbances from the annual placement of up to 600 cubic yards of material per site for the extent of the project life (*i.e.,* 50 years). Approximately 60 percent of the 600 cubic yards will be at or below the ordinary high water mark, or approximately 360 cubic yards. Take will be in the form of harm to the species through modification or degradation of the PCEs for rearing and migration that reduces the carrying capacity of

habitat.

Incidental Take Associated with Exposure to Project Facilities

At fall water surface elevations:

1. Take in the form of harm to fry and juvenile rearing CV spring-run Chinook salmon, winter-run Chinook salmon, and CCV steelhead for 50+ years after construction activities associated with the Southport EIP due to impacts to riparian habitat, IWM, and bank substrate size. The amount and extent of harm is quantified is summarized in Table 11 of this BO. The amount and extent of harm is greatest in year 15 for each species at -16 WRI, -16, and -31, respectively, and is reduced to -6, -6, and -11, respectively, by year 50.

2. Take in the form of harm to juvenile migrating CV spring-run Chinook salmon, and winter-run Chinook salmon 5-15 years after construction activities associated with the Southport EIP due to impacts to riparian habitat, IWM, and bank substrate size. The amount and extent of harm is quantified is summarized in Table 11 of this BO. The amount and extent of harm is greatest in year 5 for each species at -9 WRI, and -9, respectively. Following year 5, the SAM modeled habitat conditions exceed baseline conditions and harm from habitat modification is not expected.

At winter water surface elevations:

1. Take in the form of harm to adult migrating CV spring-run Chinook salmon, winter-run Chinook salmon, and CCV steelhead for up to 15 years after project construction due to impacts to riparian habitat, IWM, and bank substrate size. The amount and extent of harm is summarized in Table 11 of this BO. The amount and extent of harm is greatest in year 5 for each species at -67 WRI, -67, and -133, respectively. Following year 15, the SAM modeled habitat conditions exceed baseline conditions and harm from habitat modification is not expected.

2. Take in the form of harm to adult resident CCV steelhead after project construction due to impacts to riparian habitat, IWM, and bank substrate size. The amount and extent of harm is summarized in Table 11 of this BO. The amount and extent of harm is greatest in year 5 at -133 WRI. Following year 15, the SAM modeled habitat conditions exceed baseline conditions and harm from habitat modification is not expected.

3. Take in the form of harm to adult resident sDPS green sturgeon for at least 50 years after project construction due to impacts to bank substrate size. The amount and extent of harm is summarized in Table 11 of this BO. The amount and extent of harm reaches -211 WRI at year 50 and does not recover over the life of the project.

At spring water surface elevations:

1. Take in the form of harm to adult residence CCV steelhead after project construction due to impacts to riparian habitat, IWM, and bank substrate size. The amount and extent of harm is summarized in Table 11 of this BO. The amount and extent of harm is greatest in year 5 at -133 WRI. Following year 15, the SAM modelled habitat conditions exceed baseline conditions and harm from habitat modification is not expected.

2. Take in the form of harm to adult resident sDPS green sturgeon for at least 50 years after project construction due to impacts to bank substrate size. The amount and extent of harm is summarized in Table 11 of this BO. The amount and extent of harm is reaches -211 WRI at year 50 and does not recover over the life of the project.

2.8.2 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 (*i.e.,* beneficial effects of the Southport setback levee and floodplain reclamation and restoration), is not likely to result in jeopardy to the Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon or destruction or adverse modification of their critical habitat.

2.8.3 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 maintain, monitor, and adaptively manage all conservation measures as described in the MMP to ensure their effectiveness.

2. Measures shall be taken to minimize the impacts of bank protection and setback levee construction by implementing integrated onsite and offsite conservation measures that provide beneficial growth and survival conditions for salmonids, and the sDPS of North American green sturgeon.

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.

2.8.4 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 reasonable and prudent measures (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 incidental take statement (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 maintain, monitor, and adaptively manage all conservation measures as described in the MMP to ensure their effectiveness*."

   a. The Corps shall require WSAFCA to include in the MMP an overall goal of ensuring the setback floodplain area and the remnant levee have a high level of ecological function and value. The MMP shall be approved by NMFS prior to the onset of any riverside construction, including the placement of in-water revetment or construction of levee breaches.
   b. The MMP shall include specific goals and objectives and a clear strategy for achieving full compensation for all project-related impacts on the affected species described above.
   c. The MMP shall include a compensatory mitigation accounting plan to ensure the tracking of compensatory measures associated with Southport EIP and other future projects as described in the proposed action.
   d. The Corps and WSAFCA 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 MMP.
   e. The Corps and WSAFCA shall host an annual meeting and issue annual 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 MMP.
   f. The Corps and WSAFCA shall update their O&M Manual to ensure that the self-mitigating efforts and repair designs meet the expectation of the SAM values.

2. The following terms and conditions implement reasonable and prudent measure 2: "*Measures shall be taken to minimize the impacts of bank protection and setback levee construction by implementing integrated onsite and offsite conservation measures that provide beneficial growth and survival conditions for salmonids, and the sDPS of North American green sturgeon*."

   a. The Corps and WSAFCA shall ensure that the maximum SAM WRI deficits for each seasonal water surface elevation are fully offset in either the Southport offset area or through habitat improvements along the remnant levee.
   b. The Corps and WSAFCA 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.

c. The Corps and WSAFCA shall ensure that the planting of native vegetation will occur as described in the Corps 2014 BA and within this BO. All plantings must be provided with the appropriate amount of water to ensure successful establishment.

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 require that the WSAFCA provide a copy of this BO 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 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.
   c. The Corps and/or WSAFCA shall install IWM along remnant levee revetment sites at each seasonal water surface elevation consistent with the conservation measures defined in the MMP. The purpose is to maximize the refugia and rearing habitats for juvenile fish and to offset the negative SAM WRI values for adult salmon and steelhead.

2.9 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 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 land-side levee repairs instead of waterside repairs.
2. The Corps should develop an institutional mechanism for including NMFS in the review and approval of ETL variances for future projects that require ETL compliance.
3. The Corps should develop ETL vegetation variances for all flood management actions that are adjacent to any anadromous fish habitat.

4. 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 river banks, increasing the amount and extent of riparian vegetation along reaches of the Sacramento River Flood Control Project.
5. The Corps should encourage cost share sponsors and applicants to develop floodplain and riparian corridor enhancement plans as part of their projects.
6. The Corps should seek out opportunities for setback levee and other flood management activities that promote overall riverine system restoration.
7. The Corps should support and promote aquatic and riparian habitat restoration within the Sacramento River and other watersheds, especially those with listed aquatic species. Practices that avoid or minimize negative impacts to listed species should be encouraged.
8. The Corps should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects.
9. The Corps should continue to work with NMFS and other agencies and interests to restore fish passage 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.

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.

2.10 Reinitiation of Consultation

This concludes formal consultation for the Southport EIP.

As 50 CFR 402.16 states, reinitiation of formal consultation is required 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 incidental take statement 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 agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this 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 CONSULTATION

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 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) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the Corps and descriptions of EFH for Pacific coast salmon contained in the fishery management plans developed by the Pacific Fishery Management Council (updated through Amendment 18); *September 2014*.

The proposed action is described in detail in Section 1.3 of the Southport EIP BO.

3.1 Essential Fish Habitat Affected by the Project

The action area for the EIP has been identified as EFH for Pacific coast salmon. Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), CV spring-run Chinook salmon (*O. tshawytscha*), and CV fall-/late fall-run Chinook salmon (*O. tshawytscha*) are species managed under the Pacific coast salmon fishery management plan that occur within the proposed action area.

This BO addresses Sacramento River winter-run and CV spring-run Chinook salmon (*O. tshawytscha*). The Sacramento River winter-run and CV spring-run Chinook salmon are listed under both ESA and the MSA and potentially will be affected by the Southport EIP. This EFH consultation will concentrate on CV fall-/late fall-run Chinook salmon (*O. tshawytscha*) because their habitat is covered under the MSA but not covered in subject BO.

The Habitat Areas of Particular Concern (HAPCs) in the action area include complex channels, floodplain habitats and constrained channels with large woody debris.

3.2 Effects on Essential Fish Habitat

The effects of the proposed action on Pacific Coast salmon EFH will be similar to those discussed in the *Effects of the Action* section (2.4) for Sacramento River winter-run and CV spring-run Chinook salmon. Based on the information provided, NMFS concludes that the proposed action may adversely affect EFH for federally managed Pacific salmon. A summary of the effects of the proposed action on EFH for Chinook salmon are discussed below.

Adverse effects to the HAPCs of Pacific salmon EFH resulting from the proposed action construction activities may contribute sediment, increase turbidity, and increase localized sound levels, including areas downstream and upstream of the construction site. These impacts will occur only during the time when construction is occurring in or adjacent to the water column. There is potential for toxic compounds to be introduced into EFH during construction. This could occur at any time during the construction, both during in-water and out-of-water phases. All of the above impacts will be short-term. Construction activities may also eliminate or alter habitat that is essential to the life-cycle of Pacific salmon. For example, the addition of rock revetment to a previously vegetated bank may eliminate juvenile rearing habitat. These habitat impacts are better illustrated in Table 15 that summarizes SAM deficits for the Southport EIP

The proposed action will breach the existing levee and restore 119 acres of floodplain habitat. The action will also place a large amount of instream woody material into the channel of the Sacramento River and plant riparian vegetation along its banks. These actions will increase the amount of EFH HAPCs and area also expected to improve their ecological function for Pacific Salmon.

Regardless, the proposed action will result in some longer-term impacts to EFH HAPCs are due to habitat alterations. These impacts are detailed in the SAM analysis. For a summary of these SAM results, refer to Tables 15. Table 15 shows the Southport EIP maximum SAM deficits and maximum SAM benefits. For example, some SAM values never show small deficits that never recover, for example fry and juvenile rearing in the fall. Conversely, some SAM values show long-term benefits (no deficits) such as fall-run Chinook salmon adult migration in the fall.

Table 15: Southport EIP Maximum SAM Modeled WRI Deficits Below Baseline, Duration of Deficits, and Maximum SAM Modeled WRI Values by Species, Life-Stage, and Season

Season	Life Stage	Maximum WRI Deficits Below Baseline	Duration of Deficit (in years)	Maximum WRI Values Above Baseline
Fall-run Chinook Salmon				
Fall	Adult Migration	No deficit	NA	110
	Fry and Juvenile Rearing	-16	Does not recover	No benefit
Winter	Adult Migration	-67	15	53
	Fry and Juvenile Rearing	No deficit	NA	875
	Juvenile Migration	No deficit	NA	1,783
Spring				
	Fry and Juvenile Rearing	No deficit	NA	875
	Juvenile Migration	No data	No data	No data
Late Fall-run Chinook Salmon				
Fall	Adult Migration	No deficit	NA	110
	Fry and Juvenile Rearing	-16	Does not recover	No benefit
	Juvenile Migration	-9	15	89
Winter	Adult Migration	-67	15	53
	Fry and Juvenile Rearing	No deficit	NA	875
	Juvenile Migration	No deficit	NA	1,783
Spring	Adult Migration	-67	15	53
	Fry and Juvenile Rearing	No deficit	NA	875
	Juvenile Migration	No data	No data	No data

3.3 Essential Fish Habitat Conservation Recommendations

Fully implementing these EFH conservation recommendations will protect, by avoiding or minimizing the adverse effects to EFH HAPCs described in section 3.2. The Corps should mitigate for WRI deficits by offsetting the maximum deficits. Below is a summary of WRI that should be mitigated to minimize the adverse effects of the Southport EIP to Pacific coast salmon species. The Corps and WSAFCA should offset deficits either onsite or at a NMFS approved conservation bank. The mitigation should be at a 1:1 ratio if conducted prior to the compensation timing schedule described in the *Analytical Approach* section of the BO, or at a 3:1 ratio if carried out any later.

1. The maximum impact from the Southport EIP to adult fall-run Chinook salmon habitat is -67 WRI for at least 15 years.

2. The maximum impact from the Southport EIP to juvenile fall-run Chinook salmon habitat is -16 WRI, with no recovery within the 50 year time period measured.

3. The maximum impact from the Southport EIP to adult late-fall run Chinook salmon habitat is -67 WRI for at least 15 years.

4. The maximum impact from the Southport EIP to juvenile late-fall run Chinook salmon habitat is -16 WRI, with no recovery within the 50 year time period measured.

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 measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the 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, compensate, 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 WSAFCA, USFWS, CDFW, or DWR. Individual copies of this opinion were provided to the Corps and WSAFCA. This opinion will be posted on the Public Consultation Tracking System web site (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). 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 the 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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