Regional General Permit X

U.S. ARMY CORPS OF ENGINEERS BUILDING STRONG®

SMALL EROSION REPAIR PROGRAM (SERP)

EFFECTIVE DATE: TBD

EXPIRATION DATE: TBD

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee. The term "this office" refers to the U.S. Army Corps of Engineers, Sacramento District.

ISSUING OFFICE: U.S. Army Corps of Engineers, Sacramento District

ACTION ID: SPK-2006-00228

PERMITTEE: Department of Water Resources, Attn: Mr. Jon Ericson, 3310 El Camino Avenue, Sacramento, California 95821

AUTHORITIES: Section 10 of the Rivers and Harbors Act of 1899 for structures or work in or affecting navigable waters of the United States and Section 404 of the Clean Water Act for the discharge of dredged or fill material into waters of the United States.

PURPOSE: To streamline the authorization of the repair of small erosion sites along levees maintained by the California Department of Water Resources (DWR) within the Sacramento River Flood Control Project (SRFCP).

LOCATION: The Small Erosion Repair Program (SERP) coverage area is approximately 300 miles of levees on portions of the Sacramento River and its tributaries, including all or portions of the following waterways: Butte Creek; portions of Cache Creek; Cherokee Canal; Colusa Bypass; Colusa Main Drain (northern portion only); portions of the Feather River; portions of Putah Creek; Sacramento Bypass; portions of the Sacramento River; Sutter Bypass; Tisdale Bypass; Wadsworth Canal; Willow Slough Bypass; portions of Yolo Bypass; East and West Interceptor Canals. See the enclosed map titled, "Phase I SERP Area."

DESCRIPTION OF AUTHORIZED ACTIVITIES: This RGP authorizes the discharge of up to a maximum of 72,000 cubic yards (5 year total) of soil filled riprap, to repair a maximum of 15 sites each year over 5 years. Each SERP site would involve a maximum of 0.5 acre (and 1,000 linear feet) of disturbance below the ordinary high water mark or mean high water mark (OHWM/MHWM) for repair of small erosion sites along portions of the Sacramento River Flood Control Project. No project site would exceed 0.5 acres of disturbance or would extend for more than 1,000 linear feet. SERP is a collaborative interagency effort to develop a streamlined regulatory review and authorization process that will facilitate implementation of annual repairs of small erosion sites on levees within the SRFCP area. SRFCP area contains approximately 900 to 1,000 miles of levees. For the initial 5-year SERP effort, the coverage area is a subset of the SRFCP and represents approximately 300 miles of levees maintained by the DWR.

Specifically, this permit authorizes the DWR to implement the SERP (as described in the Small Erosion Repair Program Manual over a 5-year period along the SRFCP in accordance with the conservation-based design standards identified in the Small Erosion Repair Program Manual, provided the activity meets all of the following criteria:

1. Activities at each SERP site shall not result in impacts to more than 1,000 linear feet and/or 0.5-acre within the jurisdictional limits of waters of the U.S.

2. No site shall take more than two weeks of active (continuous) construction, not including revegetation unless this criterion is waived in writing by the district engineer.

3. No material shall be placed in excess of the minimum needed for erosion protection.

4. The activity shall not involve discharges of dredged or fill material into special aquatic sites, unless this criterion is waived in writing by the district engineer.

5. No fill material shall be placed in any location, or in any manner, that impairs surface water flow into or out of any water of the United States;

6. The activity shall not be a stream channelization activity.

PERMIT DURATION: This permit is valid for 5 years from issuance and will expire on **TBD**. The Corps may re-evaluate the terms and conditions of this permit at any time it deems necessary to protect the public interest. This permit may be re-issued, after public notice and documentation of the decision. Activities under this permit must be verified in writing by the Corps. Verifications are valid for 5 years. If work has not been completed prior to expiration of the verification the applicant must request an extension at least 30 days prior to the expiration date.

PROCEDURES:

1. You must submit a completed and signed SERP Project notification form requesting verification under this RGP, which is included in Section 5 of the SERP Manual (Attachment A). To process the notification, the form and supporting documents must be completed and submitted to the Sacramento District's Regulatory Division office at 1325 J Street Room 1325, Sacramento California 95819.

2. The contents of the notification shall include the following:

   a. Completed SERP Project Notification Form.

   b. A description of how each site would comply with the conditions of this RGP.

   c. A vicinity map, plan-view and cross-section drawings clearly depicting the location, size and dimensions of each proposed activity, as well as the location of the ordinary high water mark (OHWM) of non-tidal waters, or the high tide line (HTL) and mean high water mark (MHWM) of tidal waters. The drawings shall contain a title block, legend and scale, nearby structures, parcel boundaries, and dimensions of the proposed fill. All drawings shall comply with the Final Map and Drawing Standards for the South

Pacific Division Regulatory Program, which can be found at http://www.spd.usace.army.mil/Portals/13/docs/regulatory/standards/map.pdf.

d. A delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, within the proposed project area. The delineation shall show the location of the OHWM of non-tidal waters or the HTL and MHWM of tidal waters, shall be completed using the currently approved Corps delineation manual, and shall meet the Sacramento Districts *Minimum Standards For Acceptance of Preliminary Wetland Delineations,* dated November 30, 2001.

e. Biological information sufficient to demonstrate compliance with the Fish and Wildlife Service Biological Opinion (Number 08ESMF00-2013-F-0450, dated September 24, 2013) and the National Marine Fisheries Service Biological Opinion (Number 2013/9493, dated October 29, 2013) and the technical assistance letter (dated January 28, 2014).

f. A description of measures proposed to be taken to avoid and minimize impacts to the aquatic environment, including those to wetlands, Federally-listed threatened and/or endangered species, spawning habitat, and shallow water habitat, to the maximum extent practicable.

g. A description of any historic properties which may be affected by the proposed work, include a vicinity map indicating the location of historic resources, and identifying the potential for the presence of historic resources. If it is determined by this office that the project may affect cultural resources, you may be required to submit a cultural resources report, prepared in accordance with the February 25, 2011 *Guidelines for Compliance with Section 106 of the National Historic Preservation Act* (http://www.spk.usace.army.mil/Portals/12/documents/regulatory/pdf/2011-02-25_Section_106_Guidelines.pdf).

h. Pre-project color photographs of the proposed erosion repair site(s), the shoreline where the repair site(s) would be accessed, and the areas upstream, downstream, and across the channel from of the proposed repair location. The location of the photographs shall be identified on the plan view drawing required in subpart (b) of this condition.

i. Evidence you have applied for and/or received any required permits from the California State Lands Commission (SLC) (http://www.slc.ca.gov/). If a permit is not required from SLC and/or CVFPB, evidence must be provided in the SERP PCN.

3. Within 15 days following receipt of the SERP Notification Package, this office will notify you in writing if:

a. The proposed erosion repair projects may qualify for authorization under this RGP.

b. The Notification Package is complete.

c. Consultation under Section 7 of the Endangered Species Act (ESA) and/or Section 106 of the National Historic Preservation Act (NHPA) is required.

If the SERP notification package is not complete, the notification will specifically identify the additional information required to be submitted.

4. Within 15 days following receipt of a complete SERP Notification package, this office will initiate any required consultations under Section 7 of the ESA and/or Section 106 of the NHPA.

5. Within 15 days following completion of required consultations under Section 7 of the ESA and/or Section 106 of the NHPA, or, if consultation is not required, within 45 days following receipt of a complete PCN, this office will notify you via letter if the project is authorized under and subject to the terms and conditions of this RGP.

6. No work may proceed under the authority of this RGP until you have been notified, in writing, by this office that the activity is authorized.

PERMIT CONDITIONS:

1. **Special Conditions:** This office may add special conditions to verifications under this RGP to ensure the authorized activity has minimal impacts on the aquatic environment. Such conditions may include those required for compliance with Section 7 of the ESA and Section 106 of the NHPA.

2. **Endangered Species and Essential Fish Habitat:** This Corps permit does not authorize you to take an endangered species, in particular the federally-threatened: delta smelt (*Hypomesus transpacificus*), valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), giant garter snake (*Thamnophis gigas*), Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley steelhead (*O. mykiss*), and North American green sturgeon (*Acipenser medirostris*); or the endangered Sacramento River winter-run Chinook salmon (*O. tshawytscha*), or any associated designated critical habitat for these species. In order to legally take a listed species, you must have separate authorization under the Endangered Species Act (e.g., an Endangered Species Act Section 10 permit, or a Biological Opinion under Endangered Species Act Section 7, with "incidental take" provisions with which you must comply). The enclosed Fish and Wildlife Service Programmatic Biological Opinion Number 08ESMF00-2013-F-0450, dated September 24, 2013) and the National Marine Fisheries Service Biological Opinion (Number 2013/9493, dated October 29, 2013) and the technical assistance letter (dated January 28, 2014), contain mandatory terms and conditions to implement the reasonable and prudent measures that are associated with "incidental take" that is also specified in the Biological Opinions. Your authorization under this Corps permit is conditional upon your compliance with all of the mandatory terms and conditions associated with "incidental take" of the attached Biological Opinions, which terms and conditions are incorporated by reference in this permit. Failure to comply with the terms and conditions associated with incidental take of the Biological Opinions, where a take of the listed species occurs, would constitute an unauthorized take, and it would also constitute non-compliance with your Corps permit. The U. S. Fish and Wildlife Service and the National Marine Fisheries Service are the appropriate authority to determine compliance with the terms and conditions of their Biological Opinions, and with the Endangered Species Act. You must comply with all conditions of this/these Biological Opinions, including those ascribed to the Corps.

To ensure your project complies with the Magnuson-Stevens Fishery and Consultation Act, you must implement all of the mitigating measures and Essential Fish Habitat Recommendations identified in the above National Marine Fisheries document, including those ascribed to the Corps therein.

3. **Cultural Resources:** No activity is authorized that may affect cultural resources listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

4. **Discovery of Previously Unknown Remains and Artifacts:** If you discover any previously unknown historical or archeological remains during construction of the structure authorized by this permit, you shall immediately cease work and notify this office of what was found. The Corps will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

5. **Tribal Rights:** You shall ensure that the erosion repair does not impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

6. **Timing Windows:** You shall comply with the in-water and upland work windows identified in Section I, Conservation Measures of the SERP Manual.

7. **Aquatic Life Movements:** No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area. You shall ensure that the PCN contains information on how impacts to aquatic life movements will be avoided and/or minimized.

8. **Spawning Areas.** You shall avoid activities in spawning areas during spawning seasons to the maximum extent practicable. For erosion repair sites located within spawning areas, you shall ensure that the Notification Package contains information on how spawning areas will be avoided and/or how impacts to spawning areas will be minimized.

9. **Migratory Bird Breeding Areas:** You shall avoid breeding areas for migratory birds to the maximum extent practicable. For erosion repair sites located within migratory bird breeding areas, you shall ensure that Notification Package includes information on how breeding areas will be avoided and/or how impacts to migratory bird breeding areas will be minimized.

10. **Suitable Material:** You shall use suitable materials and shall ensure that materials used for construction are free from pollutants in toxic amounts (see Section 307 of the Clean Water Act).

11. **Wild and Scenic Rivers:** You shall not discharge fill in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a “study river” for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate agency responsible for the designated Wild and Scenic River or Study River. You shall not conduct any work under authority of this RGP until you have received this written determination, and shall submit proof of receipt of the determination to this office prior to construction activities in navigable waters.

12. **Contractor Compliance:** You are responsible for all authorized work and ensuring that all contractors and workers are made aware of and adhere to the terms and conditions of the permit authorization. You shall ensure that a copy of the permit authorization and associated drawings are available and visible for quick reference at the site until all construction/installation activities are completed.

13. **Notification of Start and Complete Dates:** You shall notify this office of the start date for the authorized work within 10 days prior to beginning work within waters of the U.S. and of the completion date for the authorized work within 30 days following completion of work within waters of the U.S.

14. **Floodplain Management**. The activities authorized under this RGP must comply with applicable FEMA-approved state or local floodplain management requirements.

15. **Maintenance of Authorized Fill**. You shall maintain any activity authorized by this RGP in good condition and in conformance with the terms and conditions of this permit. Should you wish to cease to maintain the authorized activity or should you desire to abandon it, you must obtain a modification of this permit from this office, which may require restoration of the area.

16. **Corps Inspections.** Work authorized under this permit may be inspected by the Corps at any reasonable time to assure that it is being or has been completed in compliance with the terms and conditions of this permit.

17. **Navigation:** For activities authorized under Section 10 of the Rivers and Harbors Act:

a. Your use of the permitted activity must not interfere with the public's right to free navigation on all navigable waters of the United States.

b. No activity may cause more than a minimal adverse effect on navigation.

c. Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at your expense on authorized facilities in navigable waters of the United States.

d. You understand and agree that, if future operations by the United States require the removal, relocation, or other alteration of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, you will be required, upon due notice from the Corps, to remove, relocate, or alter the structural work or obstructions caused hereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration

18. **Flowing Waters.** The pre-construction course, condition, capacity, and location of open waters shall be maintained for each activity authorized under this RGP. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to manage high flows.

19. **Compliance Certification.** You shall include a signed Compliance Certification for each site in the required annual report as described in the SERP Manual to the Corps and provide an electronic copy to the issuing office within 30 days after completion of the authorized work.

FURTHER INFORMATION:

1. **Congressional Authorities:** You have been authorized to undertake the activity described above pursuant to: Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Section 404 of the Clean Water Act (33 U.S.C. 1344).

2. **Limits of this authorization:**

a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal projects.

3. **Limits of Federal Liability.** In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. **Reliance on Applicant's Data.** The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. **Reevaluation of Permit Decision.** This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (see 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. **Extensions.** The permit duration, as described above, establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Activities not meeting the terms and conditions of this permit may be authorized through another type of permit from the Corps, such as a Nationwide Permit or Letter of Permission. The Corps will determine on a case-by-case basis whether an activity has a more than minimal impact, individually or cumulatively, on the aquatic environment or may be contrary to the public interest. The Corps may include additional special conditions to verification under this permit to ensure the activity has minimal impact.

CONTACTS AND ADDITIONAL INFORMATION: Please submit requests for verification under this RGP to: Krystel Bell, Senior Project Manager, USACE-Sacramento District Regulatory Division, 1325 J Street, Room 1350, Sacramento, California 95814.

ATTACHMENTS:

Attachment A: Small Erosion Repair Manual
Attachment B: USFWS Programmatic Biological Opinion
Attachment C: NMFS Programmatic Biological Opinion
Attachment D: Programmatic 401 Water Quality Certification
Attachment E: Compliance Certification

California Department of Resources
Small Erosion Repair Program Manual

Prepared on behalf of:

AECOM

July 2012

California Department of Resources
Small Erosion Repair Program Manual

Prepared on behalf of:

California Department of Water Resources
3310 El Camino Avenue, Suite 110
Sacramento, CA 95821

Contact:

Jeff Schuette
916/574-1355

Comments received by:

DFG 5/31/2012

USFWS 5/31/2012

DWR Legal: 5/29/2012

Corps: 5/23/2012

DWR: Eric Mcgrath 5/21/2012

CVFPB 6/11/2012

Kelly Briggs 6/13/2012

Noel Lerner: 6/18/2012

Not reviewed or no comments from:

RWQCB

Maintenance Yards

NMFS

Prepared by:

AECOM
2020 L Street
Sacramento, CA 95811

Contact:

Lisa Mangione
916/414-5800

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ACRONYMS AND ABBREVIATIONS

APE	area of potential effects
BAC	Baseline Assessment Checklist
BGEPA	Bald and Golden Eagle Protection Act
BO	biological opinion
Board	Central Valley Flood Protection Board
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
CVFPP	Central Valley Flood Protection Plan
CWA	Clean Water Act
CWC	California Water Code
Delta	Sacramento–San Joaquin River Delta
DFG	California Department of Fish and Game
DPEIR	draft program environmental impact report
DWR	California Department of Water Resources
EA	environmental assessment
EFH	essential fish habitat
EIS	environmental impact statement
ESA	Endangered Species Act
FONSI	finding of no significant impact
FPEIR	final program environmental impact report
FWCA	Fish and Wildlife Coordination Act
GGS	giant garter snake
GIS	geographical information system
HPTP	historic properties treatment plan
Km	kilometer
LMAs	Local Maintaining Agencies
m	meter
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act

MSA	Magnuson–Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NLAA	not likely to adversely affect letter
NMFS	National Marine Fisheries Service
NOP	notice of preparation
O&M	operations and maintenance
OHWM	ordinary high-water mark
OPR	Office of Planning and Research
PA	Programmatic Agreement (NHPA section 106)
PEIR	program environmental impact report
PCA	Pesticide Control Adviser
Phase 1	initial 5-year SERP effort
RGP	Regional General Permit
RM	river mile
RWQCB	Central Valley Regional Water Quality Control Board
SAA	streambed alteration agreement
SERP	Small Erosion Repair Program
SHPO	State Historic Preservation Officer
SLC	State Lands Commission
SPCP	Spill Prevention and Control Plan
SRA	shaded riverine aquatic
SRFCP	Sacramento River Flood Control Project
TCPs	traditional cultural properties
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USFWS	U.S. Fish and Wildlife Service
VMS	vegetation management strategy
VMZ	vegetation management zone
WSE	water surface elevation

A. PROGRAM PROPOSAL

PROGRAM OVERVIEW

INTRODUCTION

The Small Erosion Repair Program (SERP) is a collaborative interagency effort to develop a streamlined regulatory review and authorization process that will facilitate implementation of annual repairs of small erosion sites on levees within the Sacramento River Flood Control Project (SRFCP) area. The SRFCP contains approximately 900 to 1,000 miles of levees. For the initial 5-year (Phase 1) SERP effort, the coverage area is a subset of the SRFCP and represents approximately 300 miles of levees maintained by the California Department of Water Resources (DWR) (see Figure A1).

The term "levees" as used in this document is broadly defined to include levees and associated waterside slopes within the levee prism that are part of the SRFCP and addressed in operations and maintenance (O&M) manuals for identified flood management facilities maintained by DWR or other local maintaining agencies (LMAs).

To maintain the design integrity of the existing flood management system and to maintain or enhance fish and wildlife resources, levees with erosion damage that may lead to further loss of soil or potential failure should be repaired in a timely manner. Currently, small erosion repair projects require issuance of permits on a project-by-project basis. The multiple layers of agency authorizations and level of interagency coordination required for individual site repairs has generally resulted in long-term project delays up to several years, posing a potential public safety hazard and often leaving the eroded areas susceptible to further damage, greater repair costs, and loss of riparian vegetation.

To address this problem, the SERP Subcommittee was formed at the direction of the Interagency Flood Management Collaborative Program Group (Interagency Collaborative Group) on January 17, 2007. The subcommittee consists of a group of federal and state resource agency representatives charged with defining what constitutes a small erosion repair and determining appropriate repair designs that will adequately protect the levee system while avoiding substantial adverse effects on environmental resources. The subcommittee members have worked in concert to craft a program intended to improve current erosion repair practices, and thus to maintain the necessary level of flood risk reduction while seeking to achieve a cumulative net benefit to aquatic and terrestrial fish and wildlife resources, including habitat for sensitive species.

PURPOSE AND OBJECTIVES

The purpose of the SERP is to ensure the continued flood management integrity of the SRFCP levees while protecting environmental resources by providing an efficient method of selecting, evaluating, and permitting small erosion repair projects. The SERP uses programmatic authorizations, issued by federal and state agencies with regulatory obligations associated with erosion repair projects to streamline the process for implementing small erosion repairs in accordance with conservation-based design and monitoring standards established by the SERP Subcommittee. Projects that qualify under the SERP are eligible to receive authorization within a shortened time frame because they are designed to minimize effects on fish and wildlife resources, including listed species, and to protect and enhance the existing aquatic and riparian habitats comprising the riverine corridor.

The program sets apart similar small erosion repair sites and develops a streamlined permitting process for these sites with the following goals:

- provide quicker repairs to small erosion sites, thereby preventing erosion areas from becoming larger;
- foster consistent regulatory compliance efforts for similar repairs, from the standpoint of both environmental protection and operations and maintenance; and
- obtain measurable data to evaluate program success.

The identified objectives of the proposed levee/bank repairs will be to:

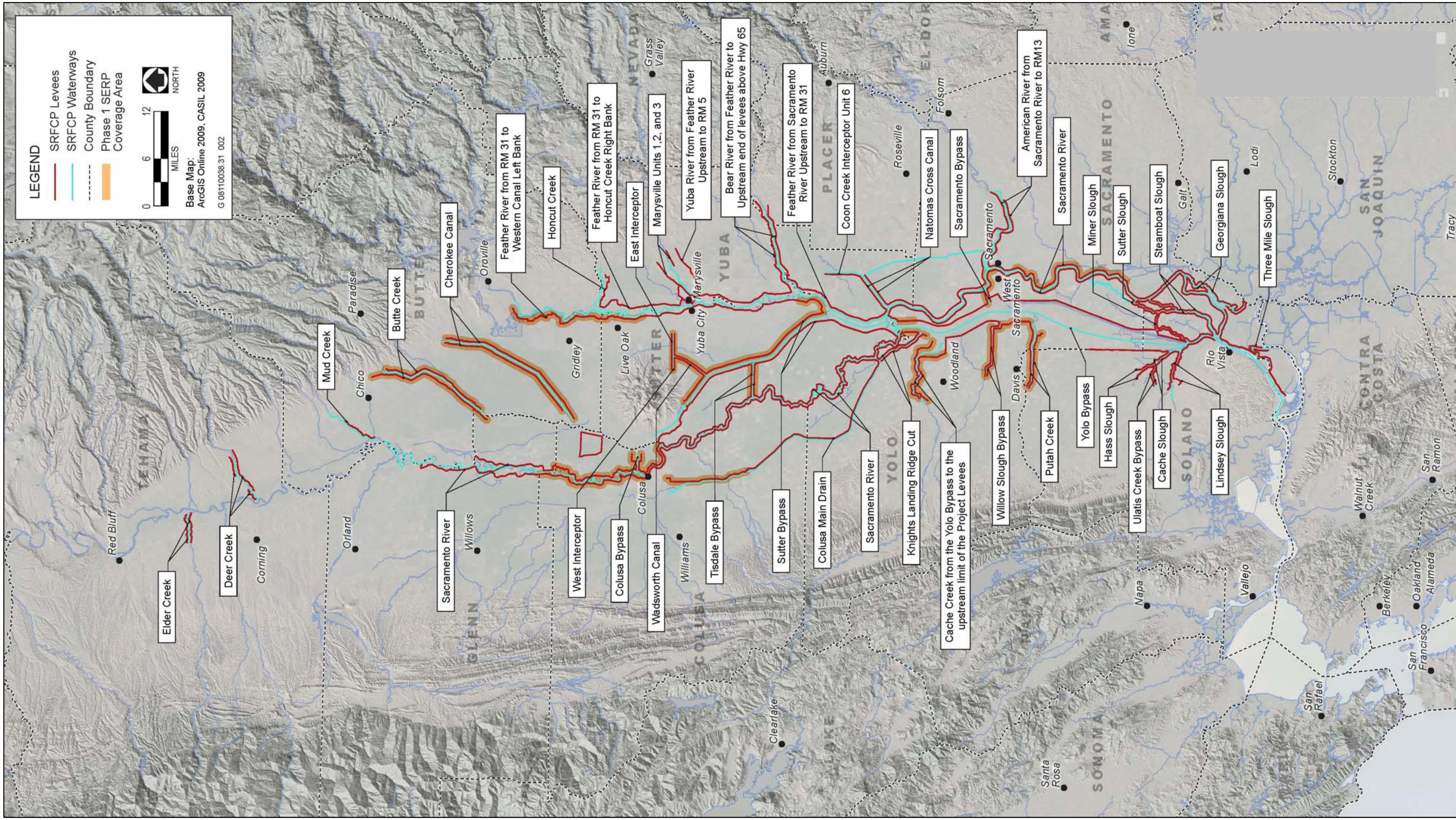
- maintain SRFCP integrity;
- prevent further erosion and loss of riparian and nearshore aquatic habitat;
- minimize the loss of riparian vegetation and endangered species habitat resulting from delayed repairs and construction activities; and
- enhance the existing riparian vegetation corridor at the erosion sites, where applicable.

CONTEXT WITH REGIONAL PRIORITIES

The environmentally sensitive erosion repair practices and the interagency cooperation incorporated into the SERP support a variety of national, regional, and local priorities.

The SERP Subcommittee was established at the direction of the Interagency Collaborative Group to further the overall objectives of that group. The subcommittee was formed to facilitate a collaborative approach to achieving environmental compliance for maintenance of regional flood management facilities. The SERP ensures that required operations and maintenance activities associated with small erosion repairs are conducted in a manner that integrates environmental and flood risk reduction objectives, and thus builds on the regional programs and agency priorities under the purview of the Interagency Collaborative Group.

The 5-year Phase 1 SERP coverage area lies within the larger SRFCP area. Phase 1 projects will be limited to levees maintained by DWR within the SRFCP. After the Phase 1 implementation period, the Interagency Collaborative Group intends to evaluate the



DWR 2010:

Figure A1 **Phase 1 SERP Coverage Area**

program's success and expand the SERP to include sites repaired by other LMAs throughout the Sacramento–San Joaquin Drainage District.

The SERP is one of many efforts being developed and implemented under the FloodSAFE California Initiative. The FloodSAFE vision is a sustainable integrated flood management and emergency response system throughout California that improves public safety, protects and enhances environmental and cultural resources, and supports economic growth by reducing the probability of destructive floods, promoting beneficial floodplain processes, and lowering the damages caused by flooding. DWR is providing leadership and working with local, regional, state, tribal, and federal officials to improve flood management and emergency response systems throughout California.

The Central Valley Flood Protection Plan (CVFPP), another FloodSAFE effort, is a plan for improving integrated flood management in the Sacramento–San Joaquin Valley. The first edition of this long-term planning document, the 2012 CVFPP, is being prepared in coordination with federal, tribal, regional, and local entities and other interested parties, will be updated every 5 years, and will guide many subsequent implementation activities. The SERP is a part of this plan.

The SERP thus provides a template for potential future expansion and use by LMAs, and is an integral component of regional long-term planning efforts and sustainable integrated flood management goals.

PROGRAM SCALE AND SCOPE

GEOGRAPHIC SCOPE

The SRFCP consists of federally constructed flood management features such as levees, dams, weirs, and bypass channels where associated pumping, drainage, and water management facilities occur within the Sacramento River system. The SRFCP contains approximately 900 to 1,000 miles of levees within approximately 620 miles of waterways (including rivers, creeks, streams, sloughs, and bypasses), waterside banks, and levees of the flood management system (see Figure A1). DWR is responsible for the maintenance of approximately 300 miles of these levees, and approximately 60 other LMAs are responsible for the remainder. For Phase 1, the initial 5 years of the SERP, only levees maintained by DWR (approximately 300 miles) will be included within the SERP. After Phase 1 of the program, the Interagency Collaborative Group intends to evaluate the program's success (see Section H, "Monitoring and Success Criteria") and consider expanding the SERP coverage area to include sites repaired by LMAs throughout the Sacramento–San Joaquin Drainage District.

WATERSHED DESCRIPTION

The SRFCP is located within the Sacramento River watershed, which drains California's northern Central Valley into the middle and lower reaches of the Sacramento River and encompasses 27,000 square miles. On average, over 22 million acre-feet of water flows through the Sacramento River watershed each year (SVWQC 2004:2). The flows consist of approximately one-third of the total runoff in California and annually average 19,000 cubic feet per second (cfs) (SVWQC 2004:2). The Sacramento River is the longest river (447 miles) entirely within California. The Sacramento River is also the state's largest river by discharge, rising in the Klamath Mountains and flowing south for over 400 miles before reaching Suisun Bay, an arm of San Francisco Bay, and then to the Pacific Ocean.

The Sacramento River's hydrology has been altered by dam, weir, and levee construction. The flood management facilities that DWR maintains are located within the valley floor of the watershed. The valley drainages include the Feather River watershed, American River watershed, Sutter Bypass watershed, Yolo Bypass watershed, and Sacramento River watershed. LMAs, including DWR's maintenance yards, maintain the levees along the waterways listed below, all of which will be eligible for inclusion in the SERP (see Figure A1). However, only the waterways identified below are included in the SERP for Phase 1. After Phase 1 is complete, the Interagency Collaborative Group intends to evaluate the program's success and consider expanding the SERP coverage area to include the repair of erosion sites along the leveed sections of the remaining waterways.

PHASE 1 WATERWAYS

- Butte Creek
- Cache Creek from the Yolo Bypass to the upstream limit of the SRFCP levees
- Cherokee Canal
- Colusa Bypass
- Northern portion of Colusa Main Drain, as identified in Figure A1
- Portions of Feather River, as identified in Figure A1
- Putah Creek
- Sacramento Bypass
- Portions of Sacramento River, as identified in Figure A1
- Sutter Bypass
- Tisdale Bypass
- Wadsworth Canal
- Willow Slough Bypass
- Portions of Yolo Bypass, as identified in Figure A1
- East and West Interceptor Canals

POTENTIAL FUTURE SERP WATERWAYS

- American River from Sacramento River to River Mile (RM) 13
- Bear River from the Feather River to the upstream end of the levees above State Route 65
- Cache Slough
- Southern Portion of Colusa Main Drain, as identified in Figure A1
- Coon Creek Group Interceptor Unit 6
- Deer Creek
- Elder Creek
- Remaining portions of Feather River, as identified in Figure A1
- Georgiana Slough
- Hass Slough
- Honcut Creek
- Lindsey Slough
- Marysville Units 1, 2, and 3
- Miner Slough
- Mud Creek
- Natomas Cross Canal
- Remaining portions of Sacramento River, as identified in Figure A1
- Steamboat Slough
- Sutter Slough
- Knights Landing Ridge Cut
- Three Mile Slough
- Ulatis Creek Bypass
- Remaining portions of Yolo Bypass, as identified in Figure A1
- Yuba River from Feather River, upstream to RM 5

AREA TOPOGRAPHY

The northern Central Valley, in which the SRFCP is located, stretches about 150 miles beginning near the town of Red Bluff in the north down to the southeast. There the Central Valley merges with the Sacramento–San Joaquin River Delta (Delta) south of the city of Sacramento. The valley is 30 to 45 miles wide in the southern to central parts, but narrows to about 5 miles near Red Bluff. Its elevation decreases almost imperceptibly from 300 feet at its northern end to near sea level in the Delta (Olmstead and Davis 1961, cited in SVWQC 2004:1). Topography of individual project sites will likely consist of gentle terrain along the creek channels to steep-sloping terrain along creek embankments and levees.

LAND USES

The primary land uses adjacent to the waterways included in the SERP are agricultural, urban, silvicultural, and open space. The largest urban center is the Sacramento metropolitan area. Agricultural uses include rice, vineyards, pasture, field crops, grain crops, and orchards. Based on acreage, rice is the largest agricultural crop in the Phase 1 SERP coverage area and historically has been the most prominent crop in the Sacramento River watershed. Irrigated pastures and orchards are the next most prominent crops. The number of farms in the area has decreased dramatically in the last decade, primarily caused by loss of farmland to urban and industrial uses (SRWP 2008).

Numerous public lands are located adjacent to the Sacramento River and its tributaries within the Phase 1 SERP coverage area. These include several wildlife refuges such as the Sacramento River Wildlife Refuge, North Central Valley Wildlife Management Area, Sutter National Wildlife Refuge, Stone Lakes National Wildlife Refuge, and Vic Fazio Yolo Wildlife Area. The Sacramento metropolitan area contains more than a dozen parks adjacent to the Sacramento River and American River. Among the larger parks are the American River Parkway and Discovery Park. Brannon Island State Recreation Area is located near the confluence of Three Mile Slough and the Sacramento River.

The major urban centers protected by DWR flood management facilities include Chico, Yuba City/Marysville, the greater Sacramento metropolitan area, and Davis. The confluence of the American River and Sacramento River is located near downtown Sacramento. These urban lands include residential, commercial, and industrial properties.

BIOLOGICAL RESOURCES

Special aquatic and floodplain resources such as riparian habitats and valuable aquatic resources for fish populations are located throughout the Phase 1 SERP coverage area.

The Phase 1 SERP coverage area and immediate vicinity contain potentially suitable habitat for approximately 31 federally listed plants and animal species, identified in the U.S. Fish and Wildlife Service (USFWS) Sacramento Office's species database list,[1] and approximately 18 state-listed species according to the California Natural Diversity Database (CNDDB). Of these species, 12 are dually listed as federally and state-protected species. Overall, approximately 90 special-status species (federally and state listed plus other special status-species) have potential to occur within the Phase 1 SERP coverage area and its immediate vicinity, according to a CNDDB search (CNDDB 2009).

The SERP Subcommittee has determined that eight of the federally listed species will be addressed by the SERP programmatic authorizations. In addition, marine mammal species to be covered will be determined through coordination with the National Marine Fisheries Service (NMFS). State-listed species such as California black rail (state listed as threatened), Swainson's hawk (state listed as threatened), bank swallow (state listed as threatened), greater sandhill crane (state listed as threatened), and western yellow-billed cuckoo (state listed as endangered) will be addressed in the program environmental impact report (PEIR), prepared pursuant to the California Environmental

1 USFWS. 2009. The database is continually updated and was last updated on January 29, 2009.

Quality Act (CEQA). In Table A1, species indicated with an asterisk (*) have designated critical habitat proposed, finalized, or designated Essential Fish Habitat.

Table A1
Federally and State-Listed Species Addressed through ESA Section 7 or CEQA under the SERP

Species Common Name	Species Name	Listing Status
California black rail	*Laterallus jamaicensis coturniculus*	ST
Bank swallow	*Riparia riparia*	ST
Delta smelt*	*Hypomesus transpacificus*	ST, FT, SCE
Central Valley Chinook salmon fall-/late fall-run ESU*	*Oncorhynchus tshawytscha* fall- / late fall-run	EFH Designated
Central Valley steelhead DPS*	*Oncorhynchus mykiss*	FT
Chinook salmon spring-run ESU*	*Oncorhynchus tshawytscha* spring-run	ST, FT
Chinook salmon winter-run ESU*	*Oncorhynchus tshawytscha* winter-run	SE, FE
Giant garter snake	*Thamnophis gigas*	ST, FT
Greater sandhill crane	*Grus Canadensis tabida*	ST
North American green sturgeon, Southern DPS	*Acipenser medirostris*	FT
Swainson's hawk	*Buteo swainsoni*	ST
Valley elderberry longhorn beetle*	*Desmocerus californicus dimorphus*	FT
Western yellow-billed cuckoo	*Coccyzuz americanus occidentalis*	SE
Marine mammal species	To be determined	Various

Notes:
DPS = Distinct Population Segment; EFH = Essential Fish Habitat; ESU = Evolutionary Significant Unit
FE = Federally listed endangered; FT = Federally listed threatened; SCE = State candidate endangered
SE = State-listed endangered; ST = State-listed threatened
* Species that have designated critical habitat proposed, finalized, or designated Essential Fish Habitat.
Source: Compiled by AECOM in 2011

HISTORICAL AND CULTURAL RESOURCES

The Phase 1 SERP coverage area includes approximately 300 miles of levees where there may be numerous cultural resources eligible for listing under the National Historic Preservation Act. In general, the resources can be categorized as prehistoric, traditional cultural properties (TCPs), gold mining features, flood management facilities, transportation structures, shipwrecks, historic settlements, and towns.

Native American habitation and mortuary sites are prehistoric resources frequently found along waterways, and thus, could be found within the Phase 1 SERP coverage area. Although many of these sites have been buried as a result of fluvial processes, agricultural practices, and flood management, significant deposits are still encountered along the waterside and landside of flood management features and in nearby uplands where water channels once occurred.

TCPs are eligible for listing, based on cultural significance derived from the “beliefs, customs, and practices of a living community of people that have been passed down through the generations” (DOI 1998:1). TCPs embrace a wide range of properties, some of which may be located within the Phase 1 SERP coverage area. The identification and evaluation of TCPs can be conducted only by consultation with members of the relevant group of people that ascribe value to the resource, or through other forms of ethnographic research.

The Sacramento Valley contains a vast array of historical activities and associated deposits and structures created by gold mining; therefore, these resources may be found within the Phase 1 SERP coverage area. Some of the most common and abiding remnants of gold mining activity include massive dredge tailings left by historical dredging of river deposits such as the deposits adjacent to the American River near Folsom (Hoover et. al. 1990:290). Other gold mining features may include ditches or water conveyance structures used in hydraulic mining.

Transportation structures encompass a large group of cultural resources and associated historical themes, and many of these structures may be found within the Phase 1 SERP coverage area. These include historic railroads located on levee crowns; bridges that span major waterways; historic road alignments associated with historically significant themes such as reclamation, settlement, and agriculture and ranching (Dames and Moore 1994); and wharfs and docks associated with historically significant themes such as navigation, agriculture, and town settlement.

Shipwrecks associated with Gold Rush era migration and other important themes in California history such as navigation, commerce, and agriculture may occur in major waterways near SERP levees.

Many small towns and settlements occurred and still occur along flood management systems within the Phase 1 SERP coverage area. Some remaining settlements or archaeological traces of settlements are significant for their importance in California history.

Please see Section D, “Regulatory Mechanisms,” for information regarding the Programmatic Agreement (PA) being developed between the U.S. Army Corps of Engineers (USACE) and the State Historic Preservation Officer (SHPO) for the treatment of cultural and archeological resources under the SERP in compliance with the National Historic Preservation Act.

PERMITTING AGENCIES AND REGULATORY AUTHORITIES

Please see Section D, “Regulatory Mechanisms,” for a detailed discussion of the regulatory mechanisms being used to authorize the SERP at the program level.

Table A2 provides a list of the authorizing agencies, their regulatory authorities, and their associated authorizations to be issued for the SERP. The agencies in Table A2 are hereinafter referred to as the “SERP Agencies.”

Table A2
SERP Authorizing Agencies, Authority, and Permits/Agreements

Agency	Authority	Permit/Agreement
U.S. Army Corps of Engineers	Clean Water Act section 404 and Rivers and Harbors Act section 10	Regional General Permit (RGP)
U.S. Fish and Wildlife Service	Federal Endangered Species Act section 7, Fish and Wildlife Coordination Act, and Migratory Bird Treaty Act	Programmatic Biological Opinion (PBO) and Not Likely to Adversely Affect Concurrence Letter
National Marine Fisheries Service	Federal Endangered Species Act section 7, Fish and Wildlife Coordination Act, Magnuson-Stevens Fishery Conservation and Management Act, and Marine Mammal Protection Act	Programmatic Biological Opinion (PBO) and Not Likely to Adversely Affect Concurrence Letter PBO will include conservation recommendations for Essential Fish Habitat
State Historic Preservation Officer	National Historic Preservation Act section 106	Programmatic Agreement
Central Valley Regional Water Quality Control Board	Clean Water Act section 401	CWA section 401 Programmatic Water Quality Certification for RGP
California Department of Fish and Game	California Fish and Game Code section 1600 et seq. California Endangered Species Act	Streambed Alteration Agreement for routine maintenance
Central Valley Flood Protection Board (Board)	California Water Code sections 8361 and 12878. California Code of Regulations Title 23 Division 1.	SERP activities are operations and maintenance activities not requiring Board encroachment permits

Source: Data compiled by AECOM in 2012

HOW THE SERP PROCESS WORKS

DWR will conduct annual maintenance surveys each spring to identify small erosion sites within the Phase 1 SERP coverage area that will require repairs to maintain the integrity of the flood management system. DWR will conduct a baseline assessment at each of these sites in accordance with Section B, “Baseline Assessment Methodology,” of this manual to evaluate and document the erosion damage. Section B provides detailed discussion of the baseline assessment methodology. Potential SERP projects will be categorized into two tiers based on the size of the project disturbance area, as described in Section B. DWR will identify the appropriate preapproved SERP design template to be applied in accordance with the standards set forth in Section C, “Project Design

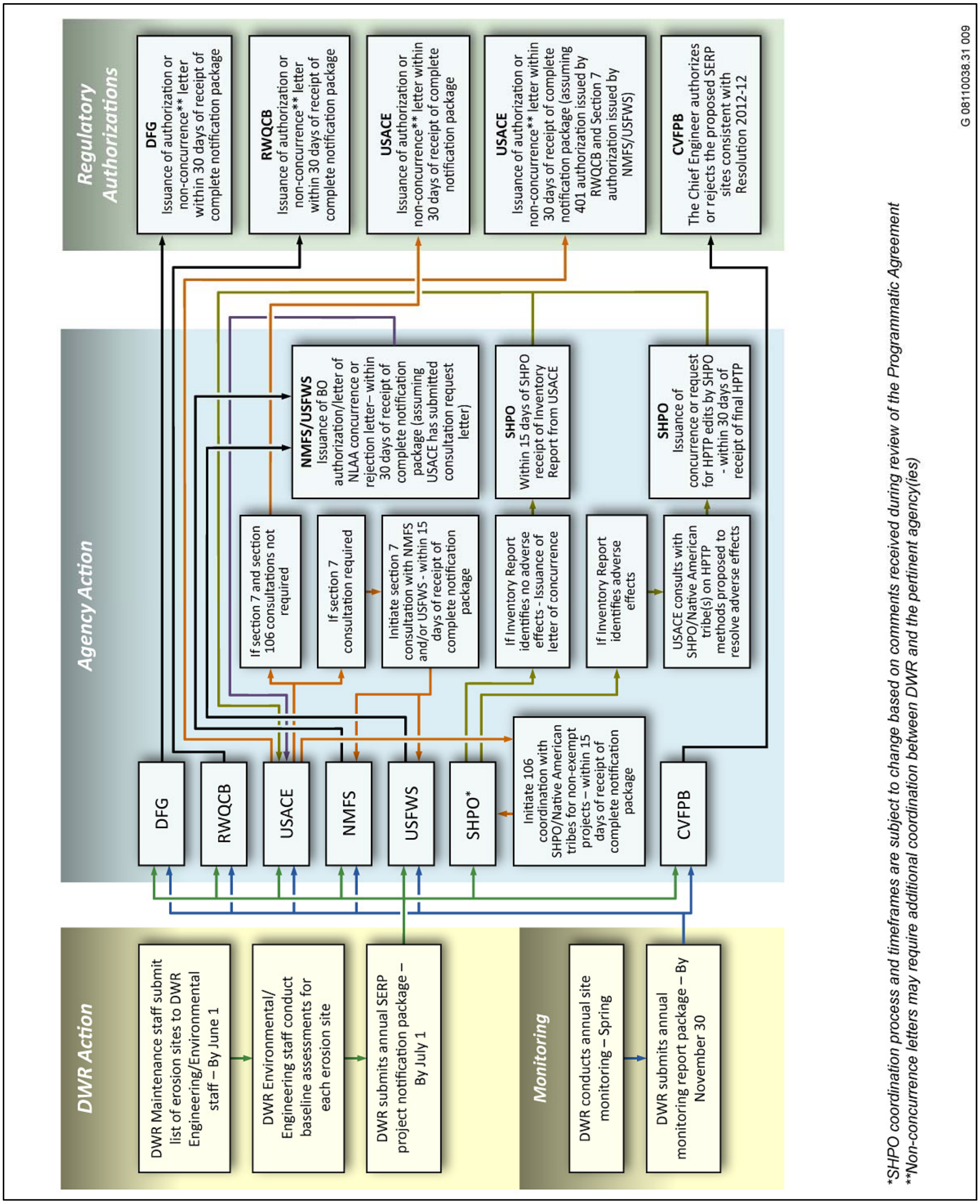
Templates and Construction Details," of this manual. This information will be provided to the relevant SERP agencies as part of the SERP project notification package.

DWR will notify these agencies of the proposed small erosion repair projects according to the process detailed in Section F, "Notification Requirements." Project notifications for potential SERP projects will be bundled and submitted to the agencies as a package each spring. To maintain consistency, a standard notification form will be used for each project. Section F includes a copy of the notification form and list of other materials to be included in the project notification package. The intent of this process is to create a program-specific notification form and materials package that facilitate timely agency review. Upon receipt of the annual SERP notification packages, the agencies will review the projects and respond to DWR within 30 days with written verification of whether the project(s) is acceptable under the programmatic SERP authorizations, including any additional terms or conditions for approval in their response. Upon receipt of the agencies' verification of SERP authorization, DWR may proceed with the repairs in accordance with the applicable conservation measures, including standard best management practices. This process thereby will result in a considerably shortened permitting time frame for those projects qualifying for SERP authorization, allowing for timely implementation of the necessary repairs while providing full consideration and protection of environmental resources.

For Phase 1, DWR will conduct monitoring of each SERP repair site for 5 years (or longer as necessary, until the final success criteria are achieved and the agencies have provided written approval) and submit annual monitoring reports to the agencies to track and evaluate the success of the program. Section H, "Monitoring and Success Criteria," presents the monitoring requirements and success criteria for SERP projects. Section J, "Annual Monitoring Reports," details the format and required contents for the annual monitoring reports.

SERP project information, including project notification packages, annual monitoring reports, and agency correspondence, will be stored electronically by DWR and used to develop a geographical information system (GIS) database to track SERP projects. The database will be made available to the SERP agencies. This will help ensure that project impacts and enhancement of habitat and other aquatic resource functions in the Phase 1 SERP coverage area are well documented and adequately monitored to achieve the program goal of net beneficial effects.

The following flowchart (Figure A2) outlines the SERP project implementation process.



Source: Prepared by AECOM 2012

Figure A2 **SERP Implementation Process Flowchart**

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B. BASELINE ASSESSMENT METHODOLOGY

This section describes the process DWR will use to evaluate damage at erosion sites that may qualify for repair under the SERP. The section includes a checklist that DWR staff will use to document baseline conditions such as site location, site dimensions, adjacent vegetation conditions, site access, and presence of existing revetment or other flood management facilities. Additionally, this section briefly describes the proposed SERP database, which will use GIS technology and be available to the SERP agencies. The SERP database will be a central source for information on already-completed SERP projects to facilitate cumulative impacts analysis and identify nearby SERP projects.

PROCESS FOR DEVELOPING AND USING PROJECT-SPECIFIC BASELINE ASSESSMENT

The baseline assessment provides a mechanism for evaluating and documenting the nature and extent of damages and existing environmental conditions at potential SERP project sites. Conducting the baseline assessment will be the first step in the process of selecting a site for repair under the SERP, determining the appropriate repair technique, and developing a project site plan based on the selected SERP design template.

As the initial step of the baseline assessment, DWR Maintenance Environmental Support Branch staff will conduct a field evaluation at each potential SERP project site annually in spring. For each site, DWR staff will complete a Baseline Assessment Checklist (BAC) (included in the SERP Project Pre-Construction Notification Form in Section F, “Notification Requirements”) and photograph the damaged and adjacent areas to document the site conditions and support DWR’s determination of the appropriate repair technique. In completing the BAC, DWR will identify the appropriate SERP design template and provide the rationale for the determination.

DWR will provide the completed BAC to the agencies as part of the project notification package, as outlined in Section F, “Notification Requirements.” Agency staff members will use this information to determine whether the project meets the criteria for coverage under their agency’s programmatic SERP authorization.

DEFINING AND CLASSIFYING SERP PROJECTS

The focus of the SERP is to facilitate streamlined authorization and implementation of small erosion repair projects and thereby prevent larger erosion sites that further jeopardize the integrity of the flood management system and may cause greater impacts to aquatic resources and associated riparian and upland habitats. The erosion repair designs were developed to be self-mitigating through incorporation of bioengineering erosion control methods. The subcommittee has defined project size and placement limits that minimize individual and cumulative effects and yet allow for practical utility by DWR in situations where several small sites occur in close proximity and can become larger sites if left untreated. The SERP Subcommittee established the following sizing and spacing criteria for defining and classifying potential SERP projects; projects not meeting these criteria will not be eligible for inclusion in the SERP.

A two-tiered definition for SERP sites has been developed for the program by the SERP Subcommittee. This approach establishes sizing and spacing limitations while providing flexibility for situations that warrant repair of sites that are larger or closer to one another. Additionally, classifying projects as Tier 1 or Tier 2 is intended to facilitate agency evaluation and approval of the proposed erosion repair projects contained in DWR's annual SERP project notification packages.

The Tier 1 site definition is as follows:

> *A site can be considered for Tier 1 if the footprint of new bank protection materials, including any additional vegetated area that will be disturbed by equipment during construction, is 0.1 acre or less with a maximum linear foot limit of 264 feet. A separation of 500 feet between sites repaired in the same year is required.*[2]

The Tier 2 site definition is as follows:

> *A site can be considered for Tier 2 if the footprint of new bank protection materials, including any additional vegetated area that will be disturbed by equipment during construction, is 0.5 acre or less with a maximum linear foot limit of 1,000 feet.*

A maximum of 15 SERP projects are anticipated to be implemented annually during Phase 1 of the SERP. To ensure that SERP projects are unconnected, single and complete actions and not part of a larger action that will exceed the SERP's size and placement limits, each project must demonstrate independent utility. A SERP project will be considered to have independent utility if it will be constructed absent the construction of other projects in the project area.

GIS DATABASE

DWR will electronically store SERP project information, including project notification packages, annual monitoring reports, and agency correspondence, over the entire period of the program (i.e., at least the 5-year Phase 1 period, or longer if the program is extended). This information will be used to develop a GIS database to track SERP projects. Although the parameters of the database have not been established, the database will be structured to allow for development of information layers that will facilitate project and program monitoring. Importantly, the GIS database will identify SERP project locations and dimensions and provide historical information that will

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2 Assuming the 0.1 acre is a square (2D figure with four straight sides, four interior angles and whose four sides are equal length), the conversion of 0.1 acre to linear feet would be the following: 1 acre = 43,560 square feet; 0.1 acre = 4,356 square feet. By taking the square root of 4,356 square feet, the length of each side is 66 feet. Thus the perimeter would be 264 feet. Note: If 0.1 acre is a circle, the circumference of the circle would be 117 linear feet. So, as a compromise to meet the SERP's goals, NMFS will agree to the maximum of 264 linear feet (Martinez, pers. comm., 2010).

facilitate cumulative impact analyses throughout the life of the program. The database will be available to the SERP agencies. This will help ensure that both project impacts and enhancement of habitat and other aquatic resource functions in the Phase 1 SERP coverage area are well documented and adequately monitored to achieve the program goal of self-mitigation.

Hydraulic Analysis

A hydraulic analysis was conducted to evaluate the potential impact of vegetation (shrub species of willow) on water surface elevation (WSE) for a prior repair site that was deemed representative of future SERP project sites with the greatest potential hydraulic impact. This repair site was selected based on its location along Butte Creek, a very narrow, leveed channel. The analysis also addressed the sensitivity of channel floodplain width on WSE. The hydraulic analysis was conducted to address the Central Valley Flood Protection Board (Board) staff's concerns over SERP's possible hydraulic impacts. The various scenarios evaluated were developed in coordination with Board staff and included incremental reviews by the Board staff that provided additional comments. The April 27, 2012 Staff Report—Resolution 2012–20, summarizes the hydraulic modeling conclusions as follows:

1. The hydraulic modeling results for the assumed base condition ("n" =0.045) and the mature vegetation condition ("n" =0.06) at the representative 390 foot wide repair site show that the change in the WSE is less than 0.1 foot.

2. For higher "n" values (0.07 and 0.08), the channel should be wider than the representative site to ensure that the maximum anticipated increase in WSE doesn not exceed 0.1 foot. The modeling results showed that the maximum change in WSE was less than or equal to 0.1 foot for "n"=0.07 at a channel width of 700 feet. Similarly, the maximum change in WSE was less than or equal to 0.1 foot for "n"=0.08 at a channel width of 1,400 feet.

3. The modeling addressed Board staff's concerns of potential adverse hydraulic impacts for SERP projects. Depending on "n" value and wide channels, most proposed SERP projects for wide channels and bypasses are anticipated to produce negligible hydraulic impacts. For narrower channels, additional site-specific hydraulic analyses may be required to assess potential impacts to WSE.

4. The following table provides guidance based on hydraulic modeling of the Butte Creek "representative site for DWR to initially assess the likelihood of adverse hydraulic impacts of proposed SERP sites. For proposed sites at channel or bypass widths less than the following thresholds, an initial hydraulic analysis should be conducted and submitted by DWR to the Board as part of the annual SERP repair proposal.

Table B-1 Channel Width Thresholds for Minimal Hydraulic Impacts		
Manning's "n"	Site Description	Minimum Channel Width (feet) to Maintain Anticipated WSEL increase at or below 0.1 foot
0.06	Butte Creek "representative"	390
0.07	Modeled	700
0.08	Modeled	1,400
Source: Hydraulic Analysis of a bioengineered repair, representative of repairs under the Small Erosion Repair Program (SERP), Mathiyarasan, April 18, 2012		

C. PROJECT DESIGN TEMPLATES AND CONSTRUCTION DETAILS

This section presents the SERP project design templates and outlines the parameters for applying each template. Construction and planting details specific to each template are included in the template drawings. General construction and planting requirements, along with sequencing and equipment staging information, are described below. Additional program requirements for project construction activities such as equipment access and fueling, construction timing, material stockpiling, and erosion control are outlined in Section I, "Conservation Measures."

DEVELOPMENT OF THE SERP DESIGN TEMPLATES

Bank protection design depends on site-specific conditions. Some of the considerations include (1) the type of bank failure such as sloughing, or wave wash; (2) hydraulic conditions in the area such as shear stress and slope angle; and (3) channel characteristics adjacent to the erosion site.

To capture some of these variables, the SERP Subcommittee evaluated a range of erosion repair alternatives that would provide the necessary level of flood risk reduction. The group focused on design alternatives that incorporate bioengineering practices and thereby provide for self-mitigation opportunities for levee maintenance projects. The designs that were evaluated have been successfully applied along California waterways by various public flood protection and transportation agencies. The SERP group considered those designs that would provide the necessary level of flood risk reduction while benefitting fish and wildlife resources, including habitat for native species.

Twelve designs that were potentially applicable to the SERP were evaluated. These design alternatives met the primary program objectives of providing both the necessary level of flood risk reduction and the opportunity for self-mitigation as defined in Section G, "Mitigation." In addition to these primary SERP objectives, the group also considered the following evaluation factors:

- types of levee damage that generally occur in the Phase 1 SERP coverage area,
- long-term maintenance requirements,
- wildlife hazards,
- aesthetics,
- difficulty of installation,
- adequacy of the design in terms of potential vegetation coverage area, and
- levee vegetation management strategy (VMS) set forth in DWR's 2012 CVFPP and associated Conservation Framework.

SERP DESIGN TEMPLATES

Based on the above criteria, seven design templates were selected: bank fill rock slope with live pole planting, willow wattle with rock toe, branch layering, rock toe with live pole planting, soil and rock fill at the base of a fallen tree (with rootwad revetment option), bank fill rock slope with native grass planting, and bank fill rock slope with emergent vegetation planting. The templates, which DWR will use as a guide to design repairs at individual SERP sites, are presented as Templates 1–7 at the end of this subsection.

The design templates included in this manual are not to scale and are only intended for use as a guide in developing the project-specific cross-section and site plan diagrams. The project-specific diagrams will be submitted with the project notification materials, as outlined in Section F, “Notification Requirements.”

Each design template includes:

- a typical cross-section of the design, plan view with details as needed, and general construction specifications; and
- an information box that describes the template’s applicability and limitations (e.g., slope, flow velocity), planting zone descriptions, reference to the SERP rock-sizing chart and plant list (included below), and general construction notes and planting specifications such as rock placement locations relative to water levels, recommended distance between plantings and water table, recommended length of cuttings, etc.

The SERP design templates are generalized program-level diagrams that describe and outline the particular bank stabilization techniques that the SERP Subcommittee has determined are applicable to SERP erosion sites. The appropriate design template for individual SERP repair sites will be selected by DWR using the applicability matrix below as a guide. DWR will provide its rationale for selecting an identified template in the BAC included in Section B, “Baseline Assessment Methodology.” The BAC will be provided to the SERP agencies with the annual project notification materials as described in Section F, “Notification Requirements.”

DWR will use the technique descriptions provided on the templates to develop the individual plan view and cross-section diagrams unique to each specific project site. For each SERP project site, DWR will incorporate the planting, soil and rock placement, and other technique-specific information from the program design templates into the project-specific cross-section and plan-view diagrams. This will help ensure that DWR correctly applies the agreed-on bank stabilization techniques. The intention of the program design templates is to provide framework descriptions of applicable bank stabilization methodologies that can be applied to SERP project sites to increase the potential to achieve a successful outcome.

- The project design figures (cross-section and plan view diagrams) created for each individual SERP project site will describe the planting specifications and detailed installation methodologies best suited for site-specific repairs. Development of site-specific design details will be a coordinated effort by DWR engineering, environmental, and maintenance staff.

- The SERP Template Applicability Matrix (Table C1) will be used by the DWR project engineers as a guide in selecting the appropriate design template to be applied at proposed SERP repair sites.

SERP ROCK-SIZING CHART

The suggested minimum riprap gradations for stream bank protection in Table C2 and the rock-sizing chart in Table C3 are excerpted from the stream bank protection guidelines of the New Brunswick (Canada) Department of Agriculture and Aquaculture (2009). Both tables provide information to help DWR determine the appropriate rock size for repairing erosion damage under the SERP. Larger rock size will be required in areas subject to wave action and areas with steep slopes. For example, a class I gradation may be used for erosion sites where a local water velocity up to 10 feet per second exists. For class I, Table C2 describes the distribution (gradation) of rock sizes and related weights that when combined will average 12-inch or 80-pound rock. This average diameter for rock is referred to as D_{50}. Table C3 provides the D_{50} and related weights for a greater variation of local water velocities.

WILLOW POLE PLANTING CRITERIA

Willow pole plantings are a major revegetation component of several of the SERP design templates. As such, specific willow pole planting criteria are presented below to guide revegetation efforts.

The willow pole cuttings should be 1 to 3 inches in diameter. The length of willow pole cuttings will be largely determined by the depth to the summer/fall water line and erosive force of the stream at the planting site. The length will typically range between 36 and 72 inches. Approximately four-fifths of the length of the poles should be below the ground surface, with the bottom ends reaching the water table or capillary fringe. The bottom ends of the poles should be cut at a 45-degree angle at the time of harvest to allow quick recognition of the bottom end of the cuttings. Plantings will be set in the holes with the buds facing upward.

INCORPORATION OF CVFPP LEVEE VEGETATION MANAGEMENT STRATEGY

The SERP is part of the 2012 CVFPP, which also includes an associated Conservation Framework. The following text and diagrams associated with the CVFPP levee VMS are excerpted from the 2012 CVFPP and associated Conservation Framework, and will be incorporated into the SERP.

Table C1
SERP Template Applicability Matrix

Templates	Description	Bank Slope (max)	Wildlife Applications*	Erosion Type**	Stream Type***	Setback or Bypass Levee****
Template 1: Bank fill Rock Slope with Live Pole Planting	Combination of covering a slope with rock and live pole cuttings	1:1	Riparian habitat + Anadromous fish + Giant garter snake -	1,2,3,4	A,B,C	Limited
Template 2: Willow Wattle with Rock Toe	Placement of bundles of branches in trenches to slow over-bank erosion	2:1	Riparian habitat+ Anadromous fish+ Giant garter snake -	2,3,5	B,C	Not likely
Template 3: Branch Layering	Layering of live branch cuttings with layer of compact fill	1.5:1	Riparian habitat+ Anadromous fish + Giant garter snake -	1,3,4,5	A,B,C	Limited
Template 4: Rock Toe with Live Pole Planting	Placement of some of the live stakes in compacted soil (typically smaller scale erosion sites)	1:1	Riparian habitat + Anadromous fish + Giant garter snake -	1,2,3	A,B,C	Not Likely
Template 5: Soil and Rock Fill at the Base of a Fallen Tree	Fill in areas where trees have fallen	1.5:1	Riparian habitat + Anadromous fish +	3	A,B,C	Limited
Template 6: Bank Fill Rock Slope with Native Grass Planting	Planting grass only with riprap and no woody installation	1:1	Giant garter snake +	1,2,3,4	A,B,C	Likely
Template 7: Bank Fill Rock Slope with Emergent Vegetation Planting	Similar to template 1, but retaining or flattened area near toe for emergent vegetation	1:1	Giant garter snake + Delta smelt+	1,2,3,4	B,C	Limited

* **Wildlife Applications Key**
Riparian habitat+ improves site for wildlife dependent on riparian vegetation
Anadromous fish + improves site for anadromous fish because of increased shaded riverine cover and large woody debris
Giant garter snake – not recommended in areas where giant garter snake occur because of increased cover of riparian vegetation
Giant garter snake + improves giant garter snake habitat by increasing cover and opportunities for basking and foraging
Delta smelt + improves Delta smelt habitat by increasing emergent vegetative cover

** **Erosion type:**
1 = Erosion caused by fast flowing streams; 2 = Extensive toe level erosion; 3 = Slumps created in stream bank;
4 = Damage caused by occasional heavy flows; 5 = Over-land runoff erosion:

*** **Stream type:**
A = main stem; B = tributary; C = Canal/Slough

******Setback or Bypass:**
Likely = best chance of success; Limited = dependent on existing vegetation and access to water;
Not likely: low potential for success

Source: Ohio Iowa Department of Natural Resources 2006

Table C2 Suggested Minimum Riprap Gradations for Stream Bank Protection		
Class I		
Nominal 12-inch-diameter or 80 pounds (lb). Allowable local velocity up to 10 feet per second grading specification:		
	100% smaller than 18 inches or	300 lb
at least	20% larger than 14 inches or	150 lb
at least	50% larger than 12 inches or	80 lb
at least	80% larger than 8 inches or	25 lb
Class II		
Nominal 20-inch-diameter or 400 lb. Allowable local velocity up to 13 feet per second grading specification:		
	100% smaller than 30 inches or	1,500 lb
at least	20% larger than 24 inches or	700 lb
at least	50% larger than 20 inches or	400 lb
at least	80 % larger than 12 inches or	70 lb
Class III		
Nominal 30-inch-diameter or 1,500 lb. Allowable local velocity up to 15 feet per second grading specification:		
	100% smaller than 48 inches or	5,000 lb
at least	20% larger than 36 inches or	2,500 lb
at least	50% larger than 30 inches or	1,500 lb
at least	80% larger than 20 inches or	400 lb
Note: The percentages quoted are by weight; the sizes quoted are equivalent spherical diameters (1.24 volume). Source: New Brunswick (Canada) Department of Agriculture and Aquaculture 2009		

Table C3 Riprap Minimum D50 Sizing Chart		
Water Velocity (feet per second)	Rock D_{50} (inches)	Rock Weight (pounds)
5	4	3
6	6	10
7	8	24
8	10	47
9	12	81
10	15	158

Table C3 Riprap Minimum D50 Sizing Chart		
Water Velocity (feet per second)	Rock D_{50} (inches)	Rock Weight (pounds)
11	18	273
12	20	375
13	24	650
14	27	925
15	30	1,268
16	35	2,013
Source: New Brunswick (Canada) Department of Agriculture and Aquaculture 2009		

SERP PLANT LIST

DWR will use the plant list in Tables C4, C5 and C6 to develop project-specific plant lists and seed mixes. SERP project sites will generally not be irrigated. Appropriate planting techniques and timing will be required to ensure the successful establishment of planted vegetation. All SERP project planting will be conducted in compliance with the interim vegetation inspection criteria presented in Figures C1 and C2. The project-specific plant lists will be provided to the agencies with the project notification materials as outlined in Section F, "Notification Requirements."

Table C4 Native Perennial Grass Seed Mix and Pure Live Seed Application Rate (Zones 1 and 2) for the Small Erosion Repair Program			
Species	Pounds/Acre	Pure Live Seeds/Square Foot	% Mix
Purple needlegrass (*Nassella pulchra*)	16	21.9	53%
Creeping wildrye (*Leymus triticoides*)	4	10.1	13%
Slender wheatgrass (*Elymus trachycaulus*)	4	7.3	13%
Blue wildrye (*Elymus glaucus*)	3	6.7	10%
Meadow barley (*Hordeum brachyantherum*)	3	6.7	10%
Total for Mix	**30**	**52.7**	**100%**
Source: Data compiled by EDAW in 2009			

Table C5 Small Woody and Herbaceous Vegetation (Zone 2) Planting Palette for the Small Erosion Repair Program		
Species	Spacing	Container Type
Narrowleaf willow (*Salix exigua*)	2 feet O.C.	live cutting
Arroyo willow (*Salix lasiolepis*)	2 feet O.C.	live cutting
Pacific willow (*Salix lucida* ssp. *lasiandra*)	2 feet O.C.	live cutting
Red willow (*Salix laevigata*)	2 feet O.C.	live cutting
California blackberry (*Rubus ursinus*)	6 feet O.C.	treepot 4
California wild rose (*Rosa californica*)	6 feet O.C.	treepot 4
Mulefat (*Baccharis salicifolia*)	4 feet O.C.	treepot 4
Buttonbush (*Cephalanthus occidentalis*)	4 feet O.C.	treepot 4
Santa Barbara sedge (*Carex barbarae*)	2 feet O.C.	plug
Deergrass (*Muhlenbergia rigens*)	2 feet O.C.	plug
Note: O.C. = on center Source: Data compiled by EDAW in 2009		

Table C6 Lower Slope Vegetation (Zone 3) Planting Palette for the Small Erosion Repair Program		
Species	Spacing	Container Type
Baltic rush (*Juncus balticus*)	2 feet O.C.	plug
Common tule (*Schoenoplectus acutus*)	2 feet O.C.	plug
Note: O.C. = on center Source: Data compiled by EDAW in 2009		

Levee vegetation management practices and procedures are an important component of the Flood System Operations and Maintenance Program, and of numerous ongoing and proposed flood risk reduction projects. Through management actions set forth in the CVFPP and associated Conservation Framework, the state proposes to implement a flexible and adaptive integrated VMS that meets public safety goals and protects and enhances sensitive habitats in the Central Valley. Implementation of the state's approach to levee vegetation management will be adaptive and responsive to (1) the results of ongoing and future research, and (2) knowledge gained from levee performance during high water events.

The state recognizes that woody vegetation on levees must be appropriately managed. The state's levee VMS is focused on improving public safety by providing for levee integrity, visibility, and accessibility for inspections, maintenance, and floodfight operations; at the same time, it protects important and critical environmental resources.

From a flood threat perspective, lower waterside slope vegetation rarely presents an unacceptable threat to levee integrity. However, lower waterside slope vegetation more typically provides beneficial functions, such as reducing nearshore water velocities and binding soil in place to reduce erosion. Dense riparian brush provides the greatest erosion protection and least levee safety threat.

To sustain important habitat, the CVFPP levee VMS retains lower waterside vegetation below the vegetation management zone (see Figures C1 and C2). Vegetation will be removed (in coordination with resource agencies) only when it presents an unacceptable threat. Furthermore, flood management actions will protect existing, and promote the development of, appropriate vegetation for erosion control on the waterside slope, outside of the vegetation management zone.

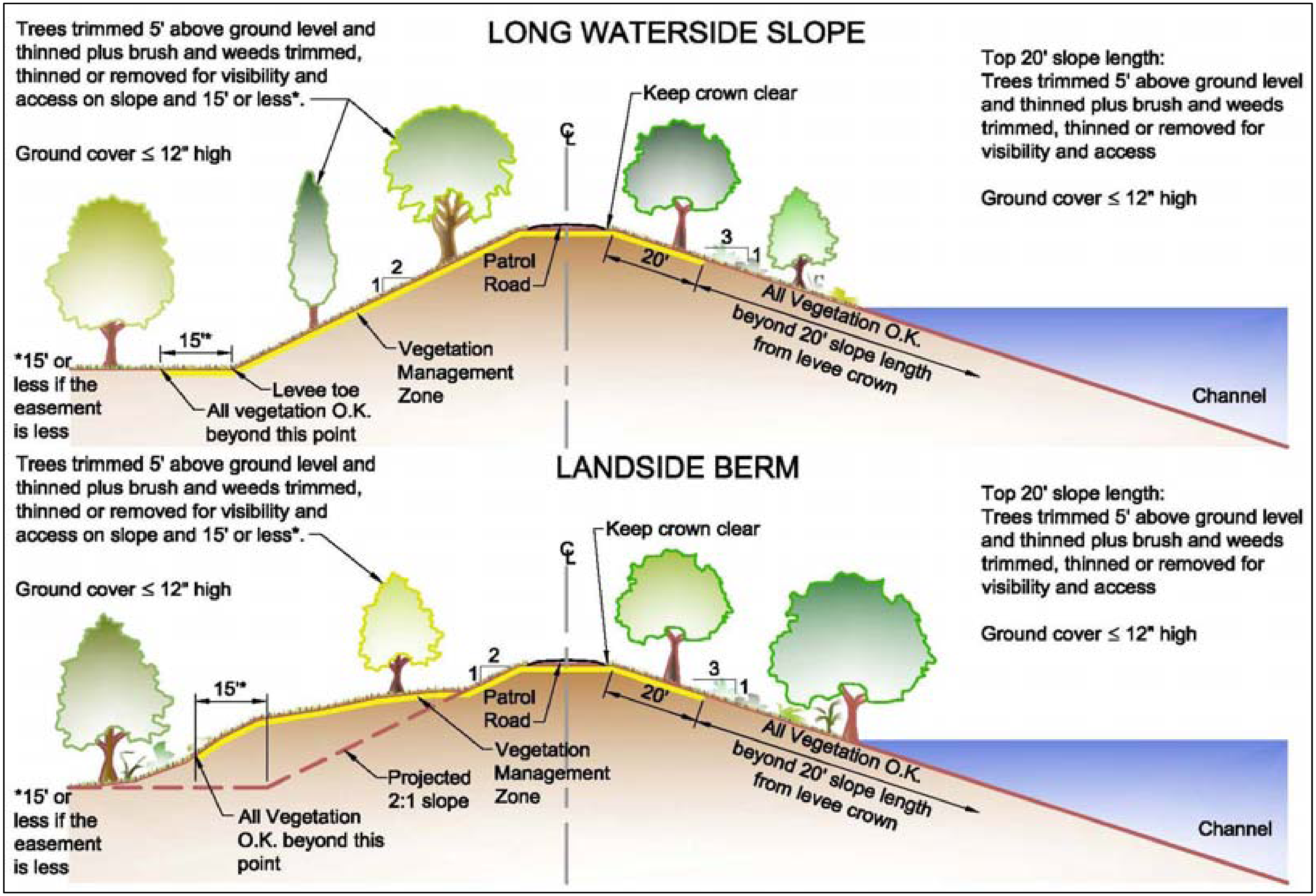
OPERATIONS AND MAINTENANCE ACTIVITIES NOT REQUIRING BOARD ENCROACHMENT PERMITS

After review of the statutes—in particular, CFR 33, section 208.10 and the Standard O&M Manual for the SRFCP—Board staff concluded that the Board's regulations as stated in Title 23, section 6(a) of the California Code of Regulations (23 CCR 6[a]) were not intended to require an encroachment permit to plant vegetation that is included as a component of routine maintenance activities.

The following code sections are applicable to SERP projects:

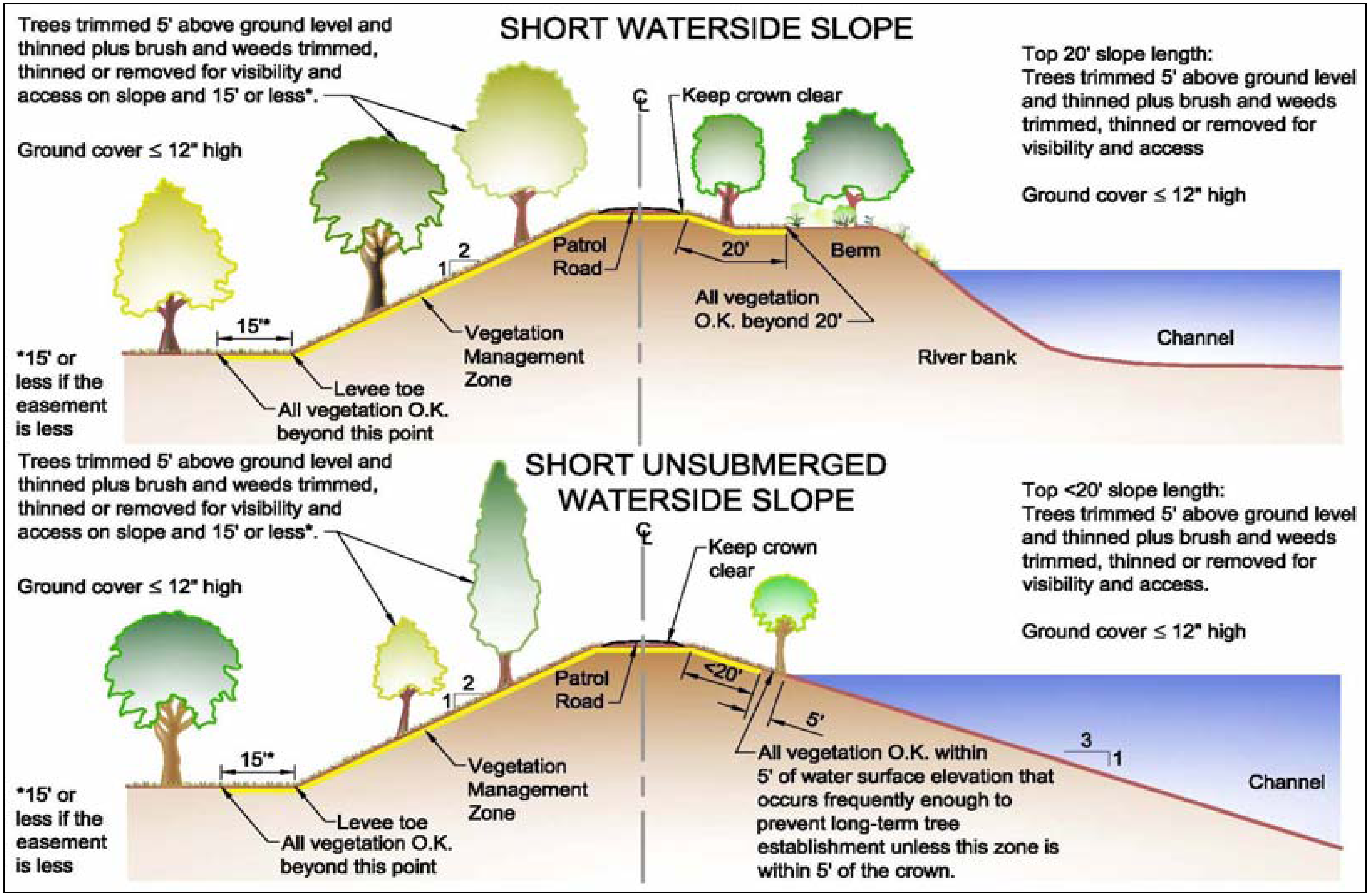
- 33 CFR, "Navigation and Navigable Water," Chapter II, "Corps of Engineers, War Department," Part 208, "Flood Control Regulations, Maintenance and Operation of Flood Control Works," section 208.10(b), "Levees (1) Maintenance" states: "The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structure in time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees."

- USACE Standard O&M Manual for the Sacramento River Flood Control Project, section 4.02, "Maintenance" (page 10), paragraph 208.10(b)(1) regarding "Applicable portions of the Flood Control Regulations," pertaining to maintenance states: "The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structure at the time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees."



Source: Attachment 2 of the 2012 CVFPP: Conservation Framework Chapter 5.

Figure C1 **DWR Vegetation Inspection Criteria for Standard Levees—Long Waterside Slope and Landside Berm**



Source: Attachment 2 of the 2012 CVFPP: Conservation Framework Chapter 5.

Figure C2 DWR Vegetation Inspection Criteria for Standard Levees—Short and Short Unsubmerged Waterside Slope

- Section 8361 of the California Water Code (CWC) states: “The department shall maintain and operate on behalf of the state the following units or portions of the works of the Sacramento River Flood Control Project [units and portions of the work not listed in the SERP Manual], and the cost of maintenance and operation shall be defrayed by the state…,” and CWC section 12878, which describes a “maintenance area.”

CONSTRUCTION SEQUENCING

Project construction will be conducted in accordance with the timing provisions outlined in Section I, “Conservation Measures.” Although some of the SERP bank stabilization techniques require plantings and rock revetment to be installed simultaneously, some design applications will allow planting to be delayed until the most appropriate season. DWR will determine the precise planting timelines on a project-by-project basis based on the availability of planting materials, appropriate timing for taking cuttings, capabilities for storage of plant materials, and appropriate timing for planting. For projects where plantings will be installed following project construction, the planting timeline will be specified in the project description section of the project notification form (see Section F, “Notification Requirements”). All planting will be conducted in compliance with the timing provisions outlined in Section I.

CONSTRUCTION MATERIALS AND EQUIPMENT

Project site preparation, and transporting and installing construction materials, will require the use of heavy equipment and motorized vehicles. Variables used to determine the types of equipment to be used include site location and accessibility, proximity to existing or potential staging areas, slope steepness, and whether the damage is at the toe of the levee or nearer to the top. A typical equipment assemblage will include an excavator or back-hoe, crane, dozer, barge or haul truck (end dump or transfer), and water truck or pumps for dust control and compaction.

Rock revetment will be obtained from a commercial source. Fill soil not obtained on-site will also be obtained commercially. Only soil and rock free of waste will be used.

SITE PREPARATION

Site clearing and grading will be conducted in a manner that avoids removal of native vegetation to the maximum extent practicable. Program requirements for removal of existing and non-native vegetation are outlined in Section I, “Conservation Measures.” The conservation measures require that all work will be done in a manner that ensures that any living native riparian vegetation within the vegetation-clearing zones that can be reasonably avoided, without compromising basic engineering design and safety, is avoided and left undisturbed to the extent feasible. No native trees with a trunk diameter at breast height in excess of 3 inches are allowed to be removed or damaged without prior notification and approval by the SERP agencies.

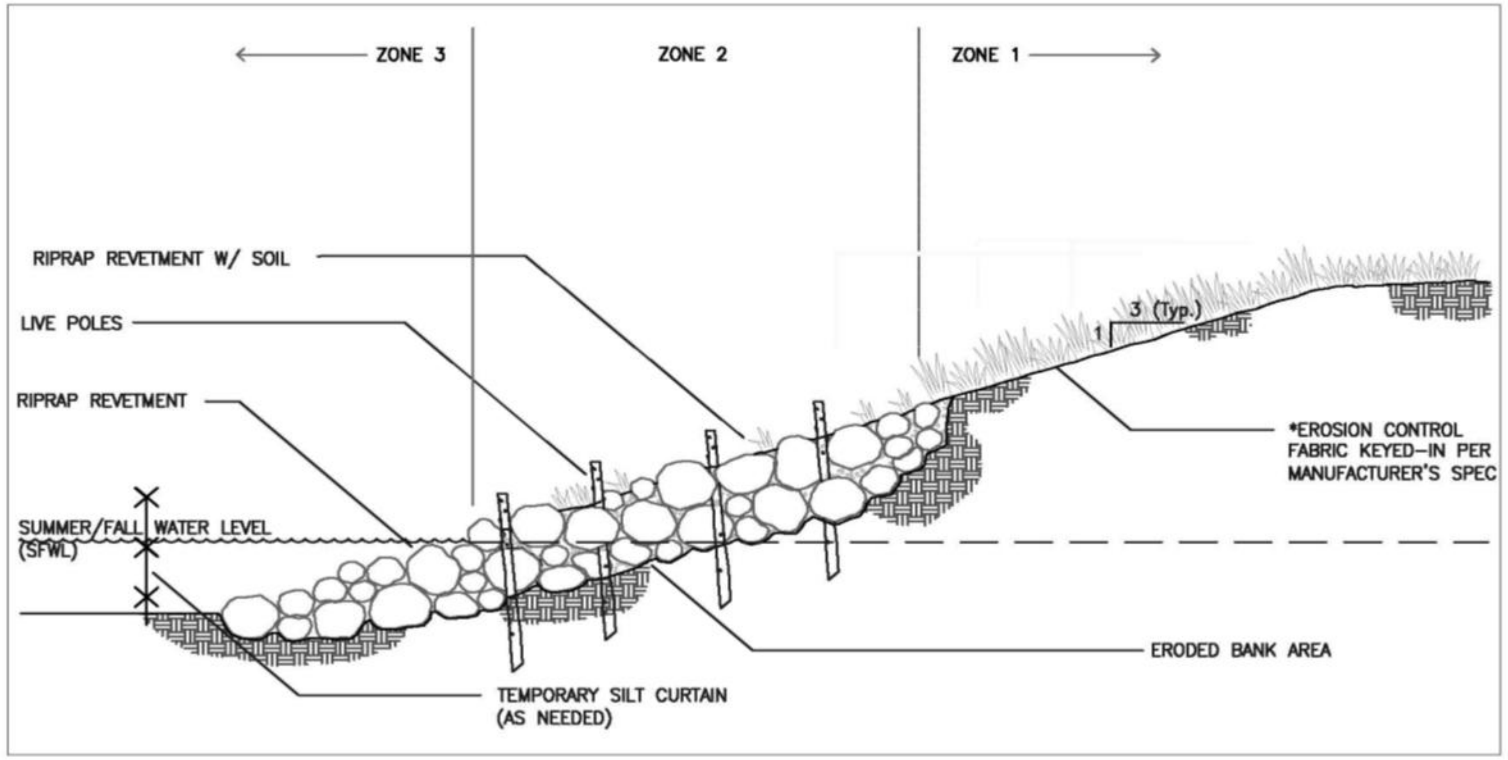
EQUIPMENT STAGING AND ACCESS

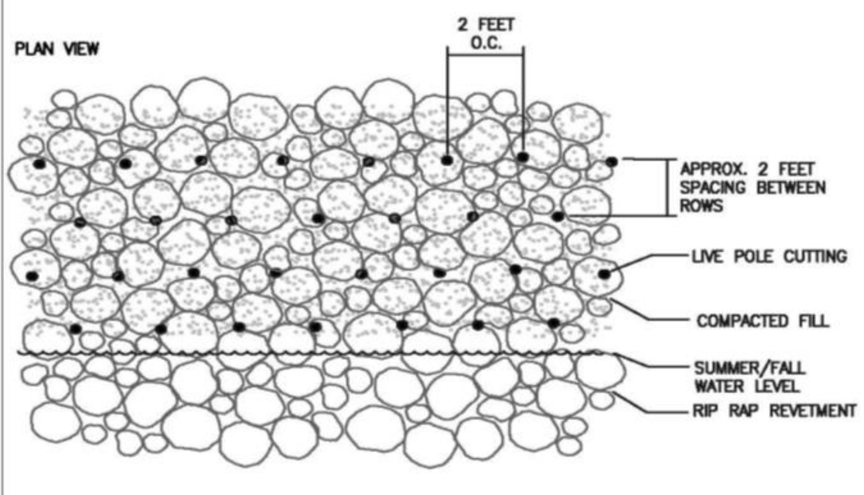
For the larger river systems where barge access is possible, a barge will be used for equipment staging and project construction. Barge use is intended to help minimize noise and traffic disturbances and effects on existing landside vegetation. For projects where barge use is not appropriate, construction equipment and plant materials will be staged in designated landside areas adjacent to the project sites. Existing staging sites and maintenance toe and crown roads will be used to the maximum extent possible for project staging and access to avoid adversely affecting previously undisturbed areas.

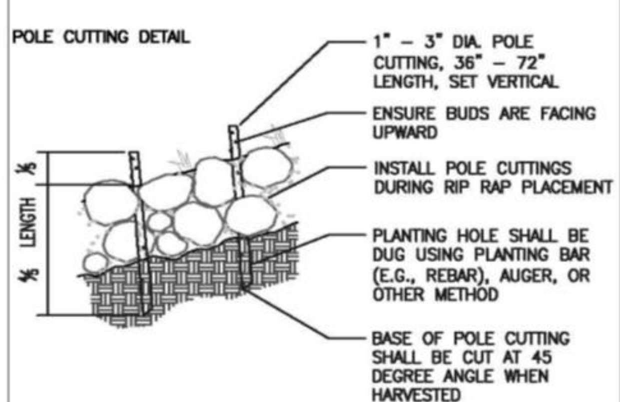
Depending on the practicality of waterside construction, revetment will either be placed from cranes mounted on barges or from adjacent landside areas using excavators.

Additional program requirements for equipment staging and access are outlined in Section I, "Conservation Measures."

TEMPLATE FOR GUIDANCE ONLY – NOT PROJECT SPECIFIC







BANK FILL ROCK SLOPE WITH LIVE POLE PLANTING

Description and Application:
Bank fill rock slope with live pole planting is suitable for situations where significant bank erosion has occurred. Rock riprap and soil filled rock is placed in the eroded area and live pole cuttings are installed in the riprap. This technique creates a stable, vegetated bank toe and protected middle and upper bank, and is suitable for banks on inner and outer bends.
Maximum Slope: 1:1
Maximum Velocity: Project specific – determined by project engineer specification for rock size.

Limitations:
Live pole plantings may not be suitable for setback levees and bypass levees that are dry most of the year unless irrigated.

Construction Notes:
Rock riprap material shall be placed from the toe of the slope to a point at minimum 1'–2' above the Summer/Fall Water Level (SFWL). Riprap revetment with soil shall be installed above the SFWL to facilitate vegetated growth.
To optimize growth, live woody cuttings should be harvested and installed during the dormant season (i.e., winter). Option: install sonotubes/steel pipes for follow–up winter planting. If live woody cuttings are harvested and installed during the growing season, the receiving site must have consistent water levels sufficient to maintain soil moisture that reaches the cuttings. Live woody cuttings shall be submerged in water for 1–7 days (24 hours min.) prior to installation.
Disturbed soil shall be seeded with a native perennial grass seed mix (broadcast or hydroseed). When surface vegetation is native species, consider stockpiling topsoil for replacement after construction.

Planting Zones:
Zone 1 – this zone extends from the top of the levee downslope to the eroded area. The lower extent of Zone 1 is determined by the upper extent of Zone 2 (described below). This zone shall be seeded with native perennial grasses. Woody vegetation shall not be planted in Zone 1. *Use non–monofilament wildlfe–safe erosion control fabric.
Zone 2 – this is the primary woody vegetation planting zone. This zone extends from the SFWL upslope to the point where erosion is not occurring. Live woody cutting growth shall extend to where it would be limited by lack of soil moisture. Live woody cuttings and native perennial grasses may be planted in this zone.
Zone 3 – this zone extends from the channel bottom up to the SFWL. Live woody cuttings and emergent vegetation may be planted in this zone. Use of soil infill in this zone will be limited by water on some sites.

Plant List and Seed Mix:
Project–specific plant species and seed mixes will be selected from the plant list included in Section C, "Project Design Templates and Construction Details."

Rock Sizing:
The project engineer will use the rock sizing chart included in Section C as a guide to determine appropriate rock size and weight based on local scour velocities, with adjustments for bank angle, bend hydraulics, wave exposure, stability factors and safety coefficients.

Compacted Fill:
Compacted impervious material shall be used to fill large voids on an as–needed basis when directed by engineer per the following:
IMPERVIOUS MATERIAL: As per CCR Title 23, section 120, ¶ 12.
COMPACTION REQUIREMENT: As per CCR Title 23, section 120, ¶ 13.

California Department of Water Resources

Small Erosion Repair Program

Deptartment of Water Resources
Division of Flood Management
Flood Maintenance Office
3310 El Camino Ave
Sacramento, CA 95821

TEMPLATE 1:
BANK FILL ROCK SLOPE WITH LIVE POLE PLANTING

PRELIMINARY
NOT FOR CONSTRUCTION

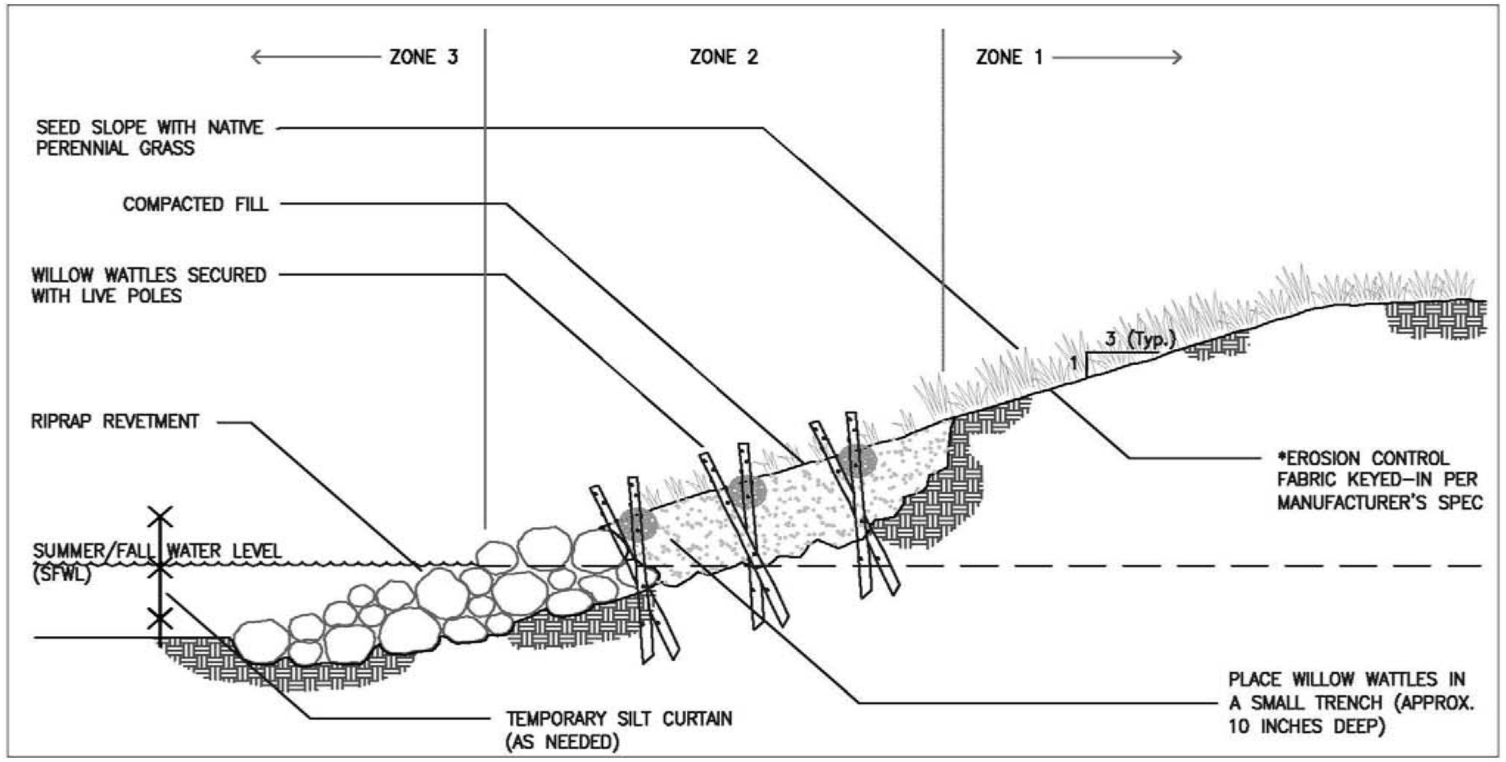
REVISIONS

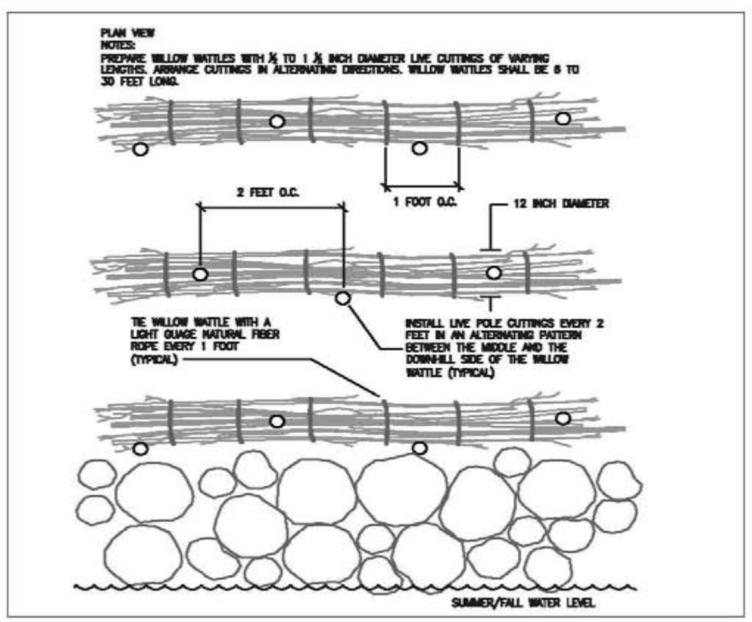
scale: NOT TO SCALE
job no.:

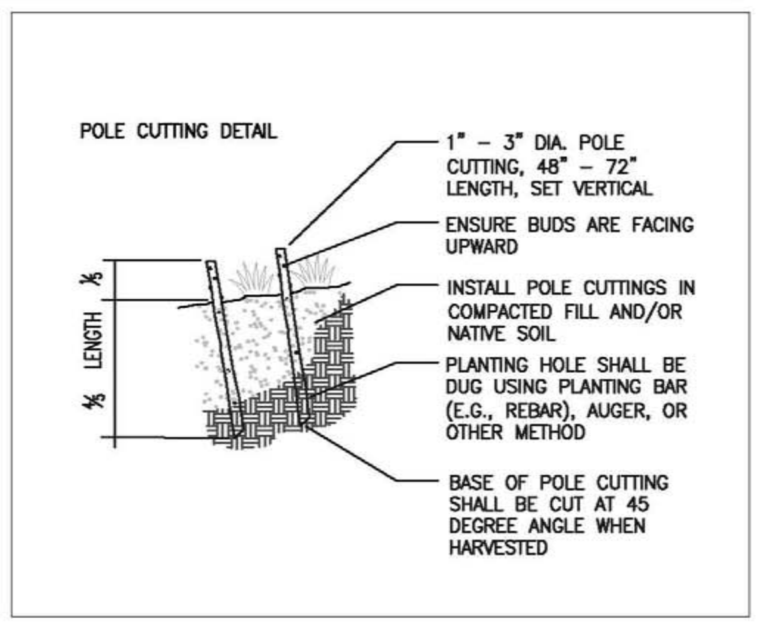
date: November 4, 2011

Template 1 Bank Fill Rock Slope with Live Pole Planting

TEMPLATE FOR GUIDANCE ONLY – NOT PROJECT SPECIFIC







WILLOW WATTLE WITH ROCK TOE

Description and Application:
Willow wattles with rock toe is suitable for situations where erosion is primarily caused by runoff on the levee slope. Willow wattles provide protection from erosion caused by runoff on the levee slope, and the rock toe provides protection from erosive flows.
Willow Wattle is suitable for shallow (e.g., 3:1) slopes in systems with low–velocity flows.
Maximum Slope: 2:1
Maximum Velocity: Project specific – determined by project engineer specification for rock size.

Limitations:
This technique is not suitable for flashy systems with high peak flows or frequently changing water surface elevations.

Construction Notes:
Rock riprap material shall be placed from a suitable catch–point on the slope to a point approximately 1'–2' above the Summber/Fall Water Level (SFWL). Willow wattles shall be placed in shallow trenches along the slope and secured with live pole cuttings. Live pole cuttings shall be installed in the center and at the downslope edge of the willow wattle.
To optimize growth, live woody cuttings should be harvested and installed during the dormant season (i.e., winter). Option: install sonotubes/steel pipes for follow–up winter planting. If live woody cuttings are harvested and installed during the growing season, the receiving site must have consisent water levels sufficient to maintain soil moisture that reaches the cuttings. Live woody cuttings shall be submerged in water for 1–7 days (24 hours min.) prior to installation.
Disturbed soil shall be seeded with a native perennial grass seed mix (broadcast or hydroseed). When surface vegetation is native species, consider stockpiling topsoil for replacement after construction.

Planting Zones:
Zone 1 – this zone extends from the top of the levee downslope to the eroded area. The lower extent of Zone 1 is determined by the upper extent of Zone 2 (described below). This zone shall be seeded with native perennial grasses. Woody vegetation shall not be planted in Zone 1. *Use non–monofilament wildlife–safe erosion control fabric.
Zone 2 – this is the primary woody vegetation planting zone. This zone extends from the SFWL upslope to the point where erosion is not occurring. Live woody cutting growth shall extend to where it would be limited by lack of soil moisture. Live woody cuttings and native perennial grasses may be planted in this zone.
Zone 3 – this zone extends from the channel bottom up to the SFWL. Live woody cuttings and emergent vegetation may be planted in this zone. Use of soil infill in this zone will be limited by water on some sites.

Plant List and Seed Mix:
Project–specific plant species and seed mixes will be selected from the plant list included in Section C, "Project Design Templates and Construction Details."

Rock Sizing:
The project engineer will use the rock sizing chart included in Section C as a guide to determine appropriate rock size and weight based on local scour velocities, with adjustments for bank angle, bend hydraulics, wave exposure, stability factors and safety coefficients.

Compacted Fill:
Compacted impervious material shall be used to fill large voids on an as–needed basis when directed by engineer per the following:
IMPERVIOUS MATERIAL: As per CCR Title 23, section 120, ¶12.
COMPACTION REQUIREMENT: As per CCR Title 23, section 120, ¶ 13.

California Department of Water Resources

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TEMPLATE 2:
WILLOW WATTLE WITH ROCK TOE

PRELIMINARY
NOT FOR CONSTRUCTION

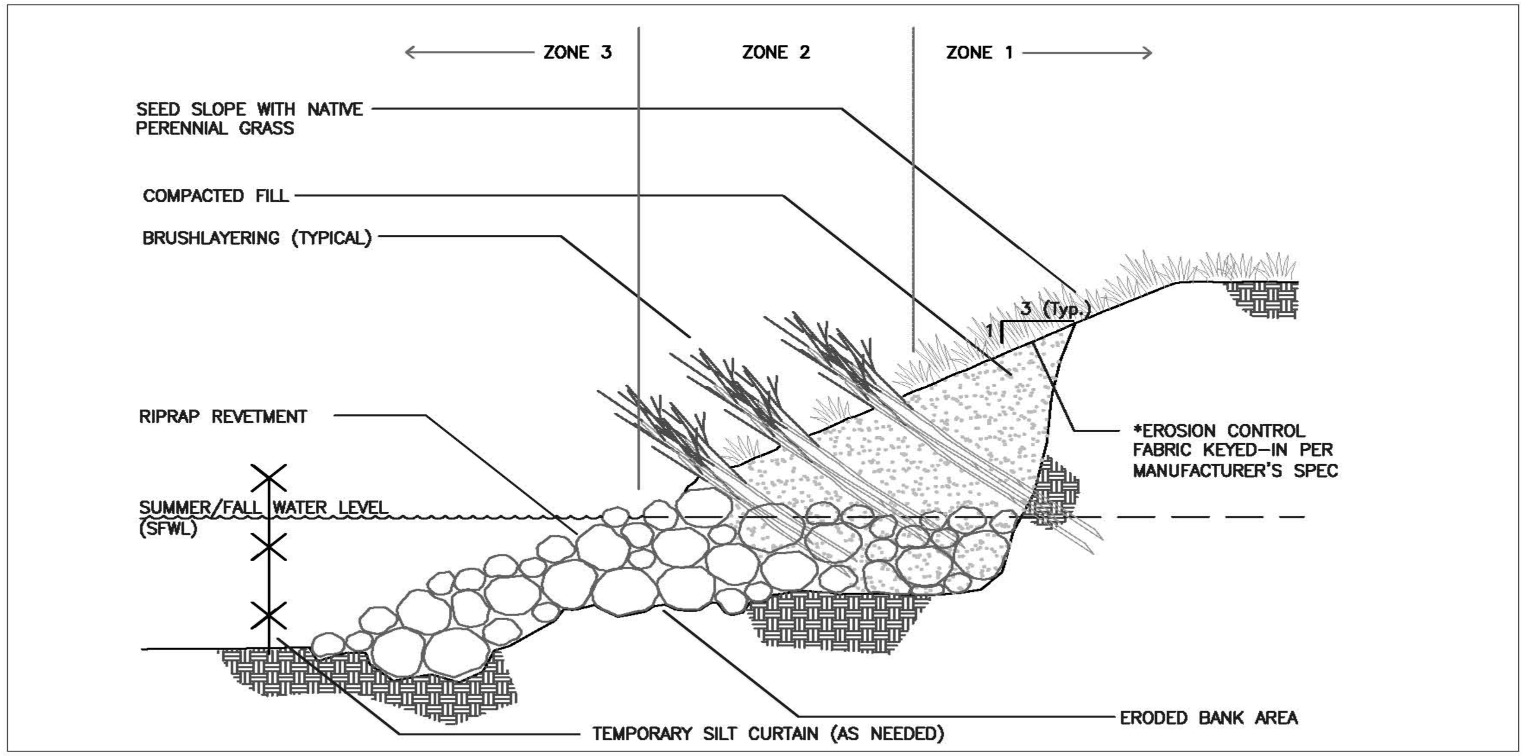
REVISIONS

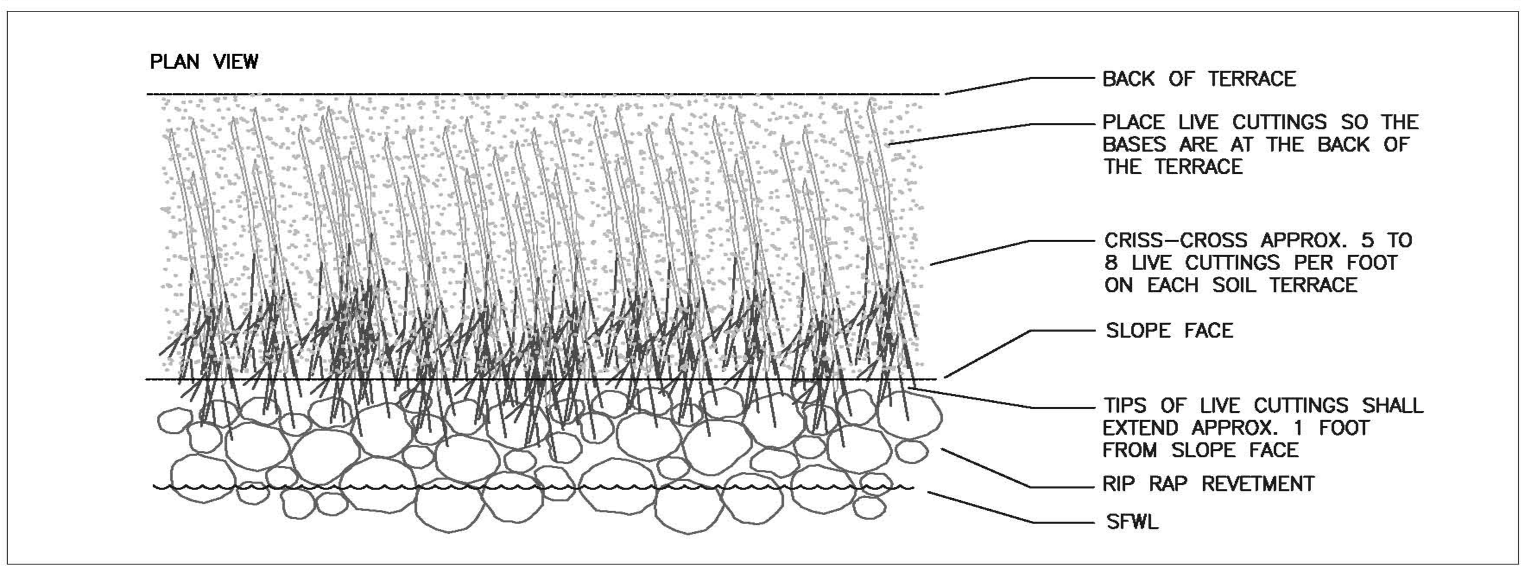
scale: NOT TO SCALE
job no.:

date: November 4, 2011

Template 2 Willow Wattle with Rock Toe

TEMPLATE FOR GUIDANCE ONLY — NOT PROJECT SPECIFIC





BRANCHLAYERING

Description and Application: Branchlayering is layers of live woody cuttings placed in rows running parallel to the channel. The cuttings are installed perpendicular to the slope, between lifts of soil, so that only the tips of the cuttings remain exposed. Live woody cuttings provide protection from erosion caused by runoff on the levee slope, as well as erosion caused by wave action. Branchlayering is suitable for steeper (i.e., 1:1.5 – 2:1) slopes in systems with low–velocity flows.
Maximum Slope: 1.5:1
Maximum Velocity: Project specific – determined by project engineer specification for rock size.

Limitations:
Brachlayering is not suitable for shallow slopes (e.g., 3:1) or upper levee banks.

Construction Notes:
Rock riprap material shall be placed from the toe of the slope to a point approximately 1'–2' above the Summer/Fall Water Level (SFWL). Alternating layers of Compacted Fill (soil or soil filled rock) and live woody cuttings shall be placed on the rock riprap above the SFWL. Each layer of live woody cuttings shall be watered before the next lift of Compacted Fill is placed on top of it.
To optimize growth, live woody cuttings should be harvested and installed during the dormant season (i.e., winter). Option: install sonotubes/steel pipes for follow–up winter planting. If live woody cuttings are harvested and installed during the growing season, the receiving site must have consistent water levels sufficient to maintain soil moisture that reaches the cuttings. Live woody cuttings shall be submerged in water for 1–7 days (24 hours min.) prior to installation.
Disturbed soil shall be seeded with a native perennial grass seed mix (broadcast or hydroseed). When surface vegetation is native species, consider stockpiling topsoil for replacement after construction.

Planting Zones:
Zone 1 – this zone extends from the top of the levee downslope to the eroded area. The lower extent of Zone 1 is determined by the upper extent of Zone 2 (described below). This zone shall be seeded with native perennial grasses. Woody vegetation shall not be planted in Zone 1. *Use non–monofilament wildlife–safe erosion control fabric.
Zone 2 – this is the primary woody vegetation planting zone. This zone extends from the SFWL upslope to the point where erosion is not occurring. Live woody cutting growth shall extend to where it would be limited by lack of soil moisture. Live woody cuttings and native perennial grasses may be planted in this zone.
Zone 3 – this zone extends from the channel bottom up to the SFWL. Live woody cuttings and emergent vegetation may be planted in this zone. Use of soil infill in this zone will be limited by water on some sites.

Plant List and Seed Mix:
Project–specific plant species and seed mixes will be selected from the plant list included in Section C, "Project Design Templates and Construction Details."

Rock Sizing;
The project engineer will use the rock sizing chart included in Section C as a guide to determine appropriate rock size and weight based on local scour velocities, with adjustments for bank angle, bend hydraulics, wave exposure, stability factors and safety coefficients.

Compacted Fill:
Compacted impervious material shall be used to fill large voids on an as–needed basis when directed by engineer per the following:
IMPERVIOUS MATERIAL: As per CCR Title 23, Section 120, ¶12.
COMPACTION REQUIREMENT: As per CCR Title 23, Section 120, ¶13.

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Flood Maintenance Office
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Sacramento, CA 95821

TEMPLATE 3:
BRANCHLAYERING

PRELIMINARY
NOT FOR CONSTRUCTION

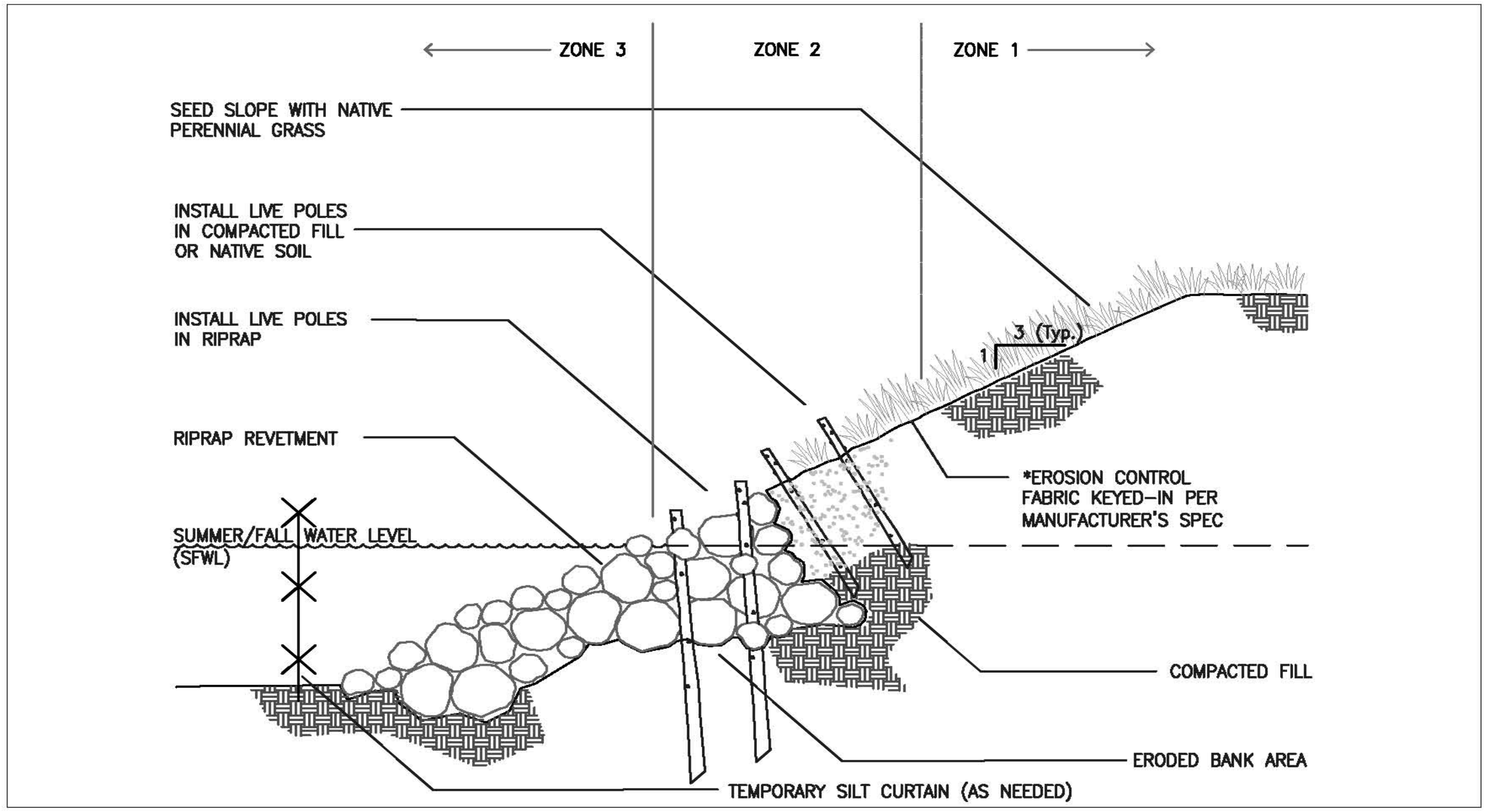
REVISIONS

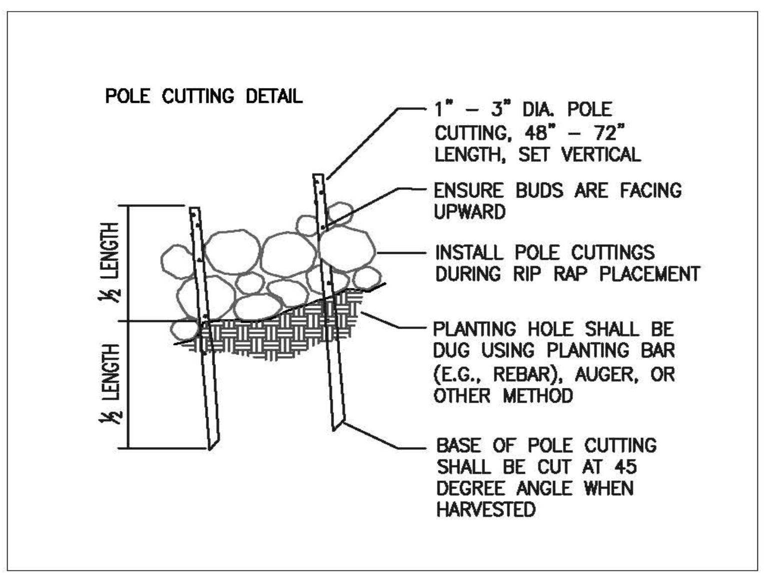
scale: NOT TO SCALE
job no.:

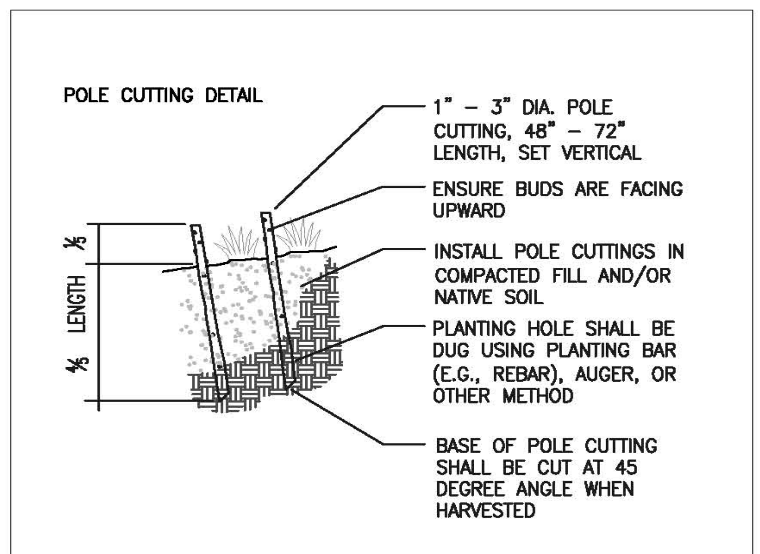
date: November 4, 2011

Template 3 Branch Layering

TEMPLATE FOR GUIDANCE ONLY – NOT PROJECT SPECIFIC







ROCK TOE WITH LIVE POLE PLANTING

Description and Application:
Rock toe with live pole planting is suitable for situations where typical flows cause erosion at the toe of the bank. Rock riprap is placed in the eroded area and live pole cuttings are installed in the rip rap and compacted or native soil as soil moisture conditions allow. This technique creates a stable, vegetated bank toe and is suitable for banks on inner and outer bends.
Maximum Slope: 1:1
Maximum Velocity: Project specific – determined by project engineer specification for rock size.

Limitations:
This technique is not suitable for flashy systems with high peak flows or frequently changing water surface elevations.

Construction Notes:
Rock riprap material shall be placed from the toe of the slope to a point at minimum 1'–2' above the Summer/Fall Water Level (SFWL). Riprap revetment with soil shall be installed above the SFWL to facilitate vegetated growth.
To optimize growth, live woody cuttings should be harvested and installed during the dormant season (i.e., winter). Option: install sonotubes/steel pipes for follow–up winter planting. If live woody cuttings are harvested and installed during the growing season, the receiving site must have consistent water levels sufficient to maintain soil moisture that reaches the cuttings. Live woody cuttings shall be submerged in water for 1–7 days (24 hours min.) prior to installation. Basic steps for construction, including timing, sequencing, materials, equipment, etc.
Disturbed soil shall be seeded with a native perennial grass seed mix (broadcast or hydroseed). When surface vegetation is native species, consider stockpiling topsoil for replacement after construction.

Planting Zones:
Zone 1 – this zone extends from the top of the levee downslope to the eroded area. The lower extent of Zone 1 is determined by the upper extent of Zone 2 (described below). This zone shall be seeded with native perennial grasses. Woody vegetation shall not be planted in Zone 1. *Use non–monofilament wildlife–safe erosion control fabric.
Zone 2 – this is the primary woody vegetation planting zone. This zone extends from the SFWL upslope to the point where erosion is not occurring. Live woody cutting growth shall extend to where it would be limited by lack of soil moisture. Live woody cuttings and native perennial grasses may be planted in this zone.
Zone 3 – this zone extends from the channel bottom up to the SFWL. Live woody cuttings and emergent vegetation may be planted in this zone. Use of soil infill in this zone will be limited by water on some sites.

Plant List and Seed Mix:
Project–specific plant species and seed mixes will be selected from the plant list included in Section C, "Project Design Templates and Construction Details."

Rock Sizing;
The project engineer will use the rock sizing chart included in Section C as a guide to determine appropriate rock size and weight based on local scour velocities, with adjustments for bank angle, bend hydraulics, wave exposure, stability factors and safety coefficients.

Compacted Fill:
Compacted impervious material shall be used to fill large voids on an as–needed basis when directed by engineer per the following:
IMPERVIOUS MATERIAL: As per CCR Title 23, Section 120, ¶ 12.
COMPACTION REQUIREMENT: As per CCR Title 23, Section 120, ¶ 13.

California Department of Water Resources

Small Erosion Repair Program

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TEMPLATE 4:
ROCK TOE WITH LIVE POLE PLANTING

PRELIMINARY
NOT FOR CONSTRUCTION

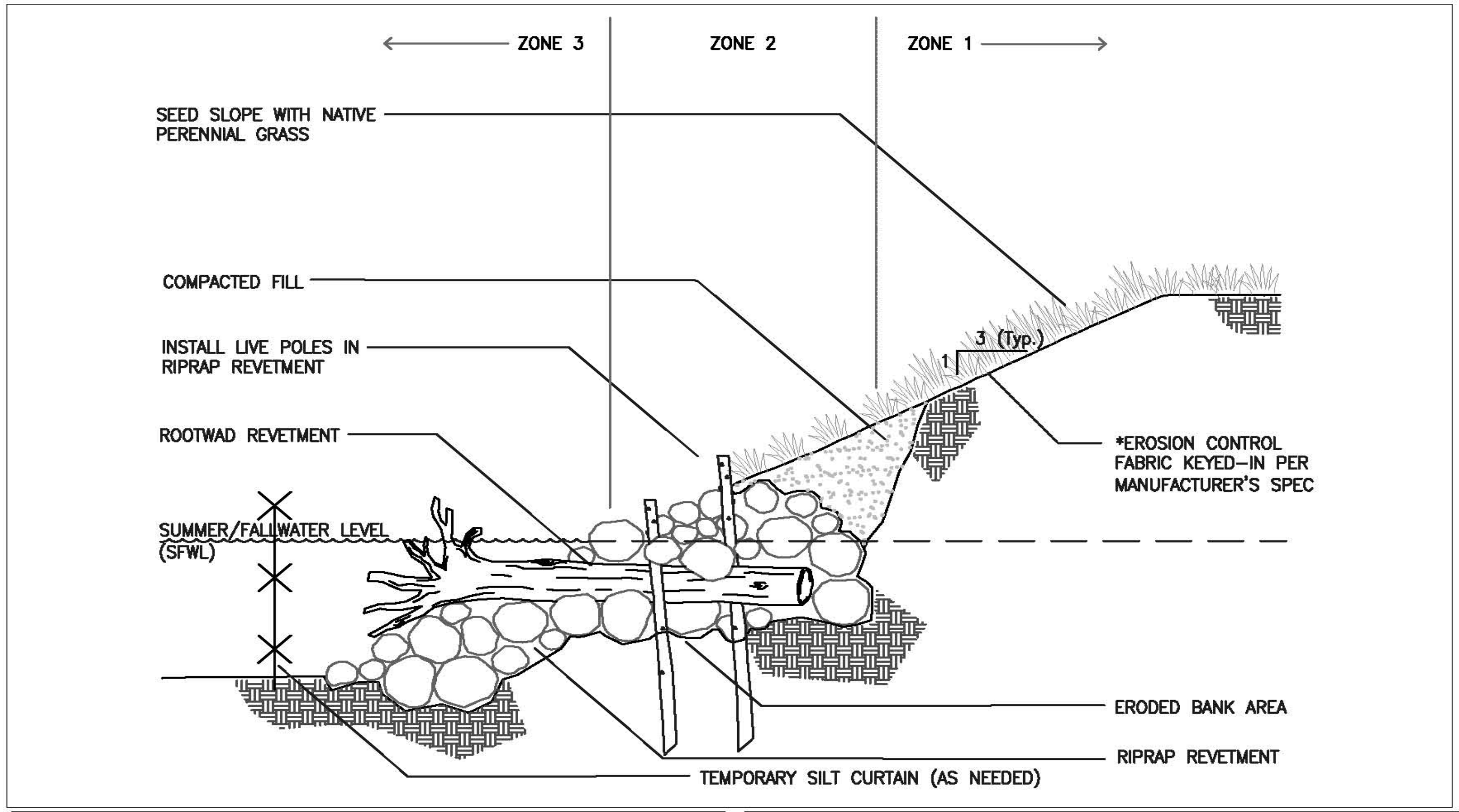
REVISIONS

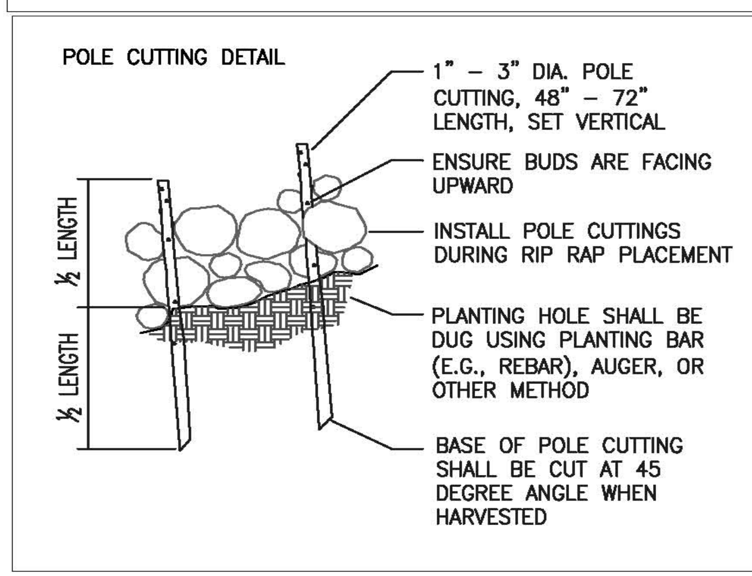
scale: NOT TO SCALE
job no.:

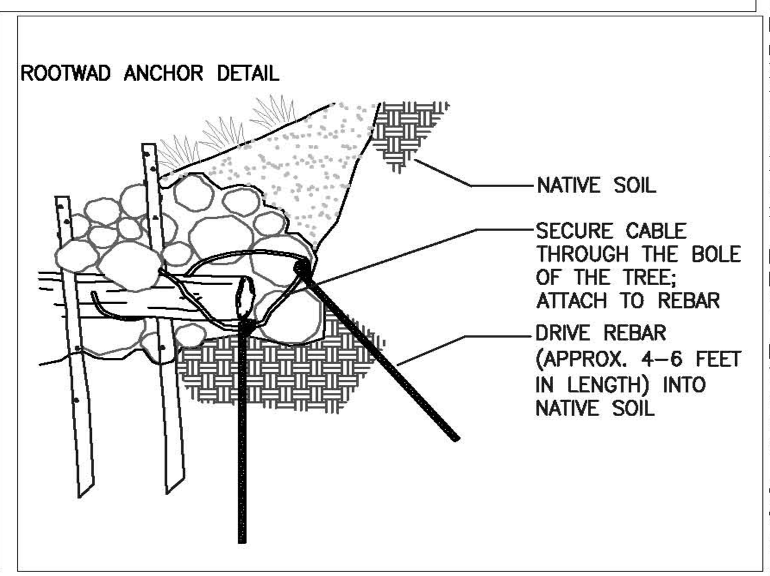
date: November 4, 2011

Template 4 Rock Toe with Live Pole Planting

TEMPLATE FOR GUIDANCE ONLY – NOT PROJECT SPECIFIC







SOIL AND ROCK FILL AT THE BASE OF A FALLEN TREE (W/ ROOTWAD REVETMENT OPTION)

Description and Application:
There are several repair options for levee banks damaged when a tree has fallen. These are typically small eroded areas. The eroded bank area can be filled with rock riprap and planted with live pole cuttings. Above the Summer/Fall Water Level (SFWL) soil filled rock may be used. In some cases, especially on outside bends, the fallen tree can be used as a rootwad revetment and flow deflector.
Maximum Slope: 1.5:1
Maximum Velocity: Project specific – determined by project engineer specification for rock size.

Limitations:
Rootwad revetments may only be appropriate on natural banks, and should not be installed if there is potential for high flows to cause erosion behind the root fan.

Construction Notes:
Rock riprap material shall be placed from the toe of the slope to a point at minimum 1'–2' above the SFWL. Riprap revetment with soil shall be installed above the SFWL to facilitate vegetated growth.
To optimize growth, live pole cuttings should be harvested and installed during the dormant season (i.e., winter). Option: install sonotubes/steel pipes for follow–up winter planting. If live pole cuttings are harvested and installed during the growing season, the receiving site must have consistent water levels sufficient to maintain soil moisture that reaches the cuttings. Live woody cuttings shall be submerged in water for 1–7 days (24 hours min.) prior to installation.
If conditions allow, the fallen tree shall be pruned and used as a rootwad revetment. The root fan shall be situated to deflect flows dowstream. The rootwad shall be anchored into the bank.
Disturbed soil shall be seeded with a native perennial grass seed mix (broadcast or hydroseed). When surface vegetation is native species, consider stockpiling topsoil for replacement after construction.

Planting Zones:
Zone 1 – this zone extends from the top of the levee downslope to the eroded area. The lower extent of Zone 1 is determined by the upper extent of Zone 2 (described below). This zone shall be seeded with native perennial grasses. Woody vegetation shall not be planted in Zone 1. *Use non–monofilament wildlife–safe erosion control fabric.
Zone 2 – this is the primary woody vegetation planting zone. This zone extends from the SFWL upslope to the point where erosion is not occurring. Live woody cutting growth shall extend to where it would be limited by lack of soil moisture. Live woody cuttings and native perennial grasses may be planted in this zone.
Zone 3 – this zone extends from the channel bottom up to the SFWL. Live woody cuttings and emergent vegetation may be planted in this zone. Use of soil infill in this zone will be limited by water on some sites.

Plant List and Seed Mix:
Project–specific plant species and seed mixes will be selected from the plant list included in Section C, "Project Design Templates and Construction Details."

Rock Sizing;
The project engineer will use the rock sizing chart included in Section C as a guide to determine appropriate rock size and weight based on local scour velocities, with adjustments for bank angle, bend hydraulics, wave exposure, stability factors and safety coefficients.

Compacted Fill:
Compacted impervious material shall be used to fill large voids on an as–needed basis when directed by engineer per the following:
IMPERVIOUS MATERIAL: As per CCR Title 23, Section 120, ¶ 12.
COMPACTION REQUIREMENT: As per CCR Title 23, Section 120, ¶ 13.

California Department of Water Resources

Small Erosion Repair Program

Deptartment of Water Resources
Division of Flood Management
Flood Maintenance Office
3310 El Camino Ave
Sacramento, CA 95821

TEMPLATE 5:
SOIL AND ROCK FILL AT THE BASE OF A FALLEN TREE (W/ ROOTWAD REVETMENT OPTION)

PRELIMINARY
NOT FOR CONSTRUCTION

REVISIONS

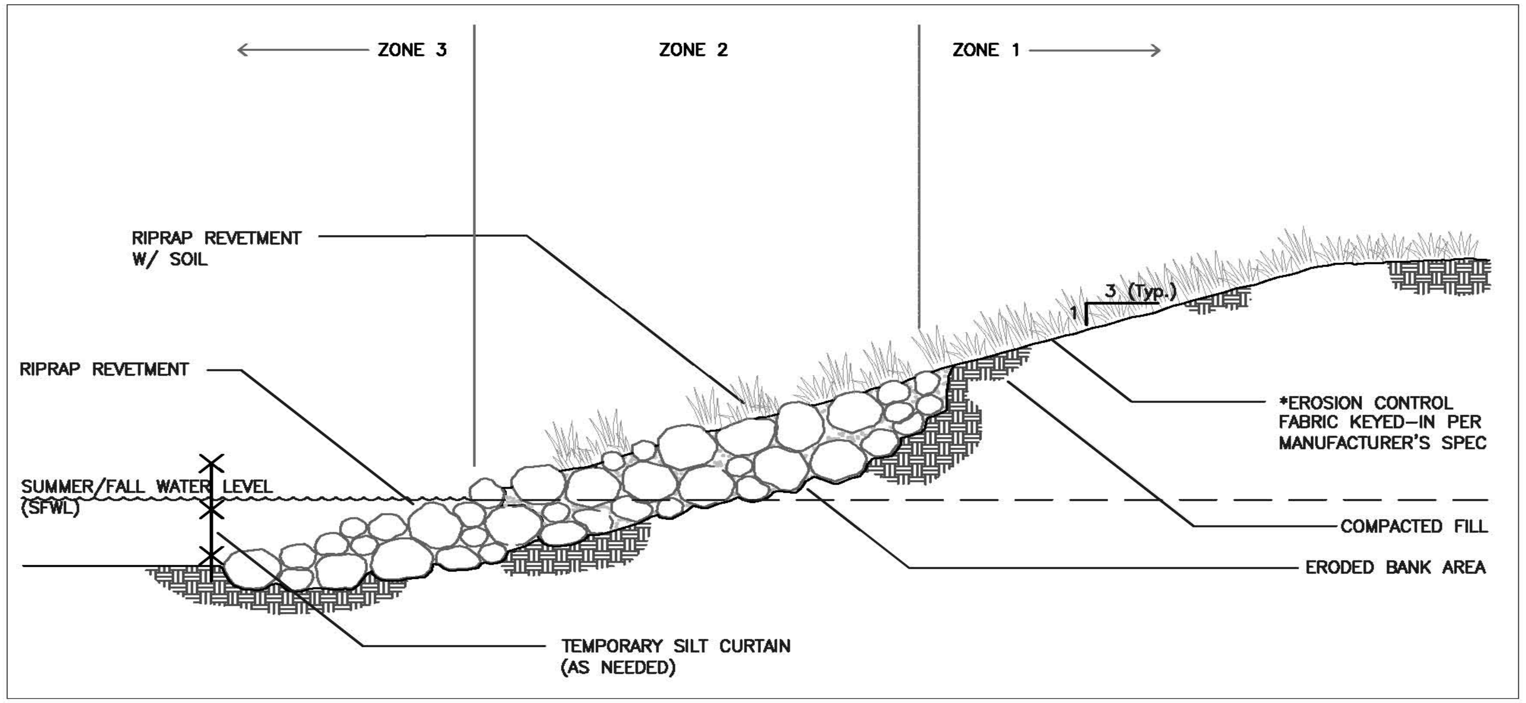
scale: NOT TO SCALE

job no.:

date: November 4, 2011

Template 5 Soil and Rock Fill at the Base of a Fallen Tree (with Rootwad Revetment Option)

TEMPLATE FOR GUIDANCE ONLY – NOT PROJECT SPECIFIC



BANK FILL ROCK SLOPE WITH NATIVE GRASS PLANTING

Description and Application: Bank fill rock slope with native grass planting is suitable for situations where significant bank erosion has occured. Soil filled rock is placed in the eroded area and grasses are installed on top. This technique creates a stable, vegetated bank toe and is suitable for banks on inner and outer bends.
Maximum Slope: 1:1
Maximum Velocity: Project specific – determined by project engineer specification for rock size.

Limitations:
Native grass plantings may not be suitable for flashy systems with high peak flows.

Construction Notes:
Rock riprap material shall be placed from the toe of the slope to a point at minimum 1'–2' above the Summer/Fall Water Level (SFWL). Riprap revetment with soil shall be installed above the SFWL to facilitate vegetated growth.
Disturbed soil shall be seeded with a native perennial grass seed mix (broadcast or hydroseed). When surface vegetation is native species, consider stockpiling topsoil for replacement after construction.

Planting Zones:
Zone 1 – this zone extends from the top of the levee downslope to the eroded area. The lower extent of Zone 1 is determined by the upper extent of Zone 2 (described below). This zone shall be seeded with native perennial grasses. Woody vegetation shall not be planted in Zone 1. *Use non–monofilament wildlfe–safe erosion control fabric.
Zone 2 – this zone extends from the SFWL upslope to the point where erosion is not occurring. Live woody cuttings and native perennial grasses may be planted in this zone.
Zone 3 – this zone extends from the channel bottom up to the SFWL. Live woody cuttings and emergent vegetation may be planted in this zone. Use of soil infill in this zone will be limited by water on some sites.

Plant List and Seed Mix:
Project–specific plant species and seed mixes will be selected from the plant list included in Section C, "Project Design Templates and Construction Details."

Rock Sizing;
The project engineer will use the rock sizing chart included in Section C as a guide to determine appropriate rock size and weight based on local scour velocities, with adjustments for bank angle, bend hydraulics, wave exposure, stability factors and safety coefficients.

Compacted Fill:
Compacted impervious material shall be used to fill large voids on an as–needed basis when directed by engineer per the following:
IMPERVIOUS MATERIAL: As per CCR Title 23, section 120, ¶ 12.
COMPACTION REQUIREMENT: As per CCR Title 23, section 120, ¶ 13.

California Department of Water Resources

Small Erosion Repair Program

Deptartment of Water Resources
Division of Flood Management
Flood Maintenance Office
3310 El Camino Ave
Sacramento, CA 95821

TEMPLATE 6:
BANK FILL ROCK SLOPE
WITH NATIVE GRASS
PLANTING

PRELIMINARY
NOT FOR CONSTRUCTION

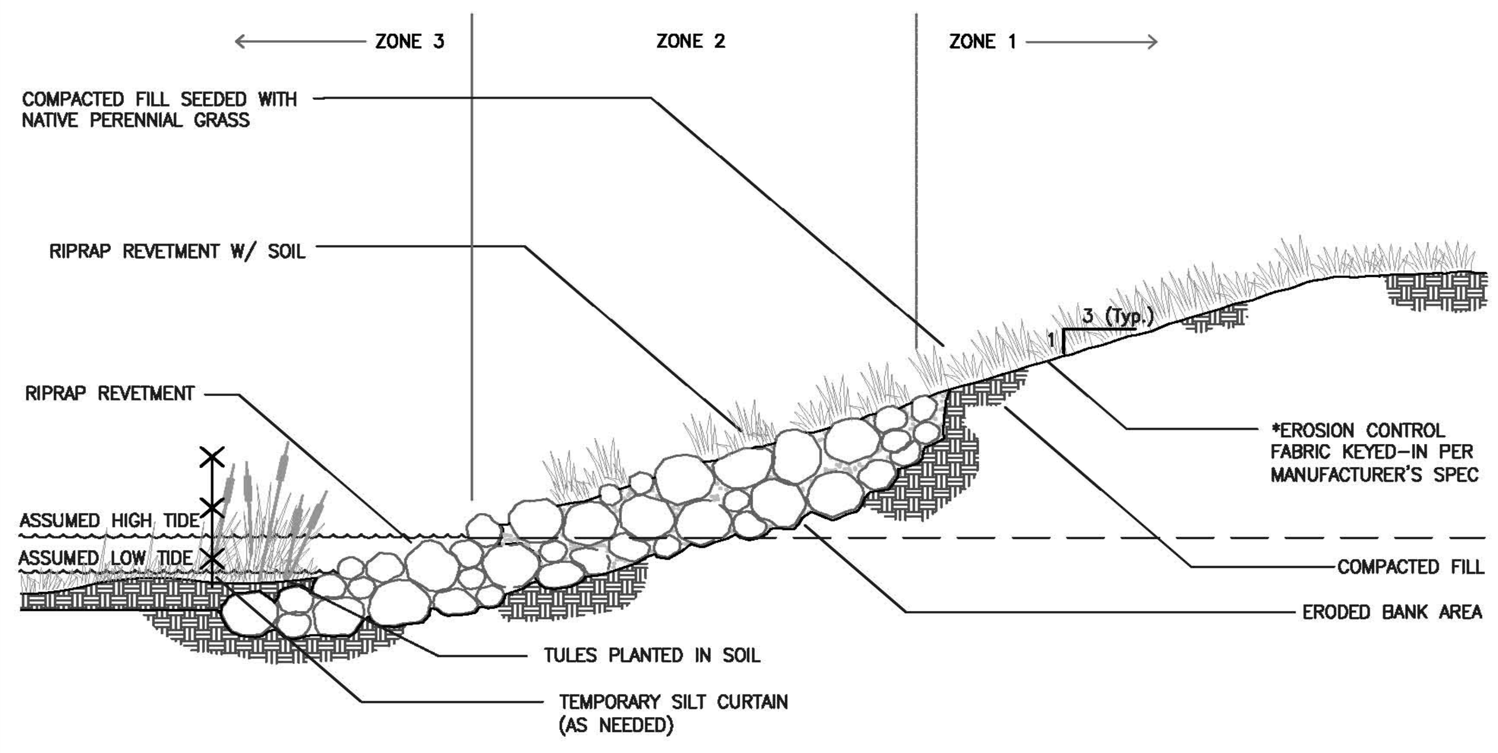
REVISIONS

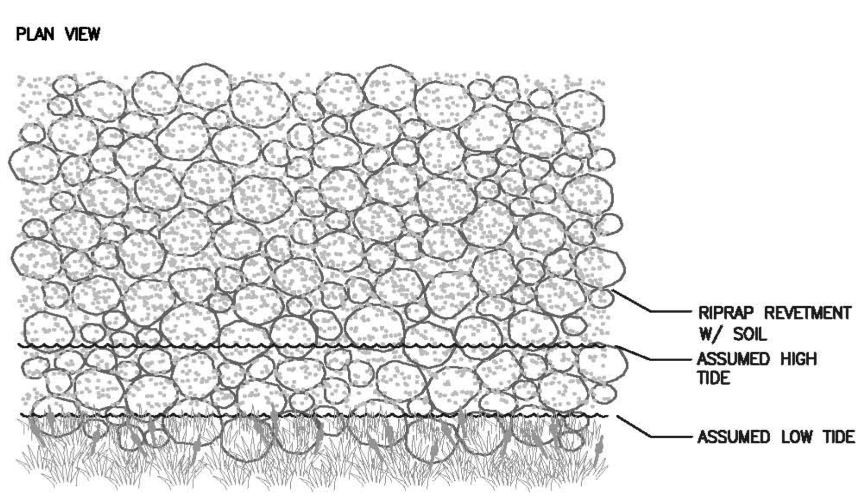
scale: NOT TO SCALE
job no.:

date: November 4, 2011

Template 6 Bank Fill Rock Slope with Native Grass Planting

TEMPLATE FOR GUIDANCE ONLY – NOT PROJECT SPECIFIC





BANK FILL ROCK SLOPE WITH EMERGENT VEGETATION PLANTING

Description and Application: Bank fill rock slope with emergent vegetation planting is suitable for situations where significant bank erosion has occurred. Soil filled rock is placed in the eroded area and emergent vegetation is installed typically below low toe. This technique creates a stable, vegetated bank toe and protected middle and upper bank.
Maximum Slope: 1:1
Maximum Velocity: Project specific – determined by project engineer specification for rock size.

Limitations:
For use typically where flatter (10:1) areas allow for emergent vegetation planting.

Construction Notes:
Rock riprap material shall be placed from just below the low tide point to a point at minimum 1'–2' above the high tide. Riprap revetment with soil shall be installed above high tide to facilitate vegetated growth.
Disturbed soil shall be seeded with a native perennial grass seed mix (broadcast or hydroseed). When surface vegetation is native species, consider stockpiling topsoil for replacement after construction.

Planting Zones:
Zone 1 – this zone extends from the top of the levee downslope to the eroded area. The lower extent of Zone 1 is determined by the upper extent of Zone 2 (described below). This zone shall be seeded with native perennial grasses. Woody vegetation shall not be planted in Zone 1. *Use non–monofilament wildlfe–safe erosion control fabric.
Zone 2 – this zone extends from the high tide upslope to the point where erosion is not occurring. Live woody cuttings and native perennial grasses may be planted in this zone.
Zone 3 – this zone extends from the channel bottom up to the high tide. Emergent vegetation may be planted in this zone.

Plant List and Seed Mix:
Project–specific plant species and seed mixes will be selected from the plant list included in Section C of the SERP Manual, "Project Design Templates and Construction Details."

Rock Sizing;
The project engineer will use the rock sizing chart included in Section C as a guide to determine appropriate rock size and weight based on local scour velocities, with adjustments for bank angle, bend hydraulics, wave exposure, stability factors and safety coefficients.

Compacted Fill:
Compacted impervious material shall be used to fill large voids on an as–needed basis when directed by engineer per the following:
IMPERVIOUS MATERIAL: As per CCR Title 23, section 120, ¶ 12.
COMPACTION REQUIREMENT: As per CCR Title 23, section 120, ¶13.

California Department of Water Resources

Small Erosion Repair Program

Deptartment of Water Resources
Division of Flood Management
Flood Maintenance Office
3310 El Camino Ave
Sacramento, CA 95821

TEMPLATE 7:
BANK FILL ROCK SLOPE WITH EMERGENT VEGETATION PLANTING

PRELIMINARY
NOT FOR CONSTRUCTION

REVISIONS

scale: NOT TO SCALE
job no.:

date: November 4, 2011

Template 7 Bank Fill Rock Slope with Emergent Vegetation Planting

D. REGULATORY MECHANISMS

PROGRAM-LEVEL PERMIT PROCESS

This section describes the regulatory mechanisms used by the regulatory and resource agencies to authorize the SERP. Section F, “Notification Requirements,” describes the approval process for individual repairs that qualify for authorization under the program. Agencies with regulatory authority over the SERP include USACE, the Central Valley Regional Water Quality Control Board (RWQCB), the California Department of Fish and Game (DFG), USFWS, NMFS, and SHPO. Figure D1 outlines the SERP programmatic authorization process and provides an estimated schedule for programmatic permit issuance.

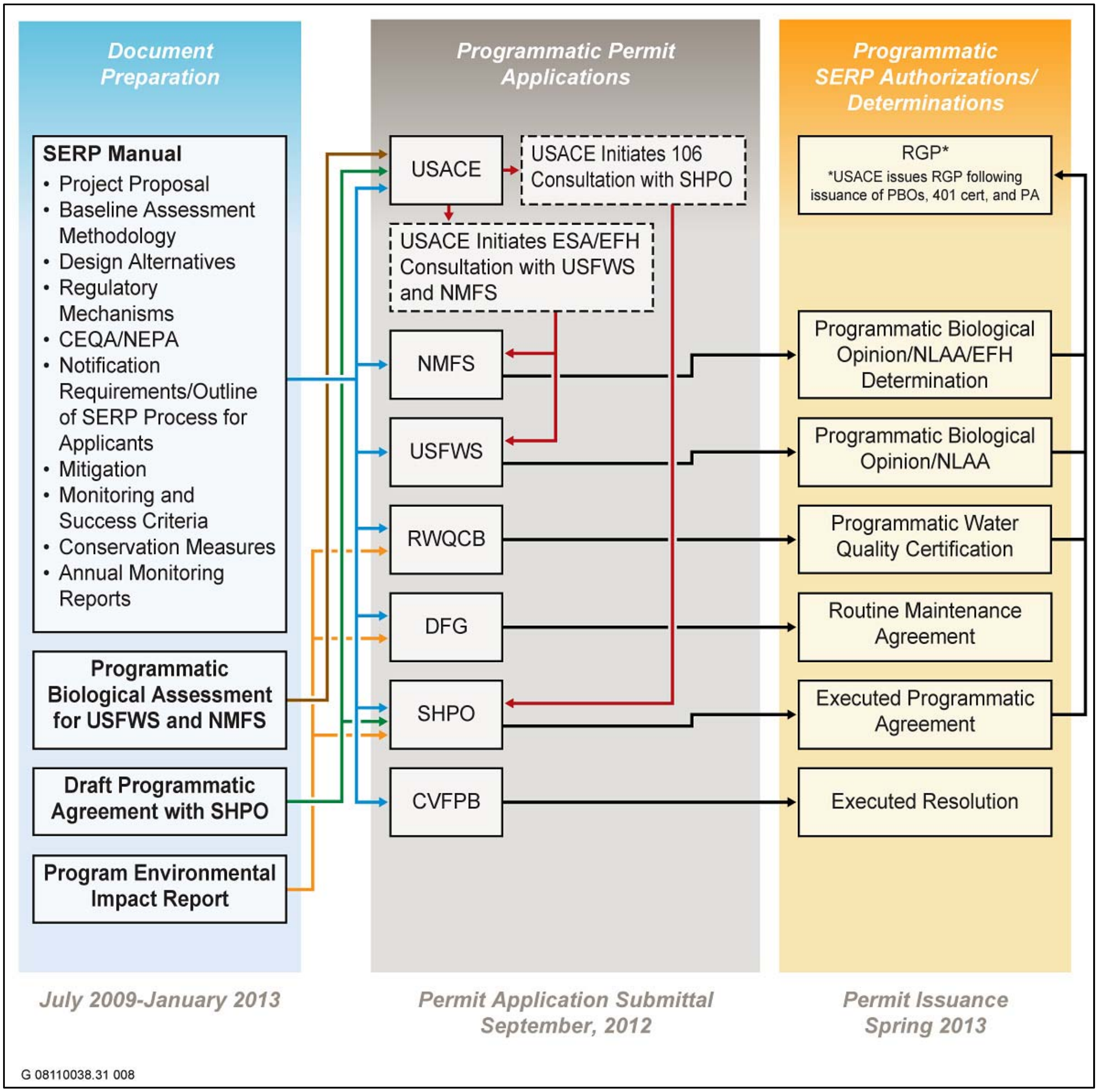
FEDERAL AUTHORIZATIONS

U.S. ARMY CORPS OF ENGINEERS

CLEAN WATER ACT SECTION 404 AND RIVERS AND HARBORS ACT SECTION 10

Section 404 of the Clean Water Act (CWA) prohibits the discharge of dredged or fill materials into waters of the United States, including wetlands, without prior USACE authorization. Section 10 of the Rivers and Harbors Act of 1899 prohibits obstruction or alteration of navigable waters of the United States without prior USACE authorization. In compliance with these statutes, USACE will develop a Regional General Permit (RGP) for the SERP under the authority of CWA section 404 (33 U.S. Code [USC] section 1344) and River and Harbors Act of 1899 section 10 (33 USC section 403), in accordance with provisions of “Regulatory Programs of the Corps of Engineers,” 33 CFR section 323.2(h) for activities which are substantially similar in nature and which cause only minimal individual and cumulative environmental impacts. The RGP will be valid for 5 years from the date of issuance and may be renewed at USACE’s discretion. Compliance with additional regulations, including but not limited to those identified below, will be required by USACE prior to its issuance of the RGP:

- (federal) Endangered Species Act (ESA)
- Fish and Wildlife Coordination Act (FWCA)
- Magnuson–Stevens Fishery Conservation and Management Act (MSA) for Essential Fish Habitat (EFH)
- Marine Mammal Protection Act (MMPA)
- Migratory Bird Treaty Act (MBTA)
- Section 106 of the National Historic Preservation Act (NHPA)



Prepared by AECOM 2010

Figure D1 **SERP Development Process Flowchart**

- Section 401 of the CWA
- National Environmental Policy Act (NEPA)
- Bald and Golden Eagle Protection Act (BGEPA)

USACE will initiate the ESA, MSA, and NHPA consultations, and initiate coordination under the MMPA and MBTA as part of the RGP permit process. ESA compliance will be achieved through section 7 consultations requested by USACE with USFWS and NMFS as described below; FWCA compliance will be achieved through a FWCA report prepared by USFWS; MSFCMA compliance will be achieved by incorporating RGP special conditions requiring implementation of EFH conservation recommendations provided in the NMFS programmatic biological opinion (BO); MMPA, MBTA, and BGEPA compliance will be achieved through coordination with NMFS and USFWS during the consultation and coordination process; NHPA compliance will be achieved by developing a PA with SHPO, as described below; and compliance with CWA section 401 will be achieved by developing a programmatic 401 water quality certification from the RWQCB, as described below. NEPA compliance will be achieved by USACE preparing an environmental assessment (EA) as part of the RGP process; a finding of no significant impact (FONSI) is anticipated.

U.S. Fish and Wildlife Service and National Marine Fisheries Service

ESA, FWCA, MSA, MMPA, MBTA, and BGEPA

Once a fish or wildlife species is listed as endangered or threatened under the ESA, the act prohibits anyone from taking the species. To “take” a species means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” Habitat modification or degradation that is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat constitutes take. USFWS administers the ESA for terrestrial and freshwater species and NMFS for marine and anadromous fish species. Section 7(a)(2) of the ESA requires federal agencies to consult with USFWS and/or NMFS to ensure that they are not undertaking, funding, permitting, or authorizing actions that will adversely affect such species or that may result in take.

As part of the issuance of an RGP, which is the federal nexus for the SERP, USACE will initiate ESA section 7 consultation with both USFWS and NMFS. It is anticipated for SERP that this effort will result in a combined programmatic BO and not likely to adversely affect letter (NLAA) from each of these agencies. The NMFS programmatic BO is anticipated to incorporate conservation recommendations for EFH to comply with the MSA.

Coordination with USFWS and NMFS will include discussion of potential impacts to any species covered by the MMPA and the MBTA. The FWCA provides the basic authority for USFWS involvement in evaluating impacts to fish and wildlife from proposed water resource development projects; thus, USFWS anticipates providing its comments in the form of a FWCA report. NMFS will provide its comments in a letter. The concerns and/or recommendations of either agency must be addressed.

Authorizations will be valid for an initial period of 5 years. At USACE's request, USFWS and NMFS will review the program for reauthorization in 5 years, concurrent with renewal of the SERP RGP.

STATE AUTHORIZATIONS

CALIFORNIA ENVIRONMENTAL QUALITY ACT

A certified CEQA document will be required for issuance of CWA section 401 water quality certification by the RWQCB and for issuance of a streambed alteration agreement (SAA) by DFG. It has been determined that a PEIR is the appropriate CEQA document for the SERP. As the designated lead agency under CEQA, DWR will prepare a PEIR that identifies the scope of the SERP and probable environmental impacts associated with expected repair projects, as well as the aggregate and cumulative impacts of the SERP to the extent that these impacts can be defined and are not speculative. In addition to providing CEQA coverage for programmatic CWA 401 certification and SAA issuance, the PEIR will provide an avenue for compliance with section 106 of the NHPA and will address potential program-level impacts to state-listed species.

STATE HISTORIC PRESERVATION OFFICER

NATIONAL HISTORIC PRESERVATION ACT SECTION 106

Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties, and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment. USACE has proposed to issue a RGP to DWR to discharge fill to the waters of the United States under authority of CWA section 404 for Phase I of the SERP. USACE must comply with section 106 of the NHPA because an RGP would be an undertaking by USACE as defined under Interim Guidance for Implementing Title 33, CFR Part 325, Appendix C and under Title 36, CFR Part 800.16[y]. Title 33, CFR Part 325, Appendix C establishes the procedures to be followed by USACE to fulfill NHPA requirements. For the SERP, USACE and SHPO will execute a PA using the process defined in 36 CFR Part 800.14 and the procedures defined in 33 CFR Part 325, Appendix C, sections 5 through 15 to satisfy compliance with NHPA section 106. This process allows deferred identification and management of cultural resources under an agreement document. Upon execution (signing and approval) of the PA by the consulting parties, NHPA section 106 compliance will be deemed complete for the purpose of permits and authorizations dependent on the section 106 process. Therefore, PA execution satisfies NHPA section 106 sufficiently to allow USACE to issue an RGP for the SERP and allow DWR and USACE to defer identification and management of historic properties until specific erosion sites require repair.

The PA will provide a process for performing an inventory of cultural resources at specific erosion repair sites as they are identified, evaluating those resources, and resolving any potential adverse effects on significant resources (i.e., historic properties). Notice is required to other potential consulting parties such as the interested public (local historic preservation organizations) and Native American tribes. USACE will provide notice by letter identifying the nature of the federal action and inviting these parties to consult in development of the PA. Coordination with other federal agencies providing permits and authorizations for the SERP will be performed to ensure that the PA identifies these other undertakings, providing a unified compliance framework for compliance with NHPA section 106. The PA will be valid for 5 years and may be renewed at the discretion of USACE and SHPO concurrent with RGP renewal.

Central Valley Regional Water Quality Control Board

Clean Water Act Section 401

The RWQCB will develop a programmatic 401 water quality certification to authorize the SERP under section 401 of the CWA. Issuance of the RWQCB water quality certification requires completion of the final PEIR (FPEIR) for compliance with CEQA. The RWQCB will be a Responsible Agency under CEQA. In acting on issuance of the 401 certification, the RWQCB will rely on the PEIR to prepare and issue its own findings regarding the SERP, and to decide whether or not to issue a water quality certification. A draft Programmatic Certification will be circulated for 30 to 60 days for public review and comment. An additional 60 days may be required to schedule a RWQCB meeting if necessary. The Programmatic Certification will be effective for 5 years and may be renewed at the RWQCB's discretion concurrent with renewal of the RGP.

California Department of Fish and Game

Lake and Streambed Alteration Program

California Fish and Game Code section 1600 requires notification to DFG before conducting activities that will substantially obstruct or divert natural flow of state waters, substantially change or use materials from a bed, bank or channel, or deposit materials into a river, stream, or lake. DFG will authorize the SERP under an SAA for routine maintenance. The agreement will be valid for 5 years and may be renewed at DFG's discretion. Issuance of the SAA will require certification of CEQA compliance. DFG will be a Responsible Agency under CEQA. In acting on issuance of the SAA, DFG will rely on the PEIR to prepare and issue its own findings regarding the SERP, and to decide whether or not to issue an SAA.

California Endangered Species Act

The California Endangered Species Act prohibits activities that will result in "take" of state-listed and candidate species without prior DFG authorization through an Incidental Take Permit. California Fish and Game Code section 86 defines take as the act or attempt to "hunt, pursue, catch, capture, or kill." DFG has indicated that with implementation of recommended conservation measures listed in this SERP Manual, such as appropriate project timing and other avoidance measures, take of state-listed species will likely be avoided. During SERP implementation, if it is determined that a particular project may result in take under the state definition, that project will no longer qualify for authorization under the SERP.

CALIFORNIA STATE LANDS COMMISSION

The California State Lands Commission (SLC) has jurisdiction over certain public lands including sovereign lands that encompass beds of navigable rivers, lakes, and streams. DWR staff will coordinate with the SLC on work within its jurisdictional areas.

CENTRAL VALLEY FLOOD PROTECTION BOARD

The Board has given assurances to USACE that the state will maintain and operate federal flood control works in accordance with federal law pursuant to CWC section 8708. Although the operation and maintenance activities proposed to repair individual SERP sites are generally not the subject of Board review and approval, Board staff does provide oversight for and authorization of maintenance activities from time to time. Because of the unique nature of the SERP program, and to provide an appropriate level of Board oversight, Board Resolution 2012-20 was approved on April 27, 2012, that provides direction to Board staff and informs DWR as to the Board's intent to participate in the SERP program as a state partner. The Board resolved the following:
Deems all SERP program activities to be operations and maintenance activities not requiring Board encroachment permits;

1. Directs Board staff to assist DWR as necessary to finalize the SERP Manual, including geotechnical and hydraulic analysis review procedures, long-term vegetation maintenance procedures, and SERP member agency and public notification procedures;

2. Directs Board staff to prepare Responsible Agency comments pursuant to CEQA when DWR's draft PEIR (DPEIR) is circulated;

3. Directs Board staff to prepare appropriate Responsible Agency findings pursuant to CEQA for Board approval when DWR's FPEIR is circulated;

4. Directs Board staff to review annual SERP repair proposals, and to determine: (A) whether or not each SERP site has been designed according to the SERP Manual, (B) that geotechnical design issues have been considered, (C) that there are no adverse hydraulic impacts, (D) that long-term vegetation management actions have been addressed, and (E) that annual noticing of SERP member agencies and the public is carried out, all in conformance with the SERP Manual;

5. Delegates to the Chief Engineer the authority to execute documents necessary to authorize or reject proposed sites for SERP pilot program repairs consistent with this resolution;

6. Directs Board staff to submit an annual report to the Board on the SERP pilot program including a detailed listing of annually proposed and authorized (or denied) SERP sites at a regular monthly Board meeting as soon as practical after the Chief Engineer's annual determination has been provided to DWR.

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E. CALIFORNIA ENVIRONMENTAL QUALITY ACT/ NATIONAL ENVIRONMENTAL POLICY ACT COMPLIANCE

This section describes how CEQA and NEPA compliance will be achieved for the SERP.

CALIFORNIA ENVIRONMENTAL QUALITY ACT

In accordance with CEQA (Public Resources Code section 21000 et seq.) and the State CEQA Guidelines (CCR section 15000 et seq.), DWR will be preparing a PEIR to evaluate the potential environmental effects associated with Phase 1 of the SERP (i.e., the first 5-year implementation phase by DWR). As mentioned previously, after the Phase 1 implementation period, the Interagency Collaborative Group intends to evaluate the program's success and may expand the SERP to include flood control facilities maintained by various other LMAs. Expansion of the program in later phases may require further analysis under CEQA.

CEQA defines a project as any activity directly undertaken by a public agency that "may cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment" (Public Resources Code section 21065). State CEQA Guidelines section 21151(a) specifies that an agency must prepare an environmental impact report for any project that it proposes to carry out or approve that may have a significant impact on the environment.

With the PEIR and corresponding permits, DWR is seeking environmental clearance for multiple sites within the SERP. The PEIR provides one mechanism for obtaining CEQA clearance for multiple sites and expediting work on specific sites once locations subject to erosion repair are identified. Under this approach, DWR will prepare a PEIR that identifies the scope of the SERP and probable environmental impacts associated with expected repair projects, as well as the aggregate and cumulative impacts of the SERP to the extent that these impacts can be defined and are not speculative. The PEIR will be subject to the standard process and public review periods as stipulated in the CEQA statute and State CEQA Guidelines.

In accordance with State CEQA Guidelines section 15082, DWR prepared and issued a notice of preparation (NOP) as notification that a PEIR will be prepared on the SERP. The NOP provides information about the proposed program and its potential environmental impacts so that the Governor's Office of Planning and Research (OPR), responsible and trustee agencies, and interested parties have the opportunity to provide meaningful comments related to the scope and content of the PEIR, including the significant environmental issues, reasonable alternatives, and mitigation measures that a responsible or trustee agency, or OPR, will need to explore in the PEIR (State CEQA Guidelines section 15082[b]).

An initial study has been prepared for the SERP in accordance with State CEQA Guidelines section 15063 and circulated along with the NOP. The initial study identifies the anticipated environmental effects of the program. Based on the results of the initial study, a DPEIR will be prepared. The DPEIR will be focused on several potentially significant environmental impacts associated with implementation of the SERP. Mitigation measures will be recommended wherever feasible to avoid, minimize, rectify, reduce, eliminate, or compensate for potentially significant and significant impacts. Issues to be addressed in the focused PEIR for the SERP include air quality, biological resources, cultural resources, geology and soils, hydrology and water quality, and noise. The combination of the initial study and PEIR satisfy DWR's obligation under State CEQA Guidelines section 15082(a)(1)(C) to identify the "probable environmental effects of the project."

Consistent with the requirements of State CEQA Guidelines section 15126.6, the DPEIR will examine a range of reasonable alternatives to the proposed project that are potentially feasible. As a result of scoping and agency consultation efforts, the alternatives selected for evaluation in the DPEIR include a no-project alternative, a traditional engineered repairs alternative, and a large-scale erosion repair alternative.

The CEQA process must be completed before certain permits can be granted by the reviewing agencies. For example, a certified CEQA document is required for issuance of CWA section 401 water quality certification by the RWQCB and for issuance of the SAA by DFG.

As specific erosion repair sites are identified, DWR will use the CEQA Implementation Checklist provided in Appendix B to determine if a proposed erosion repair project at a given location is consistent with the type and degree of impacts identified in the PEIR. If DWR determines through completion of the checklist that, after implementation of the applicable PEIR mitigation measures, the specific project-level repair work will be consistent with the findings of the PEIR, DWR will retain the checklist as documentation and approve the repair project without a second public review process or preparation of subsequent or supplemental environmental CEQA documents. If the environmental impacts associated with a specific repair project are of a substantially greater magnitude or substantially different than those identified in the PEIR, the project will not qualify for authorization under the SERP. In such cases, DWR will determine and prepare the appropriate document to satisfy CEQA for the individual repair project, and apply for the necessary permits.

Central Valley Regional Water Quality Control Board

Issuance of the RWQCB water quality certification will require a FPEIR to comply with CEQA. The RWQCB is a Responsible Agency under CEQA. In acting on issuance of the 401 certification, the RWQCB will rely on the FPEIR to prepare and issue its own findings regarding the SERP, and to decide whether or not to issue water quality certification.

CALIFORNIA DEPARTMENT OF FISH AND GAME

DFG is a Responsible Agency for CEQA compliance as well as a Trustee Agency under CEQA. In acting on issuance of the SAA, DFG will rely on the certified FPEIR to prepare and issue its own findings regarding the SERP, and to decide whether or not to issue a SAA.

CALIFORNIA STATE LANDS COMMISSION

The SLC is a Trustee Agency under CEQA. In acting on the issuance of an agreement or lease, the SLC will rely on the certified FPEIR.

CENTRAL VALLEY FLOOD PROTECTION BOARD

The Board is a Responsible Agency under CEQA. The Board may also prepare and issue its own findings based on the certified FPEIR.

NATIONAL ENVIRONMENTAL POLICY ACT

NEPA evaluation is required when a major federal action, including a permit or approval, is under consideration and may have significant impacts on the quality of the human environment. NEPA compliance will be achieved for the SERP by USACE through preparation of an EA as part of the RGP process. A FONSI is anticipated.

In accordance with USACE's Engineering Regulation 200-2-2 (33 CFR 230), the EA will be a brief document that provides sufficient information to the USACE district commander on potential environmental effects of a proposed action and, if appropriate, its alternatives, for determining whether to prepare an environmental impact statement (EIS) or a FONSI (40 CFR 1508.9). The USACE district commander is responsible for making this determination and for keeping the public informed of the availability of the EA and FONSI.

The EA will include a brief discussion of the purpose and need for the proposed action, or appropriate alternatives if unresolved conflicts exist concerning alternative uses of available resources; the environmental impacts of the proposed action and alternatives; and a list of the consulted agencies, interested groups, and public.

Pursuant to Engineering Regulation 200-2-2 (33 CFR 230), a FONSI will be prepared for a proposed action that is not categorically excluded and for which an EIS will not be prepared. If USACE determines a FONSI is warranted, the FONSI will be a brief summary document, as noted in 40 CFR 1508.13, that constitutes the legal finding that justifies the decision not to prepare an EIS.

The public notice for the SERP RGP will indicate the availability of the EA/FONSI pursuant to the requirements set forth in 40 CFR 1501.4(e)(1).

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F. NOTIFICATION REQUIREMENTS

This section describes the notification and response requirements for repairs that qualify for authorization under the SERP and outlines DWR's process for using the SERP. The section includes the interagency notification checklist to be filled out by DWR for each repair requiring agency notification under the program.

OUTLINE OF DWR'S PROCESS FOR USING THE SERP

ANNUAL PROJECT NOTIFICATION

DWR will provide SERP project notification to the SERP agencies through submittal of an annual SERP project notification package. The package will include individual project application materials for each project proposed for SERP authorization that year. The list of erosion sites will be submitted to DWR engineering and environmental staff by June 1. The engineering and environmental staff will submit the notification package to the SERP agencies' staff by July 1 in anticipation of construction during September and October. Application materials for each project will include:

1. Completed SERP Notification Form
2. Completed Baseline Assessment Checklist
3. Photographs of project site with project foot-print/action area (defined as all APE—access, staging, construction)
4. Project diagrams (i.e., project vicinity map, site plan, cross section)
5. Delineation of special aquatic sites and other waters of the United States and/or the state. Wetland delineations must be prepared in accordance with the current methods and standards required by USACE.
6. Map of adjacent repair locations
7. DFG and the RWQCB only: notification fees
8. A single (for each notification package) completed ENG Form 4345 Application for a Department of the Army Permit

AGENCIES TO BE NOTIFIED

The following agencies will be provided annual SERP project notification packages: USACE, the RWQCB, USFWS, NMFS, the Board, and DFG. The packages will be submitted concurrently to the agency points-of-contact listed below. With the exception of DFG, one application package will be submitted to each agency. For DFG, annual notification packages will be provided to the DFG Regional Office and the DFG SERP contact.

CONTACT INFORMATION

Table F1 provides the contact information for each SERP agency. Unless otherwise directed by the SERP agencies, DWR will submit annual notification packages for proposed SERP projects to the agency addresses identified below. All letters to USFWS need to be addressed to the Assistant Field Supervisor of Endangered Species Division.

Table F1
SERP Agencies Contact Information

Agency	Address	Phone
USACE	U.S. Army Corps of Engineers Regulatory Division 152 Hartnell Avenue Redding, CA 96002	(d) (530) 223-9534 (f) (530) 223-9539
USFWS	Sacramento Fish and Wildlife Office Endangered Species Program 2800 Cottage Way, Room W-2605 Sacramento, CA 95825	(d) (916) 414-6600 (f) (916) 414-6713
NMFS	National Marine Fisheries Service Protected Resources Division 650 Capitol Mall, Suite 5-100 Sacramento, CA 95814-4708	(d) (916) 930-3600 (f) (916) 930-3629
RWQCB	Central Valley RWQCB Stormwater/Certification Section 11020 Sun Center Drive, Ste. 200 Rancho Cordova, CA 95670-6114	(d) (916) 464-3291 (f) (916) 464-4645
DFG	California Department of Fish and Game North Central Region 1701 Nimbus Road Rancho Cordova, CA 95670	(d) (916) 358-2900 (f) (916) 358-2912
Board	Central Valley Flood Protection Board 3310 El Camino Avenue, Room 151 Sacramento, CA 95821	(d) (916) 574-0653 (f) (916) 574-0682

Source: Data compiled by AECOM in 2012

AGENCY RESPONSES TO PROJECT NOTIFICATION

Each agency will respond to DWR in writing via letter or e-mail within 30 days of receipt of a complete project notification indicating that it has made one of the following determinations listed below: (For USFWS, NMFS, and the RWQCB, this notification will be provided concurrently to DWR and USACE in the form of an official letter.)

a) This agency concurs with DWR and, for projects requiring consultation with USFWS and/or NMFS, USACE's determination. and/or agrees that the project qualifies for authorization under the SERP programmatic authorization issued by this agency.

b) With the additional proposed conservation measures identified, this agency concurs with DWR and USACE's determination and/or agrees that the project qualifies for authorization under the SERP programmatic authorization issued by this agency.

c) This agency does NOT concur with DWR and, for projects requiring consultation with USFWS and/or NMFS, USACE's determination, and/or the project does NOT qualify for authorization under the SERP programmatic authorization issued by this agency. If an agency does not concur with the determination and/or does not agree that the project qualifies for SERP programmatic authorization, its response will state the reason(s). NMFS or USFWS may recommend initiating ESA section 7 consultation for the proposed action as a stand-alone project.

For projects that may affect federally listed species, USACE will initiate ESA section 7 consultation with USFWS and/or NMFS by letter within 15 days of receiving a complete project notification.

If additional conservation measures are not required by any agency, project activities may commence when all SERP agencies have provided written concurrence that the identified project, as described, qualifies for authorization under the SERP programmatic authorization.

DWR Assurance of Compliance with Additional Conservation Measures

If any of the agencies' written concurrences require implementation of additional conservation measures, DWR will respond in writing via e-mail or letter to all of the SERP agencies indicating DWR's agreement to implement the identified additional conservation measures.

NOTIFICATION OF PROJECT CHANGES

In the case where project changes are determined by DWR and USACE to be required following DWR's submittal of the annual project notification packages, DWR will contact, initially by phone, those SERP agencies whose environmental conservation measures will be impacted by this change. A project change is one that falls within the authority of the various agencies and conflicts with conservation measures established under the SERP. DWR will write a "letter-of-change" to the project file for all changes to the project.

PROJECT NOTIFICATION FORM

See the Notice of Intent to Implement an Erosion Repair Project under the SERP and SERP Project Pre-Construction Notification Form on pages F-5 to F-10.

Notice of Intent to Implement an Erosion Repair Project under the SERP

As required by the programmatic authorizations issued for the SERP, the California Department of Water Resources is providing this notification of intent to conduct repairs under the SERP. The project specifics are as follows:

Project and Attachment Checklist

- ☐ CD/DVD of all data/forms, including Google Earth, GIS files of projects.
- ☐ USGS 7.5-minute quadrangle project vicinity map
- ☐ Cross-section of repair (delineate ordinary high-water mark [OHWM], mean high-water mark, and/or high tide line)
- ☐ Site plan diagram

Photographs of Erosion Repair Project Site (label photographs accordingly):

- ☐ Upstream Photograph
- ☐ Downstream Photograph
- ☐ Perpendicular Photograph

- ☐ Map showing species occurrences and/or designated critical habitat and/or essential fish habitat
- ☐ Map showing project footprint including access roads and staging areas
- ☐ Map showing adjacent repairs (within 500 radial feet), if any
- ☐ Project location included in cover letter map of all projects in this SERP packet
- ☐ Delineation of special aquatic sites and other waters of the United States and/or the state
- ☐ Historic Properties report attached
- ☐ Bank Swallow evaluation included for projects north of Knights Landing (SERP Manual BS-1)
- ☐ Number of linear feet of work proposed within Delta smelt critical habitat
- ☐ Agency Response form

SERP PROJECT PRE-CONSTRUCTION NOTIFICATION FORM
DWR INFORMATION

Baseline Assessment Information

1. SERP Project Number:			
2. SERP Project Name:			
3. Water Body Name:		☐ **Levee OR** ☐ **River Mile:**	
4. Contact Person:	**Phone:**	**Email:**	
Address:			
For Reviewing Agency Use Only:			
5. Date assessment was conducted:			
6. Maintenance staff that conducted assessment:			
Phone:	**E-mail:**		
7. Engineering staff that conducted assessment:			
Phone:	**Email:**		
8. Environmental staff that conducted assessment:			
Phone:	**E-mail:**		
9. Directions to Project:			
10. Center Point of Erosion/Project (Lat/Long in decimal degrees):			
11. UTM northing (NAD 83):	**UTM easting (NAD 83):**	**Zone:**	
12. ☐ **Left Bank OR** ☐ **Right Bank**	**13.** ☐ **Outer bend,** ☐ **Inner bend, OR** ☐ **Straight section**		
14. Erosion damage length (feet):	**Erosion damage width (feet):**	**Erosion damage depth/vertical (feet):**	**Erosion damage (square feet and acres):**
15. Description of erosion site:			
16. Description of pre-erosion condition of levee: Describe, for example, whether rock or other structures or facilities were present.			
17. Description of vegetation at erosion site: Provide general overview, for example, "the majority of the upper third of the slope is covered by non-native grasses; extending down the slope to the toe of the levee, perennial pepperweed is the dominant vegetation type; and at the toe, where the slope has sloughed off and the soil has pushed into the low-flow channel, some patchy areas of emergent vegetation, including common tules and cattails, are growing."			

18. Description of vegetation at project staging area and access routes:

19. Description of instream woody material and instream structural elements at erosion site: Describe fallen trees and other instream woody material at the project site. Also describe instream structural elements, such as pump intakes, docks, and other submerged structures that provide flow deflection and hiding cover for fish species. Instream material is considered material that is either crossing the bank or lying adjacent to the bank out to the channel centerline. Describe instream structure as a percentage of the project bank-line length, and provide trunk/stem diameter ranges for woody vegetation.

20. Description of vegetation up- and downstream of erosion site:

21. Sensitive Biological Resources present:

☐ **Yes OR** ☐ **No:** If yes describe known resource issues, such as proximity to known habitat or sightings of giant garter snake, valley elderberry longhorn beetle, Delta smelt, Central Valley Chinook salmon (fall/late-fall run ESU), Chinook salmon (spring/winter run ESU), Central Valley steelhead DPS, North American green sturgeon southern DPS, Swainson's hawk, burrowing owl, bank swallow, nesting birds/migratory birds, raptors, woody shaded riverine habitat.

22. Do irrigation canals or drainage ditches occur within 200 feet of the project site (including staging areas and access routes?

☐ **Yes OR** ☐ **No** If yes, provide the location and distance (in feet) between the canal and the nearest project site boundary. Example: A 20-foot-wide agricultural irrigation ditch runs along the landside toe of the levee approximately 150 feet from the project site's eastern boundary.

23. Cultural Resources present:

☐ **Yes OR** ☐ **No** If yes, please summarize below and attach report:

24. Adjacent Repairs (within 500 radial feet)

☐ **Yes OR** ☐ **No** If yes fill out boxes below:

SERP Repair? ☐ **Yes OR** ☐ **No**	**Distance from this site (feet):**
	Date repair completed:
Description of adjacent repair:	
Conservation measures implemented:	

Project Description

25. Project Description:					
26. Start Date:					
27. End Date: (be clear about when construction activities and restoration activities end):					
28.	**Project width (feet):**	**Project depth/ vertical (feet):**	**Project Area (square feet and acres):**	**Approximate levee slope at erosion site:**	**Approximate scour velocity at erosion site:**
29. Volume/material excavated (CY):			**Volume/material fill (CY):**		
30. ☐ **Tier 1 OR** ☐ **Tier 2 SERP project**					
31. ☐ **Water will OR** ☐ **will not be present in work area**					
32. Equipment to be used:					
33. Additional project activities outside of the erosion site: Discuss additional project activities that will occur outside of the erosion repair site. Activities such as, but not limited to, excavation of sediment within a portion of the channel that is not part of the levee repair.					
34. Recommended SERP design template (engineering): (Select from Section C, "Project Design Templates and Construction Details," of the SERP Manual):					
35. Rationale for design template selection (engineering): Additionally provide rationale for any deviations from selected templates, i.e., only rock not soil filled rock will be used for slope of the levee, or if vegetation plantings will not be placed used as described in the selected template.					

36. Project Access/Staging: ☐ **Work will include using a barge OR** ☐ **Temporary access/staging area**		
37. If temporary access/staging area: ☐ **Landside OR** ☐ **Waterside location**		
38. Access route: Existing roads will be used (dirt or paved) ☐ **Yes OR** ☐ **No** if no then fill out boxes below:		
39. Access Length (feet):	**Access Width (feet):**	**Acres:**
40. Staging Length (feet):	**Staging Width (feet):**	**Acres:**
41. Will the Access Route and/or Staging Area require grading activities or vegetation disturbance: ☐ **Yes OR** ☐ **No:** If yes describe activities and amount of vegetation disturbance below:		

42. Instream woody material removal required: ☐ **Yes OR** ☐ **No** If yes describe fallen trees and other instream woody material to be removed, and attach photograph(s). Also describe instream structural elements that require removal, such as pump intakes, docks, and other submerged structures that provide flow deflection and hiding cover for fish species. Instream material is considered material that is either crossing the bank or lying adjacent to the bank out to the channel centerline. Describe instream structure to be removed as a percentage of the total instream structure along the project bank line length, and provide trunk/stem diameter ranges for woody vegetation.
43. Riparian Habitat Impacts: ☐ **Temporary AND/OR** ☐ **Permanent OR** ☐ **No Impact:** For temporary and/or permanent impacts fill out the boxes below:

44. Vegetation Communities Impacted fill in boxes below and to the right	**Temporary Impacts**	**Permanent impacts**
	Linear Feet:	**Linear Feet:**
	Total Area (acres):	**Total Area (acres):**

45. Are trees to be removed due to project activities?
☐ **Yes OR** ☐ **No** If yes fill out the boxes below:

Tree Species	**Number of trees to be removed**	**Range of Trunk Diameters (DBH) in inches**

46. Impacts below the OHWM of waters of the United States and/or the state:
☐ **Temporary AND/OR** ☐ **Permanent OR** ☐ **No Impact:** For temporary and/or permanent impacts fill out the boxes below:

47. Temporary Impact area (type and dimensions):	**Permanent Impacts (type and dimensions):**
48. Volume/material excavated (CY):	**Volume/material excavated (CY):**

49. Impacts within wetland boundaries:
☐ **Temporary AND/OR** ☐ **Permanent OR** ☐ **No Impact:**

Temporary Impact area (type and dimension):	**Permanent Impacts (type and dimension):**
50. Volume/material excavated (CY):	**Volume/material excavated (CY):**

51. How was the U.S. Army Corps of Engineers Regulatory Jurisdiction determined:
Tidal Waters:
- ☐ **Rivers and Harbors Act section 10 (Mean High Water) AND/OR**
- ☐ **CWA section 404 (High Tide Line)**

Non-Tidal Waters:
- ☐ **Rivers and Harbor section 10 (OHWM); AND/OR**
- ☐ **CWA section 404 (OHWM and/or wetlands)**

52. Potential Federally and State-Listed Species Impacts in the Project Area:
☐ **Yes OR** ☐ **No** If yes list species below, including listing status:

53. Is the Project Area within a designated Essential Fish Habitat and/or Critical Habitat area, and if so, for what species?
☐ **Yes OR** ☐ **No** Please describe below, and indicate on attached map:

54. DFG Check the appropriate box below: **Note: Final determination regarding potential for take of state-listed species to be made by DFG**.
☐ It has been determined that with implementation of the proposed conservation measures the project will not result in take of state-listed species as defined in California Fish and Game Code section 86.
☐ Take of state-listed species may result, a separate 2081 permit is required from DFG, and coverage under the SERP is not available
Reason for decision:
55. NMFS Check the appropriate box below: **Note: Final determination regarding potential for take of federally listed species to be made by USACE**
☐ No effect. NMFS will NOT be consulted [sensitive species/habitat administered by NMFS are not present in the project area and indirect effects will not occur.]
☐ Project may affect, but is not likely to adversely affect, the following federally listed species and qualifies for application of the Programmatic Not Likely to Adversely Affect concurrence letter for the SERP
☐ Project is likely to adversely affect the following federally listed species and qualifies for application of the Programmatic Biological Opinion for the SERP
56. Reason for decision: Provide a rationale for the effects determination for each NMFS-protected species listed in the '**Potential Species Impacts in the Project Area'** box, incorporating information from the '**Sensitive Biological Resources Present'** box.
57. USFWS Check the appropriate box below: **Note: Final determination regarding potential for take of federally-listed species to be made by USACE**
☐ No effect. USFWS will NOT be consulted [sensitive species/habitat administered by the USFWS are not present in the project area and indirect effects will not occur.]
☐ Project may affect, but is not likely to adversely affect, the following federally listed species and qualifies for application of the Programmatic Not Likely to Adversely Affect concurrence letter for the SERP
☐ Project is likely to adversely affect the following federally listed species and qualifies for application of the Programmatic Biological Opinion for the SERP
58. Reason for decision: Provide a rationale for the effects determination for each USFWS-protected species listed in the **Potential Species Impacts in the Project Area** box, incorporating information from the **Sensitive Biological Resources Present** box.

59. Section 106 of the National Historic Preservation Act **DWR has performed an initial review of the proposed erosion repair sites and has attached its findings. These findings conclude that:** Check the appropriate box below:
☐ The repair activities are exempt from further NHPA section 106 review because the proposed activities do not have the potential to affect historic properties. This recommendation is factually supported in the attached memorandum.
☐ The repair activities have the potential to affect historic properties. An inventory report with a map of the area of potential effects (APE) and a finding of effect is attached. The inventory report concludes that the proposed activities will not result in adverse effects either because (a), there are no resources in the APE that qualify as historic properties, or (b), despite the presence of historic properties, the proposed activities are not anticipated to result in adverse effects as demonstrated in the finding of effect statement.
☐ The repair activities have the potential to affect historic properties. An inventory report with a map of the APE and a finding of effect is attached. The inventory report concludes that the proposed activities may result in adverse effects. DWR is including treatment selected from the program HPTP and will coordinate with USACE, SHPO, and relevant Native American tribes regarding treatment options provided in the program HPTP.
60. CEQA Checklist Completed: ☐ **Yes:** ☐ **No:**

AGENCY RESPONSE-To supplement agencies' formal written correspondence

<table>
<tr><td colspan="2">Date:</td></tr>
<tr><td>Agency:</td><td>SERP Project #:</td></tr>
<tr><td colspan="2">☐ This agency concurs with DWR and, if consultation with USFWS and/or NMFS is required, USACE's determination, and/or agrees that the project qualifies for authorization under the SERP programmatic authorization issued by this agency.</td></tr>
<tr><td colspan="2">☐ With the additional proposed conservation measures identified below, this agency concurs with DWR and USACE's determination and/or agrees that the project qualifies for authorization under the SERP programmatic authorization issued by this agency.</td></tr>
<tr><td colspan="2">☐ This agency does NOT concur with DWR and, if consultation with USFWS and/or NMFS is required, USACE's determination, and/or the project does NOT qualify for authorization under the SERP programmatic authorization issued by this agency. If an agency does not concur with the determination and/or does not agree that the project qualifies for SERP programmatic authorization, its response will state the reason(s). NMFS or USFWS may recommend initiating ESA section 7 consultation for the proposed action as a stand-alone project.</td></tr>
<tr><td colspan="2">Reason for decision:</td></tr>
<tr><td colspan="2">Additional Required Conservation Measures:</td></tr>
</table>

DEPARTMENT OF FISH AND GAME RESPONSE:

DATE:

DFG ASSIGNED #	SERP PROJECT #:

☐ DFG concurs with DWR that the project described in this SERP Project Pre-Construction Notification qualifies for authorization under the Routine Maintenance Agreement between DFG and DWR for the SERP.

☐ With the additional proposed conservation measures identified below, DFG concurs with DWR that the project described in this SERP Project Pre-Construction Notification qualifies for authorization under the Routine Maintenance Agreement between DFG and DWR for the SERP.

☐ DFG does NOT concur with DWR. DFG has determined that the project described in this SERP Project Pre-Construction Notification Form does NOT qualify for authorization under the Routine Maintenance Agreement between DFG and DWR for the SERP. DFG will provide DWR written explanation for this non-concurrence finding.

G. MITIGATION

This section describes how mitigation for impacts on biological resources will be accomplished under the SERP. The SERP Subcommittee prioritized avoidance and minimization of adverse impacts to biological resources by applying the SERP project size and placement limits described in Section B, “Baseline Assessment Methodology,” and the conservation measures described in Section I, “Conservation Measures.” Additionally, by implementing timely repairs at small erosion sites under the SERP, further erosion will be prevented and greater impact avoidance will be accomplished with the balance of enhancing the environmental function of the repaired areas.

It is anticipated that SERP projects will generally achieve “self-mitigation” for unavoidable impacts to biological resources through application of the bioengineering erosion control methodologies presented in Section C, “Project Design Templates and Construction Details.” By incorporating vegetation plantings into SERP project design, and monitoring to ensure that the established success criteria are met, aquatic and riparian resource functions are intended to be fully restored with SERP project implementation such that additional compensatory mitigation will not be required.

SELF-MITIGATING PROJECT SITES

SERP project sites will be considered “self-mitigating” if the successful establishment of vegetation plantings incorporated into the project design will restore or enhance the biological function of the existing conditions at the erosion sites. No additional compensatory mitigation will be required for these self-mitigating projects unless the final success criteria are not met. Monitoring of self-mitigating project sites will be conducted in accordance with the monitoring protocol set forth in Section H, “Monitoring and Success Criteria.” Annual reporting for self-mitigating SERP sites will be conducted in accordance with the provisions outlined in Section J, “Annual Monitoring Reports.”

ADDITIONAL COMPENSATORY MITIGATION REQUIREMENTS

In the event that a self-mitigating project site does not meet the final success criteria outlined in Section H, DWR, in coordination with the SERP agencies, may determine that additional, off-site compensatory mitigation is preferable over implementation of contingency actions on-site. This determination must be approved in writing by the agencies and will only be made when DWR has demonstrated a good faith effort to ensure planting success by implementing contingency actions as necessary during the course of the 5-year monitoring period. The agencies may also determine that additional compensatory mitigation is warranted to offset temporal impacts when planting is conducted later than the scheduled planting date provided in the project notification.

If additional compensatory mitigation is determined by the agencies to be warranted, DWR will prepare a site-specific compensatory mitigation plan to address impacts to biological resources based on mitigation ratios determined through coordination with the relevant SERP agencies (e.g., DFG, USFWS for giant garter snake [GGS] habitat impacts, USACE/RWQCB for waters of the U.S. impacts). The project-specific compensatory mitigation plan will be submitted in draft form to the SERP agencies. The agencies will have opportunity to either approve or provide comments on the draft mitigation plan. Agency comments will be incorporated by DWR into a final mitigation plan, which will be resubmitted to the agencies with a request for written approval.

COMPENSATORY MITIGATION PLAN CONTENT

Regulations at 33 CFR 332.4(c)(ii) stipulate that, for USACE general permits, if compensatory mitigation is required, a final mitigation plan incorporating the elements in paragraphs (c)(2)–(c)(14) of that section, at a level of detail commensurate with the scale and scope of the impacts, must be approved by the district engineer before the permittee commences work in waters of the United States. The USACE Sacramento District Regulatory Division has published *Mitigation and Monitoring Proposal Guidelines* (Appendix A) that provide detailed directions on the preparation of compensatory mitigation plans (USACE 2004).

For the SERP, compensatory mitigation plans prepared in accordance with the mitigation plan requirements for general permits (33 CFR 332.4[c]) and the USACE Sacramento District's *Mitigation and Monitoring Proposal Guidelines* are expected to be sufficient in content and form to suit the mitigation plan requirements of USFWS, NMFS, DFG, and the RWQCB.

SERP project-specific compensatory mitigation plans will incorporate the following elements pursuant to 33 CFR (c)(2)–(c)14, at a level of detail commensurate with the scale and scope of the project impacts:

- ***Objectives.*** A description of the resource type(s) and amount(s) that will be provided, the method of compensation (i.e., restoration, establishment, enhancement, and/or preservation), and the manner in which the resource functions of the compensatory mitigation project will address the needs of the watershed, ecoregion, physiographic province, or other geographic area of interest.

- ***Site selection.*** A description of the factors considered during the site selection process. This should include consideration of watershed needs, on-site alternatives where applicable, and the practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the compensatory mitigation project site.

- ***Site protection instrument.*** A description of the legal arrangements and instrument, including site ownership that will be used to ensure the long-term protection of the compensatory mitigation project site.

- ***Baseline information.*** A description of the ecological characteristics of the proposed compensatory mitigation project site and the impact site. This may include descriptions of historic and existing plant communities, historic and existing hydrology, soil conditions, a map showing the locations of the impact and mitigation site(s) or the geographic coordinates for those site(s), and other site characteristics appropriate to the type of resource proposed as compensation. The baseline information should also include a delineation of waters of the United States on the proposed compensatory mitigation project site.

- ***Determination of Mitigation Ratio.*** An explanation of how the compensatory mitigation project will provide the required compensation for unavoidable impacts to aquatic resources resulting from the permitted activity.

- ***Mitigation work plan.*** Detailed written specifications and work descriptions for the compensatory mitigation project, including, but not limited to, the geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water, including connections to existing waters and uplands; methods for establishing the desired plant community; plans to control invasive plant species; the proposed grading plan, including elevations and slopes of the substrate; soil management; and erosion control measures. For stream compensatory mitigation projects, the mitigation work plan may also include other relevant information, such as planform geometry, channel form (e.g., typical channel cross sections), watershed size, design discharge, and riparian area plantings.

- ***Maintenance plan.*** A description and schedule of maintenance requirements to ensure the continued viability of the resource once initial construction is completed.

- ***Performance standards.*** Ecologically based standards that will be used to determine whether the compensatory mitigation project is achieving its objectives.

- ***Monitoring requirements.*** A description of parameters to be monitored to determine whether the compensatory mitigation project is on track to meet performance standards and whether adaptive management is needed. A schedule for monitoring and reporting on monitoring results to the USACE district engineer must be included.

- ***Long-term management plan.*** A description of how the compensatory mitigation project will be managed after performance standards have been achieved to ensure the long-term sustainability of the resource, including long-term financing mechanisms and the party responsible for long-term management.

- ***Adaptive management plan.*** A management strategy to address unforeseen changes in site conditions or other components of the compensatory mitigation project, including the party or parties responsible for implementing adaptive management measures. The adaptive management plan will guide decisions for revising compensatory mitigation plans and implementing measures to address both foreseeable and unforeseen circumstances that adversely affect compensatory mitigation success.

- ***Financial assurances.*** A description of financial assurances that will be provided and how they are sufficient to ensure a high level of confidence that the compensatory mitigation project will be successfully completed in accordance with its performance standards.

- ***Other information.*** The reviewing agencies may require additional information as necessary to determine the appropriateness, feasibility, and practicability of the compensatory mitigation project.

In addition to including the above elements, compensatory mitigation plans prepared for SERP projects will be prepared in accordance with the objectives of the USACE Sacramento District's *Mitigation and Monitoring Proposal Guidelines* (Appendix A).

H. MONITORING AND SUCCESS CRITERIA

This section describes the monitoring requirements and success criteria for SERP projects. Water quality monitoring required as a standard condition of the programmatic 401 certification is not addressed in this manual.

Monitoring will be conducted by DWR staff to assess the attainment of annual performance goals and final success criteria and to evaluate whether on-site remedial actions or off-site contingency measures should be implemented. Engineering and biological monitoring components are included in the monitoring program to allow for evaluation of project success in meeting both the flood risk reduction and self-mitigation goals of the SERP. Biological monitoring will be conducted for 5 years, or longer as necessary, until the final success criteria are achieved and the agencies have provided written approval.

These monitoring and success criteria apply only to self-mitigating SERP project sites. In the event that a SERP project is determined to require additional, off-site compensatory mitigation as described in Section G, “Mitigation,” the required project-specific off-site compensatory mitigation plan will include monitoring and success criteria specific to the off-site mitigation effort.

Maintenance during the Monitoring Period

An important element of mitigation planning is to create, to the extent possible, habitats that are self-sustaining and maintenance free over the long term. Initially, maintenance is often necessary to ensure planting success, but a properly restored riparian area should persist naturally without maintenance. The maintenance and monitoring phase for SERP projects will begin immediately upon project completion. Maintenance activities that focus on maintaining restoration plantings will be conducted for 5 years, or longer as necessary, until the final success criteria are met and the SERP agencies have provided written approval. DWR will be responsible for establishing and maintaining healthy plantings throughout the maintenance/monitoring period.

SERP project site maintenance will include a vegetation management regime to prevent interference with flood management, levee maintenance, inspection, and flood fighting efforts. Vegetation management practices will include regular site inspections and implementation of vegetation management measures such as hand trimming to ensure compliance with the applicable vegetation inspection criteria for standard levees as described in Section C, “Project Design Templates and Construction Details.”

Regular levee inspections and maintenance will be conducted in accordance with the applicable USACE O&M manuals as described below. Levee maintenance activities, including vegetation management practices, will be ongoing in accordance with the established O&M procedures.

Once established, SERP project sites are expected to require limited maintenance. During the initial vegetation establishment period, maintenance activities for planted areas are anticipated to include removing invasive vegetation, pruning planted vegetation to comply with USACE vegetation management requirements for levees, and replacing dead plantings. Once the final success criteria are achieved, the vegetation should be self-maintaining.

Scheduled maintenance of the restoration component of SERP projects may require periodic weed control and debris removal. Scheduled levee maintenance will include vegetation management and routine levee maintenance activities as needed. A schedule of proposed, regularly conducted maintenance activities is provided in Table H1.

Table H1
Maintenance Schedule

Activity	Frequency
Weed/pest observation and removal, and debris removal	Twice per year in late spring and midsummer*
Vegetation management assessments	Once per year in late spring
Routine levee maintenance	Ongoing

Note:
* More frequent weed removal may be required to meet annual performance goals.
Compiled by AECOM in collaboration with DWR in 2011

WEED/PEST CONTROL

SERP project sites will be inspected by environmental staff twice annually during the woody and emergent vegetation establishment phase to evaluate potential weed problems. More frequent inspections and weed removal may be required to meet the annual performance goals for woody and emergent native species cover in planted areas. Invasive weed species that show signs of outcompeting installed woody plantings will be removed to ensure the successful establishment and long-term viability of planted woody and emergent vegetation and naturally occurring native woody vegetation. Hand removal of invasive plants and chemical control using spot-spray methods may be used in the event that weed control is necessary in areas planted with woody or emergent vegetation. For application of chemicals, DWR will follow recommendations provided by a certified pesticide control adviser (PCA). Application of chemicals will be conducted in accordance with Conservation Measure CM-11 in Section I, “Conservation Measures.”

Mowing is considered another permissible method of weed control on levees. Only methods that do not threaten the long-term viability of the mitigation effort will be used.

The annual inspections will include monitoring for damage caused by insect and other animal pest species. Pest infestations that appear to be impacting the planted vegetation will be documented, and the information will be provided to the SERP agencies in annual monitoring reports. If necessary, DWR will coordinate with the SERP agencies to identify the best methods for treatment.

Debris Removal

Site clean-up will occur as needed each year during all levee inspections. All trash and debris that washes into or is placed in the project areas will be removed. All garbage, construction debris, other discarded materials, and extraneous equipment will be removed in accordance with California and local regulations. Natural debris such as sticks, twigs, and larger instream woody material will be left untouched. Any clearing of debris and vegetation within the channel as part of flood maintenance will be limited to that debris creating a flood inspection and/or a conveyance impact. This clearing will be performed using hand-clearing methods wherever practical. If equipment use is necessary to remove debris from within the planted area, the equipment will be restricted to the upper levee areas above the riparian zone wherever possible.

Routine Levee Maintenance/Vegetation Management

DWR will continue its program of routine annual levee maintenance in accordance with the applicable USACE standard O&M manuals. Levee maintenance activities described in the O&M manuals include:

- removing debris, spraying herbicides, mowing and burning vegetation on slopes, dragging levee slopes, controlling rodents with rodenticides, grouting rodent holes or other voids in levees, and repairing minor erosion; and,

- managing vegetation with selective cutting, pruning, and spraying of young trees and selective cutting and pruning of the lower branches of mature trees to allow visual inspection of the levee and to maintain channel capacity.

DWR is aware that some of the levee maintenance activities described above (e.g., grouting rodent holes below the OHWM, repairing minor erosion that requires placing fill material below the OWHM, dragging levee slopes) may require separate authorization by the resource agencies.

Long-term Vegetation Management on Waterside of Levees

Woody or emergent vegetation installed on the waterside of the levees, as part of the SERP program, will be managed in a manner consistent with the VMS described in the 2012 CVFPP and the associated Conservation Framework; in particular, the lower waterside woody and emergent vegetation will be retained below the vegetation management zone (VMZ). However, certain events may occur in the future where vegetation may be impacted or needs to be impacted. The following strategies will be implemented following events described below:

- In the event subsequent erosion occurs at a SERP site, and the woody or emergent vegetation that was planted on the waterside of the levees is lost due to this erosion, the subsequent repair to the site will use a similar design and will replace, at a one to one (1:1) ratio, the lost vegetation.
- In the event that woody or emergent vegetation grows to extend upslope and into the VMZ, that portion extending into the VMZ will be subject to DWR's continuing program of routine annual levee maintenance in accordance with the applicable USACE standard O&M manuals and the VMS defined in the CVFPP.
- In the event that woody or emergent vegetation planted on the waterside of the levees grows to impede flow, visibility and accessibility for inspections, or maintenance and flood fight operations, DWR will coordinate with the SERP agencies on the best method to correct these impedances.

MONITORING

A primary component of SERP projects is utilization of bioengineered bank stabilization methodologies that result in bank repair sites capable of supporting vegetation and achieving on-site mitigation. Monitoring SERP project sites will allow DWR to evaluate the effectiveness of the repairs from a flood risk reduction and environmental restoration/enhancement perspective.

After the initial plantings are installed, an annual monitoring program will be implemented to determine the site's progress toward meeting the established final success criteria. Mitigation monitoring will be conducted for 5 years, or longer as necessary, until the final success criteria are achieved and the agencies have provided written approval.

SUCCESS CRITERIA

Quantifiable success criteria are used to evaluate mitigation success and to determine completion of mitigation responsibilities. For the SERP, quantitative criteria have been established for the biological component of the project effort. Success of the engineering component in meeting the objectives for reducing flood risks will be qualitatively evaluated by DWR's project engineer. Meeting the engineering objectives and the established success criteria will indicate that the project area is progressing toward replacing or enhancing environmental functions, reducing flood risk, and achieving the long-term self-mitigation goals. Success at averting erosion and subsequent loss of existing habitat adjacent to these repairs will also be considered in determining the success of the overall program in developing sustainable flood corridors.

Final Success Criteria

SERP project sites will be considered successfully self-mitigating if they exhibit the following vegetation success criteria by the end of the fifth year after installation, after all construction and remedial actions have been completed:

Percent relative cover of herbaceous* and woody native species = 80 percent

* Areas seeded with native grasses are not subject to native species cover requirement

If these criteria have not been achieved by the end of the 5-year monitoring period, annual monitoring will continue until these criteria have been met unless the SERP agencies determine that modification of the success criteria or off-site compensatory mitigation is warranted based on continued failure after implementation of remedial actions.

In addition to these quantitative criteria, qualitative assessments will include evidence of bank stability, plant health and survival, competition with weedy species, pest infestations (if any), hydrological conditions, signs of herbivory, use by wildlife, and vandalism.

Annual Performance Goals

Table H2 presents the annual performance goals and final success criteria for the biological component of SERP projects. Although achievement of the annual goals is not mandatory, meeting these goals will indicate that the mitigation area is progressing toward achieving the final success criteria; failure to meet the annual goals may indicate a need to implement remedial actions.

Table H2
Annual Performance Goals and Final Success Criteria

Year	Relative Cover of Planted (not seeded) Herbaceous Native Species (%)	SRA Cover: Relative Cover of Planted Woody Native Species (%)	Herbaceous Species Cover in Seeded Native Grass Areas (%)	Survival of Plantings (% of Original Plantings)
1	90	30	30	70
2	85	40	40	60
3	80	50	50	50
4	80	75	75	N/A
5 (Final Success Criteria)	**80**	**80**	**80**	**N/A**

Note: SRA = shaded riverine aquatic; N/A = not available

Source: Compiled by AECOM in collaboration with SERP Subcommittee in 2011

MONITORING METHODS

LEVEE MONITORING

Levee maintenance inspections are conducted by DWR in accordance with the standard O&M manual requirements. The inspections are conducted by DWR staff and generally involve driving along levee roads and observing levee conditions. Written inspection logs summarizing the inspection observations are maintained by DWR flood management staff and kept as permanent records.

- In addition to routine levee inspections, DWR environmental staff will conduct a qualitative evaluation of levee conditions at the repair sites as part of the annual monitoring protocol. Environmental staff will provide monitoring data, including photographs, to the DWR project engineer of each repair site for their evaluation and assessment of the engineering component of SERP projects. The environmental staff assessment of the levee condition will be reported on the qualitative evaluation sheet provided at the end of this section.

VEGETATION MONITORING

Vegetation monitoring will consist of both quantitative and qualitative surveys to assess plant survival and percent cover of native vegetation, and qualitative analysis to assess overall conditions and success of the on-site mitigation efforts. Monitoring will be conducted by DWR environmental staff with experience in restoration monitoring. DWR will be responsible for overseeing annual monitoring of the project sites.

Quantitative

Cover-Based Monitoring

A simple quantitative survey of the entire project site will be conducted each year in spring, during the growing season. To calculate percent relative cover for native species, the total cover for all native plants will be summed and divided by the total cover of all plants recorded. This number along with a list of species observed, whether native or nonnative, will be provided to the SERP agencies in the annual monitoring report (see Section J, “Annual Monitoring Reports”).

SRA cover will be estimated based on photographs taken from fixed photo points. The SRA photographs and relative cover estimates will be provided to the SERP agencies in the annual monitoring report.

Individual Plant Counts

During the early stages of plant establishment at the project site, individual plant counts will be used to determine the percentage of survival for each species. Although there is no performance standard for percentage of survival, individual plant counts provide an accurate determination of overall plant survival and individual species survival during the initial stages of plant establishment. Maintaining plant survival is anticipated to facilitate the project site's progress toward achieving the final performance criteria.

All woody plant species will be surveyed and plants will be considered "dead" if there is no live aboveground growth (no green tissue during the growing season). Plant counts will be used during years 1 and 2, and in year 3, if site conditions allow adequate access to individual plantings. If woody plant growth and/or volunteer vegetation make site access difficult and the use of individual plant counts in year 2 or 3 becomes impractical, the percentage of plant survival will be estimated using data collected using the cover-based monitoring methods. Data collected during individual plant counts will be recorded on data sheets and will include information on landscape position and species and general plant vigor.

The recommended performance goals for individual plant counts are 70 percent, 60 percent, and 50 percent survival of all planted woody species during years 1–3, respectively. Maintaining plant survival at these recommended levels is anticipated to facilitate the site's ability to achieve the performance standards in years 4 and 5, whereas failure to achieve these annual survival rates may indicate the need to implement remedial actions.

Qualitative

DWR will conduct qualitative monitoring of the repair sites to assess overall vegetation coverage, general plant health, overall plant community composition, evidence of vandalism, infestations of weeds and/or animal pests, wildlife use, and erosion.

Baseline photographs will be taken at fixed, pre-designated photo points immediately following initial plant installation. The photo points will be selected to provide appropriate views and orientations for a comprehensive assessment of the progress of mitigation efforts over the monitoring period. Photos may be taken on land or from a boat in the channel adjacent to the project levee. At least one on-land photo point will be established at each site for purposes of ground-truthing. The photos will be used to compare and qualitatively assess percent cover of SRA (i.e., installed native woody vegetation) along the levee bank. DWR will also use photographs to assess the general success of the planting effort over the entire site. A qualitative evaluation sheet is provided at the end of this section. The sheet will be completed by DWR environmental staff during the monitoring visit and included in the annual monitoring report.

The photographic record of the site will be kept from the time of the initial planting through the end of the monitoring activities. Each photograph will include the location number and date the photograph was taken. Each year the field notes associated with the photographs will be copied and archived along with the monitoring data and will be available to the SERP agencies upon request. Digital photos of each site will be submitted with the SERP annual monitoring report (see Section J, "Annual Monitoring Reports").

MONITORING SCHEDULE

SERP project sites will be monitored beginning the first spring after installation of the initial plantings. Monitoring will be conducted annually each spring to coincide with the peak growing season. Annual monitoring reports containing the field monitoring data will be prepared by DWR and submitted to the SERP agencies as described in Section J, “Annual Monitoring Reports.”

Levee maintenance inspections will be conducted by DWR in accordance with the standard O&M manual requirements as follows:

- during October, which is before the beginning of the flood season;
- immediately following each major high-water period;
- in the absence of high water, at periods not exceeding 90 days; and
- at intermediate times as necessary.

ADAPTIVE MANAGEMENT

REMEDIAL ACTIONS, ON-SITE

If an annual performance goal is not met for a SERP project in any given year or if the final success criteria are not met, DWR will prepare an analysis of the cause(s) of failure. If remedial actions are necessary to ensure final success criteria are met, DWR will propose remedial actions for approval by the SERP agencies. Remedial actions may involve replanting and/or irrigating the site. If the on-site remedial actions are unsuccessful or if site conditions have changed such that on-site mitigation is not practical, DWR may have to propose contingency measures. However, relocating the mitigation site will only be considered by the SERP agencies if on-site remedial actions have been unsuccessful or if site conditions have changed such that on-site remediation is not practical. If a project site has not met the final performance criterion at the end of the 5-year monitoring period, DWR’s maintenance and monitoring obligations will continue until the SERP agencies provide final written approval.

CONTINGENCY MEASURES, OFF-SITE

In the event that a self-mitigating project site does not meet the success criteria, DWR, in coordination with the SERP agencies, may determine that additional, off-site compensatory mitigation is preferable over implementation of continued remedial actions on-site. In such cases, DWR will submit a compensatory mitigation plan prepared in accordance with the SERP mitigation plan guidelines outlined in Section G, “Mitigation.”

NOTIFICATION OF COMPLETION OF MITIGATION OBLIGATION

At the end of the 5-year monitoring period or when the final success criteria have been met, DWR will provide written notification to the SERP agencies that the mitigation effort has been successfully completed. This notification will be provided in the final annual monitoring report or in another form of written communication.

SERP Agency Confirmation

The SERP agencies may require a site visit to confirm completion of the mitigation effort. Following the site visit, or after receiving written notification of mitigation completion if a site visit is not required, the SERP agencies will confirm in writing that DWR has met the required conditions for final approval. The mitigation requirement will be considered satisfied upon receipt of written approval from all SERP agencies.

SERP PROJECT SITE REVEGETATION QUALITATIVE EVALUATION SHEET

Date:

Monitor Name:

Site Characteristics	Comments/Observations
Vegetation Conditions	
Visual Estimate of Plant Survival (Estimate percentage of surviving plantings; indicate whether mortality is evenly distributed or occurring in a particular portion of the site; state cause of mortality if evident, e.g., herbivory, lack of irrigation)	
General Plant Health and Vigor (Indicate whether healthy/unhealthy plants are evenly distributed or occurring in a particular portion of the site; state cause of unhealthy plants if evident, e.g., disease, insect damage)	
Signs of Native Species Recruitment	
Non-native Vegetation (Note species and density)	
Irrigation Needs	
Shaded Riverine Aquatic	
Visual Estimate of Shaded Riverine Aquatic (SRA) cover and Large Woody Debris (LWD) Conditions (Describe development of SRA overhead cover plantings, persistence of shallow water habitat and installed LWD, generation of LWD from on-site sources, lodging of transported LWD, and use of the site by fish)	
Herbivory	
Insect and/or Rodent Damage	

Levee Condition at Repair Site	
General Condition of Levee Repair (Note whether repair site seems to be intact; report any signs of damage such as sloughing and uprooted trees; if damage from erosion is evident, provide details under "Bank Stability" below.)	
Erosion/Hydrology	
Bank Stability (Estimate percent of bank with active erosion; state cause of erosion if evident, e.g., overbank flow, scouring during high flows)	
Debris (Note type and source)	
Hydrology (Note signs of flooding, past season OHWM, presence of rack or drift line, etc.)	
Wildlife Use	
Species Observed or Signs of Use	
Vandalism/Trespassing	
Indications of Vandalism or Trespassing and Possible Sources (Note, e.g., presence of trash from local fast-food restaurants)	
Recommendations for Remediation	
Recommendations to Address Deficiencies Noted Above	

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I. CONSERVATION MEASURES

This section describes the conservation measures to be applied by DWR, or its construction contractor(s) under DWR's direction, to SERP projects to avoid and minimize impacts on sensitive resources, including federally listed and state-listed species. The SERP conservation measures have been developed based on extensive interagency coordination, pulling from multiple agreements, documents, and policies to develop measures specifically tailored to the SERP.

Measures that will apply to all projects are identified and listed below. Resource-specific measures are also provided in this section and will be applied as determined necessary by DWR in coordination with the appropriate SERP agencies. Resource-specific measures applied to each particular SERP project will be listed on the project notification form included in Section F, "Notification Requirements," of this manual. In completing the notification form, DWR will reference the applicable numbers for the resource-specific conservation measures included in this section and will provide the text of the referenced measures. The only exception to this practice will be for the conservation measures that will be applied to all SERP projects. If DWR proposes implementation of conservation measures not identified in this manual, those measures will be labeled as "Supplemental Conservation Measures" on the project notification form for clarification to the SERP agencies.

Upon receipt of a SERP project notification, agency staff will review the conservation measures listed on the notification form and respond to DWR with any additional conservation measures required for project authorization by their agency. This process is described in Section F of this manual.

MANDATORY CONSERVATION MEASURES TO BE APPLIED TO ALL SERP PROJECTS

The following measures will apply to all SERP projects unless deletion or revision of a measure is approved in writing by all the SERP agencies. The conservation measures listed in this section will not be modified. Modified conservation measures will be listed as "Supplemental Conservation Measures" on the project notification form.

TIMING RESTRICTIONS

CM-1 The following timing restrictions apply to SERP projects within Regions 1–4 as defined below and shown in Figure I1 below:

REGION 1: DELTA-SACRAMENTO RIVER AND MAJOR TRIBUTARIES, RM 0 TO RM 60

Major tributaries include:

- Putah Creek
- Sacramento Bypass

- Portions of Sacramento River downstream of RM 60
- Yolo Bypass, as identified in Figure A1

REGION 2: MAINSTEM SACRAMENTO RIVER AND MAJOR TRIBUTARIES, RM 60 TO RM 143

Major tributaries include:

- Butte Creek
- Cherokee Canal
- Colusa Bypass
- Northern portion of Colusa Main Drain, as identified in Figure A1
- Portions of Feather River, as identified in Figure A1
- Portions of Sacramento River between RM 60 and 143
- Sutter Bypass
- Tisdale Bypass
- Wadsworth Canal
- East and West Interceptor Canals

REGION 3: UPPER SACRAMENTO AND MAJOR TRIBUTARIES, RM 143 TO RM 194

Major tributaries include:

- Portions of Sacramento River between RM 143 and RM 194

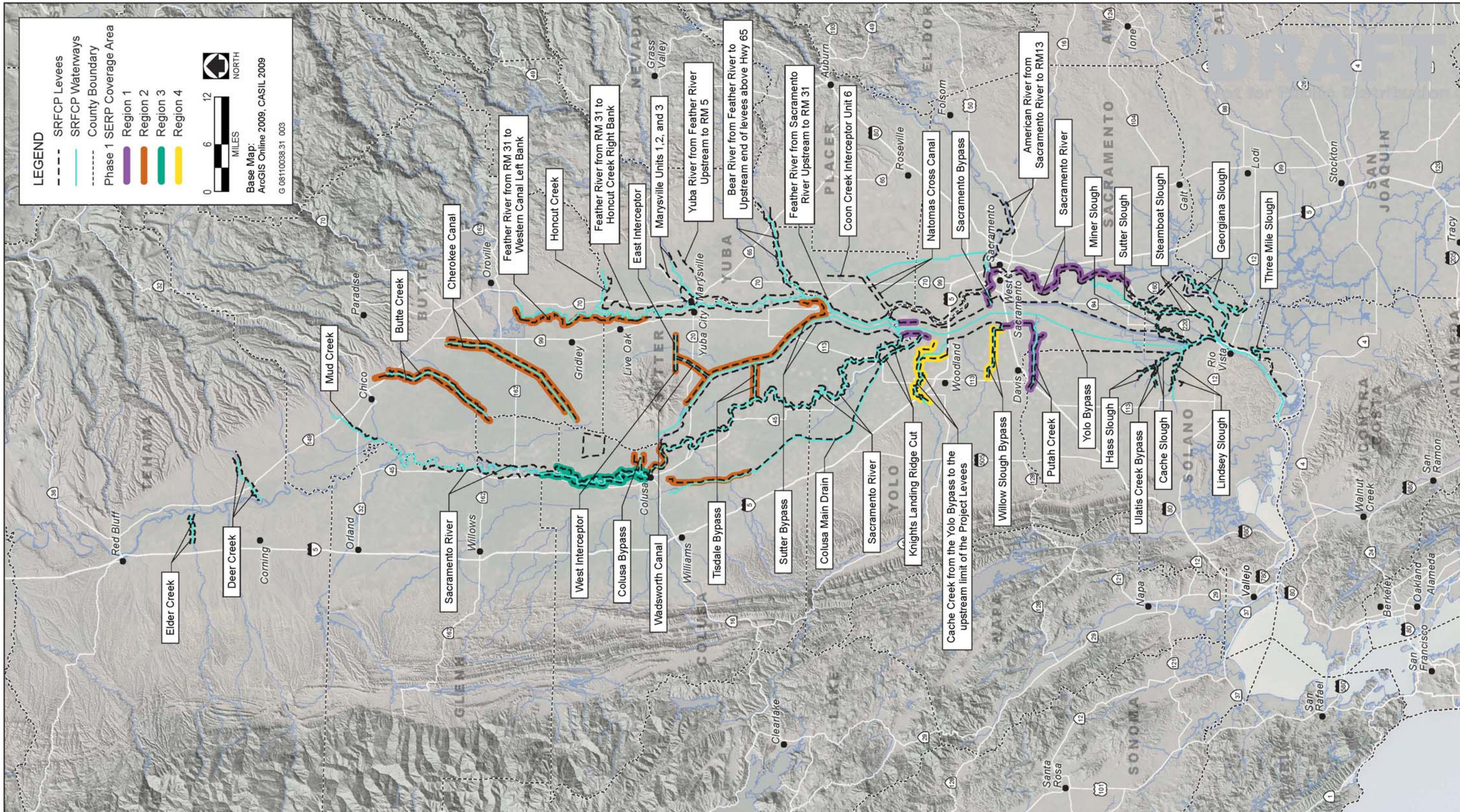
REGION 4: NON-ANADROMOUS SERP WATERWAYS, INCLUDING:

- Willow Slough Bypass
- Cache Creek, from the Yolo Bypass to the upstream limit of the SRFCP levees

CM-1(a) Region 1 Timing Restrictions: All in-water construction will occur from August 1 to November 30. The time period for completing work outside the active stream channel is April 15 to October 15 (dates determined by SERP agency collaboration).

CM-1(b) Region 2 Timing Restrictions: All in-water construction will occur from July 1 to October 15. With rare exception, no extensions will be granted on this timing window. The time period for completing work outside the active stream channel is April 15 to October 15 (dates determined by SERP agency collaboration).

CM-1(c) Region 3 Timing Restrictions: All in-water construction will occur from July 1 to August 31. The time period for completing work outside the active stream channel is April 15 to October 15 (dates determined by SERP agency collaboration).



Source: DWR 2009 (from USFWS 2007); adapted by AECOM in 2010

Figure I1 **Phase 1 SERP Coverage Area Regions**

CM-1(d) Region 4 Timing Restrictions: All in-water construction will occur from April 15 to October 1. The time period for completing work outside the active stream channel is April 15 to October 15 (dates determined by SERP agency collaboration). Note: For projects occurring within 200 feet of drainage or irrigation canals that may support GGS, conservation measure GGS-6, which stipulates that ***all*** project work be completed May 1 to October 1, may be applicable, as determined through coordination with USFWS.

CM-1 (e) Flood Season Timing Restrictions: All work within the floodway will occur from April 15 to November 1. The Board, on prior written request, may allow work to be done during flood season, within the floodway, provided that in the judgment of the Board, forecasts for weather and river conditions are favorable. For the SERP, this written request may be in the form of an e-mail request.

Revegetation and erosion control work that do not involve the use of heavy equipment are not confined to the above timing windows.

CM-2 Timing Extensions for CM-1(a)–(d): Requests for extensions on the above timing windows may be considered by the SERP agencies on a project-by-project basis upon written request from DWR. Requests for timing extensions must include a justification for the request, and any additional information deemed necessary by the agencies. Modifications to the established timing windows may be made only with written concurrence from the SERP agencies.

CM-3: Construction activities will be timed to avoid precipitation and increases in stream flow. If there is a chance of rain within 48 hours, the project site will be prepared with adequate erosion control measures to protect against wind and water erosion. Within 24 hours of any predicted storm event, construction activities within the stream zone will cease until all reasonable erosion control measures, inside and outside of the stream zone, have been implemented.

VEGETATION/HABITAT DISTURBANCE

CM-4: Disturbance to existing grades and vegetation will be limited to the actual site of the project, necessary access routes, and staging areas. The number of access routes, the size of staging areas, and the total area of the project activity will be limited to the minimum necessary to achieve the project goal. All roads, staging areas, and other facilities will be placed to avoid and limit disturbance to stream bank or stream channel habitat as much as possible. When possible, existing ingress or egress points will be used and/or work will be performed from the top of the creek banks or from barges on the waterside of the project levee. Following completion of the work, the contours of the creek bed and creek flows will be returned to preconstruction conditions, or improved to provide increased biological functions.

CM-5: If vegetation removal is required within project access or staging areas, the disturbed areas will be replanted with native species and monitored and maintained to ensure the revegetation effort is successful.

CM-6: If erosion control fabrics are used in revegetated areas, they will be slit in appropriate locations as necessary to allow for plant root growth. Only non-monofilament, wildlife-safe fabrics will be used.

CM-7: To minimize ground and vegetation disturbance during project construction prior to beginning project activities, DWR will establish and clearly mark the project limits, including the boundaries of designated equipment staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; and equipment exclusion zones.

CM-8: Disturbance or removal of vegetation will not exceed the minimum necessary to complete operations. Except for the trees specifically identified for removal in the notification, no native trees with a trunk diameter at breast height in excess of 3 inches will be removed or damaged without prior consultation with and approval by a DFG, USFWS, and NMFS representative. Using hand tools (e.g., clippers, chainsaw), trees may be trimmed to the extent necessary to gain access to the work sites. Work will be done in a manner that ensures that, to the extent feasible, living native riparian vegetation within the vegetation-clearing zones is avoided and left undisturbed where this can reasonably be accomplished without compromising basic engineering design and safety.

CM-9: The amount of rock riprap and other materials used for bank protection will be limited to the minimum needed for erosion protection.

CM-10: All invasive species (e.g., giant reed, *Arundo donax*) will be completely removed from the project site, destroyed using approved protocols, and disposed of in an appropriate upland disposal area.

CM-11: All pesticides/herbicides (pesticides) used to control nonnative vegetation will be used in accordance with label directions. Methods and materials used for herbicide application will be in accordance with DWR's most current guidelines on herbicide use and with laws and regulations administered by the Department of Pesticide Regulation.

Note: Improper application of any pesticides near water can affect fish species and may result in "take" of protected fish as defined under the ESA. To aid in protection of these species, NMFS emphasizes caution and awareness of the following when working near water:

- Label is the law: read and follow the pesticide label.
- Check wind/weather conditions hourly (minimum) or at any observed change.
- Avoid drift: wind can cause drift; adhere to label requirements for wind speed.
- Do not allow spray to drift off target.
- Avoid spraying over or in the water.

- When spraying near the water's edge, spray should be directed away from the water toward the targeted plant.
- Keep all sprayed materials out of the water.
- Use caution and be aware of adjoining areas with potential liability as listed on any attachments.

Construction Equipment Staging

CM-12: Construction materials such as portable equipment, vehicles, and supplies, including chemicals, will be stored at designated construction staging areas and on barges, exclusive of any riparian or wetland areas.

CM-13: Barges will be used to stage equipment and construct the project when practical to minimize noise and traffic disturbances and effects on existing landside vegetation. When barge use is not practical, construction equipment and plant materials will be staged in designated landside areas adjacent to the project sites. Existing staging sites, maintenance toe roads, and crown roads will be used to the maximum extent possible for project staging and access to avoid affecting previously undisturbed areas.

Material Stockpiling

CM-14: Stockpiling of soil and grading spoils will occur in designated areas on the landside of the levee reaches or on offshore barges. Sediment barriers (e.g., silt fences, fiber rolls, and straw bales) will be installed around the base of stockpiles to intercept runoff and sediment during storm events. If necessary, stockpiles will be covered to provide further protection against wind and water erosion.

Erosion Control during Construction

CM-15: There will be no site dewatering activities, including temporary diversion of flows around the work area, unless deemed necessary by DFG and USFWS to avoid impacts to GGS (NOTE: If dewatering is deemed necessary by DFG and USFWS, dewatering activities must be conducted in a manner that does not result in the discharge of fill material into waters of the United States or waters of the state).

CM-16: Erosion control measures (best management practices) that minimize soil or sediment from entering waterways and wetlands will be installed, monitored for effectiveness, and maintained throughout construction operations.

CM-17: If use of erosion control fabrics is necessary, only non-monofilament, wildlife-safe fabrics will be used.

CM-18: DWR will ensure sand, sediment, or sediment-water slurry does not enter the stream channel.

CM-19: No material will be placed in a manner or location where it can be eroded by normal or expected high flows. Jute netting or another non-monofilament erosion control fabric will be used to cover soil that is placed over or mixed into riprap or other revetment materials.

CM-20 Adequate erosion control supplies (e.g., gravel, straw bales, shovels) will be kept at all construction sites during all construction and maintenance activities to ensure that sand and sediments are kept out of any water bodies.

CM-21: Precautions to minimize turbidity/siltation will be taken into account during project planning and will be implemented at the time of construction. This may require placing silt fencing, well-anchored sandbag cofferdams, coir logs, coir rolls, straw bale dikes, or other siltation barriers so that silt and/or other deleterious materials are not allowed to erode into downstream reaches. These barriers will be placed at all locations where the likelihood of sediment input exists and will be in place during construction activities, and afterward if necessary. If any sediment barrier fails to retain sediment, corrective measures will be taken immediately. The sediment barrier(s) will be maintained in good operating condition throughout the construction period and, if necessary, the following rainy season. Maintenance includes, but is not limited to, removing or replacing these barriers. DWR is responsible for removing nonbiodegradable silt barriers (such as plastic silt fencing) after the disturbed areas have been stabilized with vegetation (usually after the first growing season). Upon determination by any of the SERP agencies that turbidity/siltation levels resulting from project-related activities constitute a threat to aquatic life, activities associated with the turbidity/siltation will be halted until effective control devices approved by the determining agency are installed or abatement procedures are initiated.

CM-22: DWR will inspect performance of sediment control barriers at least once each day during construction to they are functioning properly. Should a control barrier not function effectively, it will be immediately repaired or replaced. Additional controls will be installed as necessary.

CM-23: Sediment will be removed from sediment controls once the sediment has reached one-third of the exposed height of the control. Sediment collected in these devices will be disposed of away from the collection site at designated upland disposal sites. The location of the sediment disposal site for the project will be shown on the site plan diagram submitted to the SERP agencies with the project notification.

CM-24: All disturbed soils will undergo appropriate erosion control treatment (e.g., sterile straw mulching, seeding, planting) prior to the end of the construction season, or prior to October 15, whichever comes first.

CM-25: All debris, sediment, rubbish, vegetation, or other material removed from the project site or access or staging areas will be disposed of at an approved disposal site. There will be no sidecasting of material into any waterway.

CM-26: All work pads and other construction items will be removed upon project completion.

CM-27: Upon completion of the construction phase and installation of erosion control materials, the work area within the stream zone will be digitally photographed to document the completed state of the repair site.

HAZARDOUS MATERIALS

CM-28: DWR will exercise every reasonable precaution to protect streams and other waters from pollution with fuels, oils, bitumens, calcium chloride, and other harmful materials.

CM-29: Petroleum products, chemicals, fresh cement, and construction by-products containing, or water contaminated by, any such materials will not be allowed to enter flowing waters and will be collected and transported to an authorized upland disposal area. DWR will identify the location of the hazardous materials disposal site as part of the project description information contained in the project notification.

CM-30: Gas, oil, or other petroleum products, or any other substances that could be hazardous to aquatic life and resulting from project-related activities, will be prevented from contaminating the soil and/or entering waters of the state and/or waters of the United States. Any of these materials placed by DWR or any party working under contract or with the permission of DWR below the OHWM or within the adjacent riparian zone, or where they may enter these areas, will be removed immediately. In the event of a spill, work will stop immediately and DFG, USFWS, the RWQCB, NMFS, and USACE will be notified within 24 hours. DWR will implement the spill prevention and control plan (CM-32) and consult with these agencies regarding any additional cleanup procedures. Any such spills and the cleanup efforts will be reported in an incident report and submitted to the SERP agencies.

CM-31: Safer alternative products (such as biodegradable hydraulic fluids) will be used where feasible.

CM-32: A written spill prevention and control plan (SPCP) will be prepared, and the SPCP and all material necessary for its implementation will be accessible on-site prior to initiation of project construction and throughout the construction period. The SPCP will include a plan for the emergency cleanup of any spills of fuel or other material. Employees will be provided the necessary information from the SPCP to prevent or reduce the discharge of pollutants from construction activities to waters and to use the appropriate measures should a spill occur.

CM-33: No solid petroleum products such as asphalt will be used.

CM-34: No concrete or similar rubble will be used.

CM-35: Construction vehicles and equipment will be properly maintained to prevent contamination of soil or water from external grease and oil or from leaking hydraulic fluid, fuel, oil, and grease.

CM-36: Heavy equipment will be checked daily for leaks. If leaks are found, the equipment will be removed from the site and will not be used until the leaks are repaired.

CM-37: Equipment other than barges will be refueled and serviced at designated refueling and staging sites located on the crown or landside of the levee and at least 50 feet from active stream channels or other water bodies. All refueling, maintenance, and staging of equipment and vehicles will be conducted in a location where a spill will not drain directly toward aquatic habitat. Appropriate containment materials will be installed to collect any discharge, and adequate materials for spill cleanup will be maintained on-site throughout the construction period.

CM-38: Storage areas for construction material that contains hazardous or potentially toxic materials will have an impermeable membrane between the ground and the hazardous material and will be bermed to prevent the discharge of pollutants to groundwater and runoff water.

OTHER MANDATORY CONSERVATION MEASURES

CM-39: Water (e.g., trucks, portable pumps with hoses, etc.) will be used to control fugitive dust during temporary access road construction.

CM-40: All materials placed in streams, rivers, or other waters will be nontoxic. Any combination of wood, plastic, cured concrete, steel pilings, or other materials used for in-channel structures will not contain coatings or treatments or consist of substances deleterious to aquatic organisms that may leach into the surrounding environment in amounts harmful to aquatic organisms.

CM-41: No materials will be placed in any location or in any manner that will impair the flow of surface water into or out of any wetland area.

CM-42: No fill material other than silt-free gravel or riprap will be allowed to enter the live stream.

CM-43: Water containing mud or silt from construction activities will be treated by filtration, or retention in a settling pond, adequate to prevent muddy water from entering live streams.

CM-44: Screens will be installed on water pump intakes as directed by NMFS salmonid-screening specifications. Where Delta smelt may be present, the intake for water pumps must meet a 0.2 feet per second approach velocity standard.

CM-45: All litter, debris, unused materials, equipment, and supplies that cannot reasonably be secured will be removed daily from the project work area and deposited at an appropriate disposal or storage site. All trash and construction debris will be removed from the work area immediately upon project completion.

Resource-Specific Conservation Measures to be Applied as Necessary to SERP Projects

The following measures are resource-specific and will be applied to SERP projects as determined necessary by DWR in coordination with the appropriate SERP agencies. DWR will identify and list the applicable resource-specific measures for each project on the project notification form, which is included in Section F, “Notification Requirements,” of this manual. DWR will reference the applicable numbers for the resource-specific conservation measures used in this section *and* will provide the text of the referenced measures. The conservation measure language included in this section will not be modified. Modified conservation measures will be listed as “Supplemental Conservation Measures” on the project notification forms.

Sensitive Biological Resources

SBR-1: A qualified biologist will provide environmental awareness training to workers before project activities begin and will appoint a crew member to act as an on-site biological monitor. The awareness training will include a description of the relevant species and their habitats that are known to occur in the project vicinity and will describe the guidelines that will be followed by all construction personnel to avoid impacts to the species during project activities. A set of guidelines will be provided by DWR to the maintenance crew foreman or contractor(s) participating in the project, and the crew foreman will be responsible for ensuring that crew members comply with the guidelines.

SBR-2: Construction barrier fencing or stakes and flags will be placed around sensitive biological resources located in and within the project site boundaries and will remain in place until all project work involving heavy equipment is complete to ensure that construction activities avoid disturbing these resources. The size of the fenced buffer area will be determined on a project-specific basis through coordination with DFG and/or other relevant resource or regulatory agencies.

SBR-3: A qualified biologist will monitor all construction activities in and within 100 feet of the project site boundaries to ensure that no unauthorized activities occur within the project area. The 100-foot distance may be increased at the direction of a DFG or other agency representative. The biological monitor will be empowered to stop construction activities that threaten to cause unanticipated and/or unpermitted project impacts. Project activity will not resume until the conflict has been resolved. DWR will notify the relevant agency(ies) if the stopped project activity is related to a provision of any SERP permit/authorization.

Giant Garter Snake

GGS-1: To the extent possible, construction activities will be avoided within 200 feet from the banks of GGS aquatic habitat, including marshes, sloughs, ponds, irrigation canals, drainage ditches, and flooded rice fields. Movement of heavy equipment in these areas will be confined to existing roadways, where feasible, to minimize habitat disturbance.

GGS-2: Vegetation clearing will be confined to the minimal area necessary to facilitate construction activities. GGS habitat, including marshes, sloughs, ponds, irrigation canals, drainage ditches, and flooded rice fields, within or adjacent to the project site will be flagged and designated as environmentally sensitive areas. These areas will be avoided by all construction personnel.

GGS-3: Work crews and contractors will be given environmental awareness training before beginning work on the project site. This training will instruct workers to recognize GGS and its habitats and explain the possible penalties of noncompliance.

GGS-4: No more than 24 hours prior to construction activities, the project area will be surveyed for GGS by a qualified biologist. Surveys will cover all upland habitat within 200 feet of GGS aquatic habitat and will be repeated if a lapse in construction activity of 2 weeks or greater occurs. If construction activities are proposed within aquatic habitat, the qualified biologist will determine if the habitat could support GGS, and if so, implement measures to exclude GGS from the work area. A GGS-exclusion plan could include measures such as installation of a snake exclusion fence or dewatering the work area (NOTE: Dewatering must be conducted in a manner that does not result in the discharge of fill material into waters of the United States or waters of the state). Any proposed GGS-exclusion plan will be reviewed and approved by DFG, USFWS and NMFS prior to implementation. If a GGS is encountered during construction, activities will cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed. DWR will report any sighting and any incidental take to USFWS immediately by telephone at (916) 414-6600 and to DFG at (916) 358-4353.

GGS-5: Any temporary fill and construction debris will be removed after completion of construction activities, and, wherever feasible, disturbed areas will be restored to pre-project conditions. Restoration work may include such activities as replanting banks or emergent vegetation in the active channel. Restoration work beyond what is approved under the SERP must be approved by USFWS prior to implementation.

GGS-6: All construction activity within GGS habitat, including marshes, sloughs, ponds, irrigation canals, drainage ditches, and flooded rice fields, will occur from May 1 to October 1. This includes in-water construction and work outside the active stream channel.

VALLEY ELDERBERRY LONGHORN BEETLE

VELB-1: DWR work crews and contractors will be given environmental awareness training that will emphasize the identification of elderberry shrubs, the need to avoid damaging the elderberry shrubs, and the possible penalties of noncompliance.

VELB-2: Signs will be erected every 50 feet along the edge of elderberry avoidance areas. The signs will include 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 federal Endangered Species Act. Violators are subject to prosecution, fines, and imprisonment." The signs must be clearly readable from a distance of 20 feet and will be maintained throughout the construction period.

VELB-3: Avoidance areas for valley elderberry longhorn beetle will be temporarily fenced or flagged to serve as a visual boundary and keep people, vehicles, and other sources of disturbance from crossing into the area.

VELB-4: No insecticides, herbicides, fertilizers, or other chemicals that might harm the elderberry shrub or beetle will be used within 100 feet of any elderberry shrub having one or more stems measuring 1.0 inch or greater in diameter at ground level unless written approval for encroachment within the 100-foot buffer has been secured from USFWS. For projects where the application of insecticides, herbicides, fertilizers, or other chemicals may encroach upon the 100-foot buffer from an elderberry shrub, a description of that encroachment, including methods of application and chemicals to be used, will be specified in the project description section of the project notification form (see Section F, "Notification Requirements") for USFWS review and approval.

VELB-5: When a 100-foot (or wider) buffer is established and maintained around elderberry plants, complete avoidance (i.e., no adverse effects) will be assumed. Where encroachment on the 100-foot buffer has been approved by USFWS, a setback of 20 feet from the dripline of each elderberry plant will be maintained whenever possible. In areas where work will need to occur within the 20-foot setback, a biological monitor will be on site to ensure that no unauthorized take of the beetle or damage to its habitat occurs. Erosion controls will be installed and revegetation with appropriate native seed or plants will be completed on the disturbed areas.

VELB-6: DWR will secure the approval of USFWS prior to working within 100 feet of an elderberry shrub during the flight season of the valley elderberry longhorn beetle (March 15 and June 15).

DELTA SMELT

DS-1: DWR work crews and contractors will be given environmental awareness training that will emphasize the identification of Delta smelt, its habitat needs, and the possible penalties of noncompliance.

SWAINSON'S HAWK

SWH-1: DWR will initiate nest site surveys by March 15 for all projects that are scheduled between March 15 and September 1. All nest sites within 0.5 mile of the project site will be noted and reported to DFG.

SWH-2: DWR will conduct a preconstruction breeding-season (approximately February 1 through August 30) survey of the project site. The survey will be conducted by a qualified biologist and must conform to the Swainson's Hawk Technical Advisory Committee (2000) guidelines. If the protocol-level surveys do not identify any nesting raptor species within the survey area, no further mitigation is required. If nesting raptors are detected, DWR will ensure avoidance by project activities of all active bird nest sites located in the survey area during the breeding season (approximately February 1 through August 30). This avoidance may require a delay of construction to avoid the nesting season. Any occupied nest will be monitored by a qualified biologist to determine when the nest is no longer in use. If construction cannot be delayed, avoidance will include the establishment of a non-disturbance buffer zone around the nest site. The size of the buffer zone will be determined in consultation with DFG.

Burrowing Owl

BO-1: Prior to any ground-disturbing project-related construction activity, a focused survey for burrowing owls will be conducted by a qualified biologist in accordance with DFG protocol (DFG 1995) to identify active burrows on and within 250 feet of the project site. The surveys will be conducted no more than 30 days prior to the beginning of construction. If no occupied burrows are found in the survey area, no further mitigation is required. If an occupied burrow is found, a buffer will be established—165 feet during the nonbreeding season (September 1 through January 31) or 250 feet during the breeding season (February 1 through August 31)—for all project-related construction activities. The size of the buffer area may be adjusted if a qualified biologist and DFG determine project-related construction activities are not likely to have adverse effects. No project-related construction activity will commence within the buffer area until a qualified biologist confirms that the burrow is no longer occupied, or until consultation with DFG specifically allows certain construction activities to continue. If avoidance of occupied burrows is infeasible for project-related construction activities, on-site passive relocation techniques approved by DFG will be used to encourage owls to move to alternative burrows outside of the project site. However, no occupied burrows will be disturbed by project-related construction activities during the nesting season unless a qualified biologist verifies through noninvasive methods that the burrow is no longer occupied.

Bank Swallow

BS-1: For any SERP project located above (north of) Knights Landing, the project site must be evaluated for its impacts on occupied and potential bank swallow habitat. A pre-project bank swallow survey will be conducted by a DFG-approved biologist. The survey will include mapping of known and existing bank swallow colonies within a 500-foot radius of the disturbance boundaries of the project. The survey will also include mapping of any suitable breeding colony habitat within the same 500-foot radius. Suitable breeding colony habitat is herein defined by the habitat suitability index model developed to evaluate habitat for bank swallow breeding colonies within the continental United States (Garrison 1989). Based on that model, it is assumed that a bank suitable for a nesting colony must be at least 5 meters (m) (16.7 feet) long; that suitable foraging habitat occurs within 10 kilometers (km) (6 miles) of the colony; that insect prey are not limited; and that optimal colony locations are in vertical banks, greater than 1 m (3.3 feet) tall, greater than 25 m (83 feet) long, and consisting of suitable soft soils (i.e., sand, loamy sand, sandy loam, loam, and silt loam) in strata greater than 0.25 m (0.8 feet) wide. The pre-project bank swallow survey information will be submitted to DFG in a written report accompanying the project notification materials.

BS-2: Projects at sites containing occupied and/or potential bank swallow habitat within the proposed disturbance boundaries will not be authorized under the SERP. Project sites that contain suitable nesting colony habitat outside the project disturbance limits, but within the 500-foot survey radius, may be authorized under SERP at the discretion of DFG with implementation of additional, site-specific protective measures. However, no project that will affect an existing bank swallow colony will be authorized under the SERP. Any project that would result in take of bank swallow, as defined in California Fish and Game Code section 2081, will require issuance of an incidental take permit from DFG and does not qualify for authorization under the SERP.

NESTING BIRDS/MIGRATORY BIRDS

NB-1: It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird except as otherwise provided by the Fish and Game Code. Without prior consultation and approval of a DFG representative, no trees that contain active nests of birds will be disturbed until all eggs have hatched and young birds have fledged. Under the MBTA, it is unlawful to pursue, hunt, take, capture, kill, attempt to take capture, or kill, possess any migratory bird, any part, nest, or eggs of any such bird. Because incidental take coverage is not authorized under the MBTA, incidental take of a migratory bird should be avoided. If it is necessary to remove trees for purposes of the project, it is recommended that the trees that are identified for removal be removed during the non-nesting period of August 31 to February 1. If tree removal must occur during the period of February 1 to August 31, a qualified biologist will conduct a preconstruction survey for bird nests or nesting activity within 500 feet of the project boundaries. If any active nests or nesting behaviors are found, DFG and USFWS must be notified prior to further action. DWR may be required to create exclusion zones of between 75 feet and 0.25 mile depending on the species observed. The exclusion zone must be maintained until birds have fledged or the nest is abandoned. The survey results will be provided to DFG prior to removal of any trees.

RAPTORS

R-1: If project work will occur during the raptor nesting season (February 1 to August 31), a focused survey for raptor nests will be conducted by a qualified biologist during the nesting season to identify active nests within 500 feet of the project site. The survey will be conducted no less than 14 days and no more than 30 days prior to the beginning of construction. If nesting raptors are found within 500 feet of the project area, no construction will occur during the active nesting season of February 1 to August 31, or until the young have fledged (as determined by a qualified biologist), unless otherwise approved by DFG.

WOODY SHADED RIVERINE HABITAT

WSRH-1: All remaining, natural woody riparian or shaded riverine aquatic (SRA) habitat will be avoided or preserved to the maximum extent practicable.

WSRH-2: Woody riparian and SRA habitat will be replaced at a 3:1 ratio on an area or linear-foot basis, as determined appropriate by DWR in coordination with NMFS.

WSRH-3: Species chosen for replanting will reflect native species lost during the permitted activity or native species usually found in the riparian and SRA zones of the project location.

WSRH-4: Plantings will be installed during the optimal season for the species being planted. Therefore, completion of the planting effort may not occur at the same time as the remainder of the permitted activity.

WSRH-5: Maintenance of revegetated sites will continue for at least three growing seasons to allow the vegetation to establish. Maintenance will be continued as necessary until the final performance criteria are met.

ANADROMOUS FISH

Conservation measures pertaining to anadromous fish are captured in the above conservation measures.

CULTURAL RESOURCES

CR-1: DWR will ensure that SERP project activities near any historic property do not approach closer to the property than identified and allowed for in the resource-specific historic properties treatment plan (HPTP) and the construction monitoring and inadvertent discovery plan in accordance with requirements of the PA.

CR-2: DWR will ensure that an archaeological monitor is present during any ground-disturbing activities in areas where monitoring of construction is necessary to prevent or reduce adverse effects. Specific situations requiring archaeological monitoring and the methods and procedures for archaeological monitoring will be described in the *Construction Monitoring and Inadvertent Discovery Plan* as stipulated by the PA. In situations other than those described in the *Construction Monitoring and Inadvertent Discovery Plan* which specifically require archaeological monitoring, an archaeologist will be available on an on-call basis. If suspected archaeological materials are discovered during ground-disturbing activities, work will stop at that location and within 50 feet of the find until the archaeologist can inspect and assess the find and provide recommendations to DWR and USACE. Work may not resume at that location until DWR and USACE authorize resumption of work.

J. ANNUAL MONITORING REPORTS

An annual report package that includes the monitoring results from multiple SERP project sites will be submitted to the SERP agencies by November 30 of each year. The report will assess both attainment of yearly performance goals and progress toward final success criteria for each project. The first monitoring report package will be due in November following the first spring monitoring visit (see monitoring schedule in Section H, “Monitoring and Success Criteria”). The monitoring reports will specify the monitoring years (e.g., year 1, year 2) for which the report is being submitted. The information in the reports will be used to assess progress toward meeting the annual performance goals and final success criteria and will include recommended remedial actions to address any performance shortfalls.

The monitoring reports contained in the annual package will include annual monitoring information for each SERP project in accordance with the format outlined below. The projects will be grouped by year to facilitate agency review. A CD containing word versions of the annual report files will provided as part of the annual report package.

A. Project Information

1. Project name
2. Name, address, and phone number of person(s) preparing the report
3. Acres of project impact and type(s) of habitat impacted
4. Date project construction was completed
5. Date planting was completed
6. Mitigation monitoring year (i.e., first, second, third, etc.)

B. Regional Location Map

C. Site Map (no larger than 11 by 17, unless a different scale is requested by the SERP agencies)

The map should include the following information:

1. Habitat types
2. Locations of designated photo points
3. Landmarks
4. Location of sample points, if applicable

D. Site Information

1. Driving directions to the site
2. Specific purpose/goals for the mitigation efforts at the site
3. Dates and summary of previous maintenance and monitoring visits
4. Summary of previous remedial actions implemented, if any

E. List of Annual Performance Goals and Final Success Criteria

F. Tabulated Results of Monitoring Visits, Including Previous Years, Versus Success Criteria

G. Summary of Recorded Field Data to Determine Compliance with Success Criteria

1. Copy of completed “Qualitative Evaluation Sheet for SERP Project Sites”
2. Color photographs taken from designated photo points during most recent monitoring visit
2. List of plant species originally planted
3. List of plant species observed and relative cover estimates
4. SRA description and relative cover estimates
5. Levee inspection logs (if levee damage was reported during inspection)

H. Conclusions

1. Comparison of monitoring results with the established annual performance goals and final success criteria, including trends toward meeting final success criteria
2. Analysis of quantitative monitoring data
3. Discussion of qualitative monitoring data
4. Suggested changes for monitoring and/or maintenance activities

I. Problems Noted and Proposed Contingency Actions

1. Suggested remedial activities, such as replanting, fencing, irrigating, weeding, revising success criteria, or providing off-site compensatory mitigation.
2. Suggested remedial repairs, if inspection indicates continuing erosion or other damage to levee.

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U.S. Fish and Wildlife Service. March 2007. *Draft Programmatic Biological Assessment for the Sacramento Bank Protection Project.* Figure 2.

USFWS. *See* U.S. Fish and Wildlife Service.

APPENDIX A

USACE Mitigation and Monitoring Proposal Guidelines

US Army Corps of Engineers®

SPECIAL PUBLIC NOTICE

SAN FRANCISCO and SACRAMENTO DISTRICTS

MITIGATION AND MONITORING PROPOSAL GUIDELINES
December 30, 2004

INTRODUCTION

The Sacramento and San Francisco Districts of the Corps are jointly publishing these Mitigation and Monitoring Proposal Guidelines to update the existing Habitat Mitigation and Monitoring Guidelines published October 25, 1996 in the Sacramento District and October of 1991 in the San Francisco District. These Guidelines have been updated based upon experience, field investigations, and public input, but retain the main elements presented in the previous Guidelines.

These Guidelines apply throughout the U.S. Army Corps of Engineers' (Corps) San Francisco District, which encompasses the coastal portions of California from northern San Luis Obispo County to the Oregon border; and the Sacramento District, which covers the Central Valley of California, Nevada, Utah and western Colorado (see Figure 1). Both the San Francisco and Sacramento Districts shall herein be referred to as the "Districts." If modifications occur to the Districts' boundaries in the future, these Mitigation and Monitoring Proposal Guidelines will apply to all areas within the revised boundaries.

Overview

U.S. Army Corps of Engineers and U.S. Environmental Protection Agency (EPA) regulations (33 CFR Parts 320-331 and 40 CFR Part 230) authorize the Corps to require compensatory mitigation for unavoidable impacts to wetlands and other jurisdictional waters of the U.S. The Corps has commenced several initiatives in response to recommendations contained in the recent National Academy of Science / National Research Council publication "Compensating for Wetland Losses under the Clean Water Act," (2001) and is committed to improving the success of future compensatory mitigation projects.

After the applicant has demonstrated maximum avoidance and minimization of project impacts to waters of the U.S., Corps Districts will likely require compensatory mitigation for the remaining unavoidable impacts. While there may be other options for compensatory mitigation, these guidelines apply to development of plans for onsite and/or offsite establishment (creation), enhancement, and restoration activities, as well as mitigation bank design.

These Mitigation and Monitoring Proposal Guidelines are designed to assist the regulated public and their hired consultants with all aspects of the mitigation process. Approval of a mitigation plan is based on a demonstration that the proposed mitigation can successfully replace all lost functions and values associated with regulated impacts to waters of the U.S.

Changes from the December 31, 2003 Draft Guidelines

This Public Notice finalizes the draft guidance proposed in the Public Notice issued for public comment on December 31, 2003. Based upon comments received during the one-month comment period, we have made significant revisions to the Guidelines format. Most notably, Section I of the original Public Notice included both a section of the comprehensive report entitled "Compensating for Wetland Losses Under the Clean Water Act," from the National Research Council (NRC), and a list of ten guidelines to aid in planning and implementing successful mitigation projects ("Operational Guidelines for Creating or Restoring Wetlands that are Ecologically Self-Sustaining"; NRC, 2001). Section I, according to many commenters, created unnecessary confusion, contained too many examples of habitat types that are not represented within the boundaries of either District, and was redundant with other portions of the Public Notice. As a result, we did not include the information in this final version (however for reference, this section's content can be found in Chapter 7 of the National Academy of Science's report found at http://www.usace.army.mil/inet/functions/cw/hot_topics/nrchottopic.htm). Section II has been simplified and renamed "Section I. Mitigation Planning." Finally, we moved the annotated proposal outline from Appendix A to the main text of the final guidelines to accurately accentuate its importance in this document and mitigation planning.

Changes from Sacramento District's 1996 and San Francisco District's 1991 Guidelines

Sacramento District

There have been a number of changes to the Sacramento District's 1996 guidelines as a result of the adoption of these guidelines. The Corps policy section and mitigation-banking summary have been replaced, primarily, with a reference list of relevant regulations, guidance, and agreements. The section concerning different submittals for individual and nationwide permits has been removed. Contact information has been updated and enhanced by inclusion of links to the Districts' websites. *Section I. Mitigation Planning* has been added.

Guidelines for submittal of information on both the project and mitigation sites have been updated. Requests to submit Cowardin designations for types of jurisdictional areas and discuss proposed compensation ratios and long-term goals have been added. The success criteria section has been modified to better allow for site-specific selection of success criteria. Sections on "Maintenance During Monitoring Period" and "Long-term Management" have been added. The request to identify contingency mitigation sites has been removed. Finally, an outline for monitoring reports, and a list of common Cowardin habitat types that occur within the boundaries of the two districts, are included as appendices.

San Francisco District

The primary changes from the previous SF District Proposal Guidelines include requests for Cowardin descriptor codes, slope ratios, groundwater and soil information, aquatic functions, identification of compensation ratios (by applicant), monitoring schedule, and long-term management plans. Expanded information is requested for the monitoring and report sections.

Contact Information for Project Specific Questions:

For answers to questions regarding the interpretation of these Mitigation and Monitoring Proposal Guidelines or acceptable compensatory mitigation for a specific project, contact the Corps Project Manager responsible for your geographic area of interest:

San Francisco District Office general line	415-977-8436
Eureka Field Office general line	707-443-0855
Sacramento District Office general line	916-557-5250
Redding Office	530-223-9534
Reno Office	775-784-5304
Bountiful Office	801-295-8380
Colorado/Gunnison Basin Office	970-243-1199
Durango Office	970-375-9506
Frisco Office	970-668-9676
St. George Office	435-986-3979

References

The documents listed below have been used in creating this guidance and pertain to Corps mitigation policy. They are available for your use on the internet at www.gpoaccess.gov/legislative.html or www.usace.army.mil/inet/functions/cw/cecwo/reg/sadmin3.htm.

1. Clean Water Act Section 404 (33 USC Section 1344)
2. Rivers and Harbors Act of 1899 Section 10 (33 USC Sections 403 et seq.)
3. Environmental Protection Agency, Section 404 (b)(1) Guidelines (40 CFR Part 230)
4. Department of the Army Permit Regulations (33 CFR Parts 320-331)
5. *Memorandum of Agreement between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation under the Clean Water Act Section 404 (b)(1) Guidelines*, dated 6 Feb 1990
6. *Federal Guidance for the Establishment, Use and Operation of Mitigation Banks*, dated 28 Nov 1995
7. *Federal Guidance on the Use of In-Lieu-Fee Arrangements for Compensatory Mitigation under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act*, dated 7 Nov 2000
8. *Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899*, dated 26 Dec 2002 (RGL 02-02)

Additional Information Available on the Internet

The Corps Regulatory websites also provide important information regarding Corps jurisdiction, processing of permit applications, mitigation design, vernal pools, riparian mitigation guidelines, conservation easements, operation and maintenance plans, dredging, etc.:

San Francisco District's site: www.spn.usace.army.mil/regulatory/
Sacramento District's site: www.spk.usace.army.mil/regulatory.html

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I. MITIGATION PLANNING

Compensatory mitigation projects will proceed through several stages. There are specific issues the applicant must address at each stage in the process, to increase the probability of a successful compensatory mitigation project. The key stages in the development of a compensatory mitigation project are (A) Project Site Impact Assessment, (B) Compensatory Mitigation Site Selection, (C) Compensatory Mitigation Site Design, (D) Compensatory Mitigation Site Construction, (E) Long-Term Compensatory Mitigation Site Maintenance and Monitoring, and (F) Long-Term Site Management. Within each of these areas, the Corps has identified specific concerns that the applicant needs to consider in developing an adequate compensatory mitigation and monitoring plan.

A. Project Site Impact Assessment

An important aspect of any permit application is the assessment of the project site before impacts occur. An adequate assessment of site functions and values is important for determining the relative importance of the existing aquatic resources to the site and to the region or watershed. Assessment results can provide a basis for modifying pre-construction plans to avoid and/or minimize impacts to these resources. This assessment should be completed before the proposed project is designed or the proposed compensatory mitigation site is selected.

B. Compensatory Mitigation Site Selection

1. The selection of a site with suitable hydrologic conditions has been one of the most neglected aspects of compensatory mitigation planning. The National Research Council's *Compensating for Wetland Losses Under the Clean Water Act* (2001) stated that hydrological conditions, including variability in water levels and flow rates, are the primary driving force influencing wetland development, structure, functioning, and persistence. Without a naturally variable source of water (e.g., stream, lake, tidal action), hydrologic processes may not function fully. Lack of a natural water source has been the number one physical factor leading to the low rate of success of past compensatory mitigation projects. Therefore, mitigation projects that rely on artificial hydrology are generally unacceptable.

2. Site selection should include and prioritize the following criteria:

a. Natural Hydrology. The goal should be to have the aquatic feature be supported by a self-sustaining, natural hydrologic process requiring little or no long-term maintenance. It is recommended that the applicant compare hydrologic information at the compensatory mitigation site to similar reference (i.e., high-functioning) sites in the region, as well as to the impact site for design guidance.

b. Wildlife Corridors. Where possible compensatory mitigation projects should be developed adjacent to existing high-quality habitats. Even more desirable would be the construction of a compensatory mitigation site that links two or more habitats, which had been previously separated.

c. Soil Characteristics. Many past compensatory mitigation projects did not address the development of suitable soils. Examination of soils at reference sites will provide important information on the target habitat. Thorough assessments of mitigation site soils should be conducted to determine the site's suitability for supporting the target habitat. In the case of in-kind compensatory mitigation for wetlands, soils from the impacted aquatic habitat can be used at the compensatory mitigation site.

3. Generally, the physical characteristics of the sites considered determine whether establishment (i.e., creation), restoration, enhancement, or, more rarely, preservation are viable compensatory mitigation options. The categories of compensatory mitigation, as applied to wetlands and as defined in Regulatory Guidance Letter 02-02, are:

a. *Establishment (Creation)*: The manipulation of the physical, chemical or biological characteristics present to develop a wetland on an upland or deepwater site, where a wetland did not previously exist. Establishment results in a gain in wetland acres.

b. *Restoration:* The manipulation of the physical, chemical or biological characteristics of a site with the goal of returning natural or historic functions to a former or degraded wetland. For the purpose of tracking net gains in wetland acres, restoration is divided into:

i. Re-establishment: The manipulation of the physical, chemical or biological characteristics of a site with the goal of returning natural or historic functions to a former wetland. Re-establishment results in rebuilding a former wetland and results in a gain in wetland acres.

ii. Rehabilitation: The manipulation of the physical, chemical or biological characteristics of a site with the goal of repairing natural or historic functions of a degraded wetland. Rehabilitation results in a gain in wetland function but does not result in a gain in wetland acres.

c. *Enhancement:* The manipulation of the physical, chemical or biological characteristics of a wetland (undisturbed or degraded) site to heighten, intensify or improve specific function(s) or to change the growth stage or composition of the vegetation present. Enhancement is undertaken for specified purposes such as water quality improvement, flood water retention or wildlife habitat. Enhancement results in a change in wetland function(s) and can lead to a decline in other wetland functions, but does not result in a gain in wetland acres. This term includes activities commonly associated with enhancement, management, manipulation and direct alteration.

d. Protection/Maintenance (Preservation): The removal of a threat to, or preventing the decline of, wetland conditions by an action in or near a wetland. This term includes the purchase of land or easements, repairing water control structures or fences, or structural protection such as repairing a barrier island. This term also includes activities commonly associated with the term preservation. Preservation does not result in a gain of wetland acres and will be used as mitigation only in exceptional circumstances.

C. Compensatory Mitigation Site Design

1. Use a reference site to guide the design of mitigation. A reference site is a functioning aquatic system containing habitat that functions equal to or preferably better than the impact site and should be used to guide both the mitigation design and the success criteria of the final compensatory mitigation plan. The reference site may be the impact site or a similar site near the proposed mitigation site that supports the target habitat.

2. There are several important features to any successful compensatory mitigation design or plan. Each aspect of the plan must be identified in detail and explained clearly. Although there may be variation in the number of items required for a particular plan, those identified below should be assumed to be the minimum. The Corps strongly recommends that contents of written submittals follow the format provided in “Section II. Mitigation and Monitoring Proposals.”

a. *Clearly Define the Purpose of the Compensatory Mitigation Project*. The purpose of the compensatory mitigation project shall be clearly identified and include specific statements about the type(s) of habitat (and associated functions and values) impacted by constructing the proposed project, the functions and values that would be replaced at the proposed compensatory mitigation site, and any other functions and/or values that are desired (e.g., endangered species habitat, water quality functions, etc.).

b. *Develop a Comprehensive Hydrology Component*. For wetlands, information should be developed on depth, duration, and timing of ponding/saturation (inland areas); porosity of underlying soils; tidal ranges and frequencies (estuarine and marine areas); groundwater levels and fluctuations; mitigation site topography; and whether urban stormwater runoff is a water source. Provide information about the amount and the variability of water available to the site in an average rain year (October 1 – September 30). For channels, information should be developed on longitudinal profiles, frequency and depth of flooding (usually for 2-year, 5-year, 10-year, and 100-year storms), bank-full (channel-forming) flows under current and projected conditions, relevant cross-sections, substrate in the project/reference reach, channel history, upstream watershed conditions, and water-rights availability (if applicable).

c. *Develop a Complete Grading Plan Making Use of the Hydrology Data*. Elevations are critical to design success; grading plans should depict no coarser than one-foot contours. Topographic variation should often be incorporated into the design to maximize aquatic habitat diversity. Examine adjacent or nearby viable habitats as a reference.

d. *Determine the Adequacy of the Soils to Support the Target HabitatTtypes*. It is important to consider whether the soils will support the target aquatic habitat. Additionally, consider whether site preparation activities will significantly alter the site's ability to support the target aquatic habitat type. Finally, determine whether soil amendments will be necessary for long-term habitat development (e.g., organic matter, nitrogen, etc.).

e. *Develop a Draft Plant Palette Based on the Compensatory Mitigation Project Purpose, Soil Types, and Hydrology*. Identify tree, shrub, and herbaceous species to be planted, the source of the material, and the number and size of individual plants. Plant stock should be obtained from areas as near to the compensatory mitigation site as possible, to preserve the genetic integrity of the area.

f. *Propose Realistic Success Criteria Based on the Purpose of the Compensatory Mitigation, Design of the Site, and Functional Assessment Criteria*. Develop measurable success criteria, consistent with the purpose and goals of the compensatory mitigation project, that are achievable by the end of the maintenance and monitoring period (generally five years to ten years). Success criteria in compensatory mitigation projects have included percent canopy cover, percent plant survival, plant vigor, percent of native species, period of inundation, stability of designed hydrologic features, wildlife usage and plant heights.

g. *Develop a Specific Maintenance and Monitoring Program Including Contingency Measures.* Cover all subjects in the Guidelines that are appropriate to your project. The discussion of potential contingency measures should be brief, but acknowledge that should all or a portion of the required mitigation fail, additional measures may be necessary to fulfill the permittee's mitigation responsibility. If all feasible mitigation areas at the original mitigation location have already been used, a new off site location may be necessary to complete the mitigation.

3. In general, the Corps prefers that the compensatory mitigation site be constructed prior to or concurrently with the project construction. If compensatory mitigation will not be constructed until after project impacts, the Corps will likely increase the replacement ratio, to minimize temporal losses of functions and values associated with project impacts.

D. Compensatory Mitigation Site Construction

The permittee will not begin construction until the Corps approves the final compensatory mitigation and monitoring plan. The mitigation implementation process will normally require on-site management of construction personnel by one or more of the permittee's representatives, who have complete knowledge of the compensatory mitigation and monitoring plan and an understanding of soil science, hydrology, and botany, horticulture, or plant ecology. Sensitive areas should be staked, flagged or fenced to preclude unauthorized construction impacts. The permittee is responsible for the successful implementation of the compensatory mitigation. Any significant deviations identified during construction must be approved by the Corps. Additionally, consideration should be given to exotic species control during site preparation to minimize future maintenance and ensure successful mitigation. Personnel should consider removal of exotic species prior to grading and take invasive plant material from the site; in some circumstances, it may be necessary to remove the exotic seed banks by scraping and disposing the top few inches of soil.

E. Long-Term Compensatory Mitigation Site Maintenance and Monitoring

1. Develop specifics regarding the type and timing of maintenance and monitoring. Detail how often and when it will occur.

2. After the site has been graded and planted, the maintenance and monitoring phase of the compensatory mitigation project begins immediately. There are many invasive problematic plant species that will readily colonize a recently disturbed site. A proactive program to remove these plants upon discovery is usually advisable to allow establishment of desirable vegetation. As the target vegetation becomes established, the need for invasive plant species removal will likely lessen.

3. An important aspect of the maintenance and monitoring phase of nearly all compensatory mitigation projects is ensuring the appropriate depth, duration, and timing of onsite water. It is recommended that the permittee compare hydrologic information at the compensatory mitigation site to reference (i.e., high-functioning) sites in the region.

4. Contingency measures should be considered in mitigation site design. If approved success criteria are not met, the permittee must prepare an analysis of the likely cause(s) of failure(s) and propose remedial actions for Corps approval. Consider what sources of funding will be available to ensure the required compensatory mitigation occurs successfully. Contingency measures could include selection of an alternative location.

5. Monitoring reports are required for all mitigation sites. Propose annual dates that monitoring reports will be provided to the Corps. Appendix C provides an outline of what content should be provided in the specific pages of the monitoring report. The Corps recognizes there may be cases where this outline would not be practical (for very small, large, or complex compensatory mitigation projects). Failure to submit complete and timely monitoring reports could result in suspension of the permit or requirements for additional compensatory mitigation. Non-compliance with Corps permit conditions, which can result in additional compensatory mitigation requirements, may be subject to the Corps' Enforcement Procedures (33 CFR Part 326).

F. Long-Term Site Management

1. Protection of mitigation sites is usually required "in perpetuity" in keeping with the mitigation goals. The mitigation and monitoring plan must include the identification of a long-term manager/owner (usually a non-profit or a governmental agency), and should include a conservation easement or other documentation of long-term protection and a well-designed long-term management plan.

2. The permittee is usually required to provide a realistic endowment or other financial assurance to cover long-term maintenance activities.

SECTION II.   RECOMMENDED PROPOSAL CONTENTS

A. Table of Contents

B. Responsible Parties: Provide names, titles, addresses, and phone numbers of responsible parties including contact persons.

1. ***Applicant/Permittee:*** The project proponent, not consultant, should be listed.

2. ***Applicant's Designated Agent*** (if any)

3. ***Preparer(s) of the Proposal/Plan***

C. Project Requiring Mitigation

1. ***Location:*** Describe location and provide: a) road map with site location clearly shown, and b) USGS quad map with project site and watershed outlined (clear photocopies are acceptable).

2. ***Brief Summary of Overall Project:*** In a few paragraphs, describe the overall project for which a permit or authorization is required. Include type of development (or other work), project size, and a brief projected schedule of project construction.

3. **Site Characteristics:**

   a. *Jurisdictional Areas* – Identify those jurisdictional areas as shown on the approved delineation to be directly or indirectly affected by the project. Provide an appropriately sized topo base map with jurisdictional areas and impacts clearly shown (may be same map as under "1." above). Indicate on the map whether the jurisdictional areas are wetlands and/or other waters. Also provide a table indicating acreage of wetland impacts by habitat common name with Cowardin designation, and linear feet and width of impacts to streams and/or tributaries.

   b. *Aquatic Functions* - Describe functions of aquatic features that will be lost and/or directly or indirectly impacted. This may include, but is not limited to, water filtration, sediment storage, flood retention, wildlife habitat, endangered species habitat, etc. (For further information, see http://www.epa.gov/watertrain/wetlands/).

   c. *Hydrology/Topography* – Describe hydrology and topography, including slope ratios of wetland features and stream banks, and identify the water's source, frequency, duration and depth of inundation for the site. Indicate groundwater level(s), if known, and significant pollutants.

   d. *Soils/Substrate* – Describe texture, organic matter content, permeability, and presence of restrictive layers in aquatic features.

   e. *Vegetation* – The dominant plant communities, as well as special status plant species, of each stratum in the vegetated plot should be identified. Provide a map of the dominant plant communities.

f. *Threatened/Endangered Species* – Identify any federally-listed (including proposed) species found on or near the site for which suitable habitat is present, including whether the site is within designated critical habitat.

D. Mitigation Design

1. *Location* – Describe location and provide: a) road map with site location clearly shown, and b) USGS quad map with project site outlined. Clear photocopies are acceptable.

2. *Basis for Design:* Provide a concise summary of the rationale for choosing the proposed type(s) and location(s) of mitigation.

3. *Characteristics of Design Reference Site* (if different from impact site):

a. *Jurisdictional Areas* **-** Provide a jurisdictional determination of the reference site(s) with identified sample plots that are large enough to capture the desired aquatic design characteristics.

b. *Aquatic Functions* – Describe functions of the reference aquatic site. This may include but is not limited to, water filtration, sediment storage, flood retention, wildlife habitat, endangered species habitat, etc.

c. *Hydrology/Topography* – Describe hydrology and topography, including slope ratios of wetland features and stream banks, and identify the water's source, frequency, duration and depth of inundation for the site. Indicate groundwater level(s) if known and significant pollutants.

d. *Soils/Substrate* – Describe texture, organic matter content, permeability, and presence of restrictive layers in aquatic features.

e. *Vegetation* – The dominant plant communities, as well as special status plant species, of each stratum in the vegetated plot should be identified.

4. Proposed Mitigation Site

a. Location – Describe location, indicating distance from project site, if applicable. Provide the following maps: a) site location on a road map, and b) original or copy of USGS quad map with mitigation location outlined.

b. Ownership Status – Indicate who owns the proposed mitigation site. If different from permit applicant(s), describe the property's availability and easement history.

c. Jurisdictional Areas (if any) – Provide a proposed jurisdictional map of the site. Indicate what portions of the jurisdictional areas, if any, are to be filled and/or altered under the mitigation proposal.

d. Aquatic Functions (if any) – Describe expected functions and values of any existing aquatic features on the mitigation site. This may include, but is not limited to, water filtration, sediment storage, flood retention, wildlife habitat, endangered species habitat, etc.

e. *Hydrology/Topography* – Describe the current hydrology and topography of the site, including intended water source for mitigation features.

f. *Soils/Substrate* – Describe overall site series and existing channel substrate (if applicable).

g. *Vegetation* –Describe and provide a map of the existing dominant plant communities, as well as any special status plant species. Also provide a table indicating approximate acreage of the habitats.

h. *Present and Historical Uses of Mitigation Area* - Briefly describe all known present and historical uses of mitigation area. On a plan view, indicate any pipelines, power lines, roads, encroachments, or easements. Also show distance and location of nearest structures, if any, on the mitigation property or on any properties adjoining the mitigation project. Give all present and proposed zoning designations for mitigation site, including city and county.

g. *Present and Proposed Uses of All Adjacent Areas* - Briefly describe all known present and proposed uses and zoning designations of all property sharing a common border with the proposed mitigation site.

5. *Created/Restored Habitat(s)*

a. *Compensation Ratios* – Provide a table indicating the ratio(s) of impact wetland acreage and/or linear feet of channel to compensation acreage and/or linear feet of channel, both overall and by aquatic feature type.

b. *Long-Term Goal(s)* – Describe the target habitat to be created/restored. Most mitigation designs are aimed at a habitat with certain characteristics that will not exist at the site until long after the monitoring period has ended. Please describe the projected state of the mitigation area in 10 to 30 years following implementation.

c. *Aquatic Functions* – Describe expected functions of the compensatory aquatic features.

d. *Hydrology/Topography* – Provide a hydrologic budget that identifies source, duration, volume and direction of water flow for the proposed mitigation feature(s) during the average climatic year. Provide information on the feature's hydrologic connectivity to downstream tributaries and navigable waters, as applicable. If the mitigation site is targeting a saturated, flooded or ponded wetland, an estimation of the average period of saturation, ponding or flooding should be included, as well as a wetland watershed map.

Include a grading plan indicating intended slope ratios of wetlands and/or stream banks and overall area of disturbance.

e. *Soils/Substrate* – Describe suitability of soils/substrate at intended compensation locations for creation/restoration of aquatic features.

f. *Vegetation* – Describe target plant communities and species. Provide a proposed planting plan.

E. Success Criteria and Monitoring

1. Success Criteria – Provide a table of success criteria. Quantifiable success criteria are used to determine completion of a permittee's mitigation responsibilities and are proposed by the applicant for Corps approval. Meeting these criteria will indicate that the mitigation area is progressing well towards replacement of lost functions and achievement of the long-term mitigation goals. The criteria should address each major aspect of the project, including hydrological success, establishment of appropriate vegetation, and habitat establishment.

2. Monitoring

a. *Methods* – Explain why each method has been chosen to evaluate progress in relation to each success criterion. The appropriateness of a method will depend on the objective it is addressing and the characteristics of the feature being surveyed. Describe sampling methods used. Include size of sample unit, number of samples. If using transects for assessment of vegetation, provide a map of the mitigation area(s) showing intended transect lines.

b. *Monitoring Schedule* – Monitoring should be tied to the appropriate growing, tidal or hydrology cycle rather than the point at which implementation happens to occur. Monitoring will generally not be considered to be "first year" monitoring until one full growing season (for vegetation) or target activity period (for hydrology/geomorphology) has passed following completion of installation. Also, although in many situations it is crucial to monitor all project components during the first five years or so, this is not necessarily true for every project. In some cases, it is not appropriate to begin quantitatively monitoring one or another component until a few years after implementation. In other cases it may be necessary to do annual monitoring for the first four to six years, and then monitor every other year for the remainder of the monitoring period. (However, in years where formal monitoring reports are not required, on-site inspections and documentation of site conditions should still occur.)

c. *Photo-Documentation* – In addition to quantitative methods, ground and/or aerial photos can be used to illustrate year-to-year progress of the overall project. Ground photos should generally be panoramic, and taken from a high point relative to the mitigation site such that photos taken in later years will not be obscured by developing vegetation. All such photos should be taken from the exact same point every year to allow for inter-annual comparison. If aerial photos are being used for measurements, they should be directly vertical and have identifiable ground-references to provide a reasonably accurate scale. Copies of color photos should be done in color.

F. Implementation Plan

1. ***Site Preparation***

a. *Grading Implementation* – Describe equipment, procedures, access paths, etc., if they affect aquatic resources.

b. *Avoidance Measures* – Describe any measures used to avoid sensitive areas outside of the grading plan.

c. *Soil Disposal* – Indicate storage location, if any, and ultimate destination of any excavated materials.

d. *Soil Treatment* – Indicate any soil modification(s) planned for the mitigation site, including spreading of inoculum. Also indicate source, storage location, storage duration, and intended placement of any soil to be used.

e. *Pest Plant Removal* – Describe method(s) to be used to remove any pest plants from the mitigation site.

f. *Construction Monitor* – Provide a statement that a person/firm familiar with the mitigation/monitoring plan will supervise all site phases of mitigation construction. This person should have authority to direct equipment operators, and should submit a summary report to the Corps documenting construction observations and any problems that arose during construction.

2. *Planting/Seeding*

a. *Planting Plan* – Provide a table of species to be planted and indicate geographic source of plants (should be as local as possible), type of propagules to be used, and season in which seeding/planting/transplanting is to be done. Include size and quantity of propagules and/or intended spacing.

b. *Nature and Source of Propagules* – Indicate types, sizes, and sources of propagules. Seeds, seedlings, canes, young plants and transplants should be from as local a stock as possible. For transplant propagules, describe method, location of harvest site, and duration of storage, if applicable

3. *Irrigation* - Most mitigation projects should become hydrologically self-sustaining. The function of irrigation in the early years of a project is to give new vegetation a head start at becoming established. Describe any proposed irrigation methods, including estimated frequency, and indicate month(s) in which it is to occur. Also indicate water source(s) for irrigation. In arid climates, mitigation planning should include contingency irrigation in case of drought. In most cases, irrigation is usually confined to the first 2-3 years after plant installation and success criteria are not considered met until at least two years have passed since irrigation ceased.

4. *Implementation Schedule* - Provide a schedule showing intended timing (by month) of site preparation, any seed/topsoil storage, seed/topsoil application, and plantings**.**

G. Maintenance during Monitoring Period

1. *Maintenance Activities*

a. *Overall* – Describe planned maintenance activities (e.g. inspection of irrigation system, inspection of water structure(s), erosion control, weeding, etc.). Note that irrigation-system failure is a common source of difficulties in the early years of a project. Many of these problems can be avoided by relatively frequent inspections of the system during the dry season in the first couple of years.

b. *Pest Species Control* - Identify any pest species (plant and/or animal) that might cause problems on the site, and provide a control plan for these species if appropriate. Indicate the critical threshold of disturbance that will trigger the implementation of control methods.

2. ***Maintenance Schedule*** – Provide a table showing proposed schedule of frequency of maintenance inspections over the life of the project.

H. Proposed Monitoring Reports

1. ***Due Dates*** **-** The applicant must identify an annual due date for reports (i.e., month and day).

2. ***As-Builts*** – A topographic survey of the as-built mitigation area should be submitted to the Corps within 6 weeks of completion of mitigation construction. The Corps will decide the appropriate scale of topographic survey on a case-by-case basis.

3. ***Annual Reports***

   a. *File Number* – Include the Corps permit/file number on the cover and title page of all reports and correspondence.

   b. *Content*s – The required contents for annual reports is listed below:

      i. Years of full monitoring – Appendix C describes the content of annual monitoring reports.

      ii. Years of partial monitoring, where required - Occasionally, due to project-specific factors, it is appropriate to perform a reduced monitoring program for one or more monitoring years. The nature and extent of this monitoring would be described in permit documents, and the reporting is usually in the form of a letter.

      iii. Final monitoring report – In the final monitoring report, include a delineation of any constructed wetlands, in addition to the normal content of a monitoring report.

I. Potential Contingency Measures

1. ***Initiating Procedures*** – If an annual performance goal is not met for all or any portion of the mitigation project in any year, or if the final success criteria are not met, the permittee should prepare an analysis of the cause(s) of failure and propose remedial action for Corps approval. Remedial actions could range from replanting, to relocating the mitigation site.

2. ***Contingency Funding Mechanism*** **-** Indicate what funds will be available to pay for planning, implementation, and monitoring of any contingency procedures that may be required and present all necessary assurances that the funds will remain available until success criteria have been achieved.

J. Completion of Mitigation Responsibilities

1. ***Notification*** – When the required monitoring period is complete and the permittee believes that the final success criteria have been met, the permittee shall notify the Corps when submitting the proposed final report. For mitigation plantings, final success criteria will not be considered met until a minimum of two years after all maintenance (e.g. irrigation, replanting, rodent control, fertilization) has ceased**.**

2. ***Corps Confirmation* -** Following receipt of the proposed final report, the Corps will either confirm the successful completion of the mitigation obligation or require additional years of monitoring. The permittee is not released from any mitigation obligation until written notice of completion is received from the Corps**.**

K. Long-Term Management

1. ***Property Ownership* -** Identify the owner of the mitigation site following completion of mitigation monitoring period.

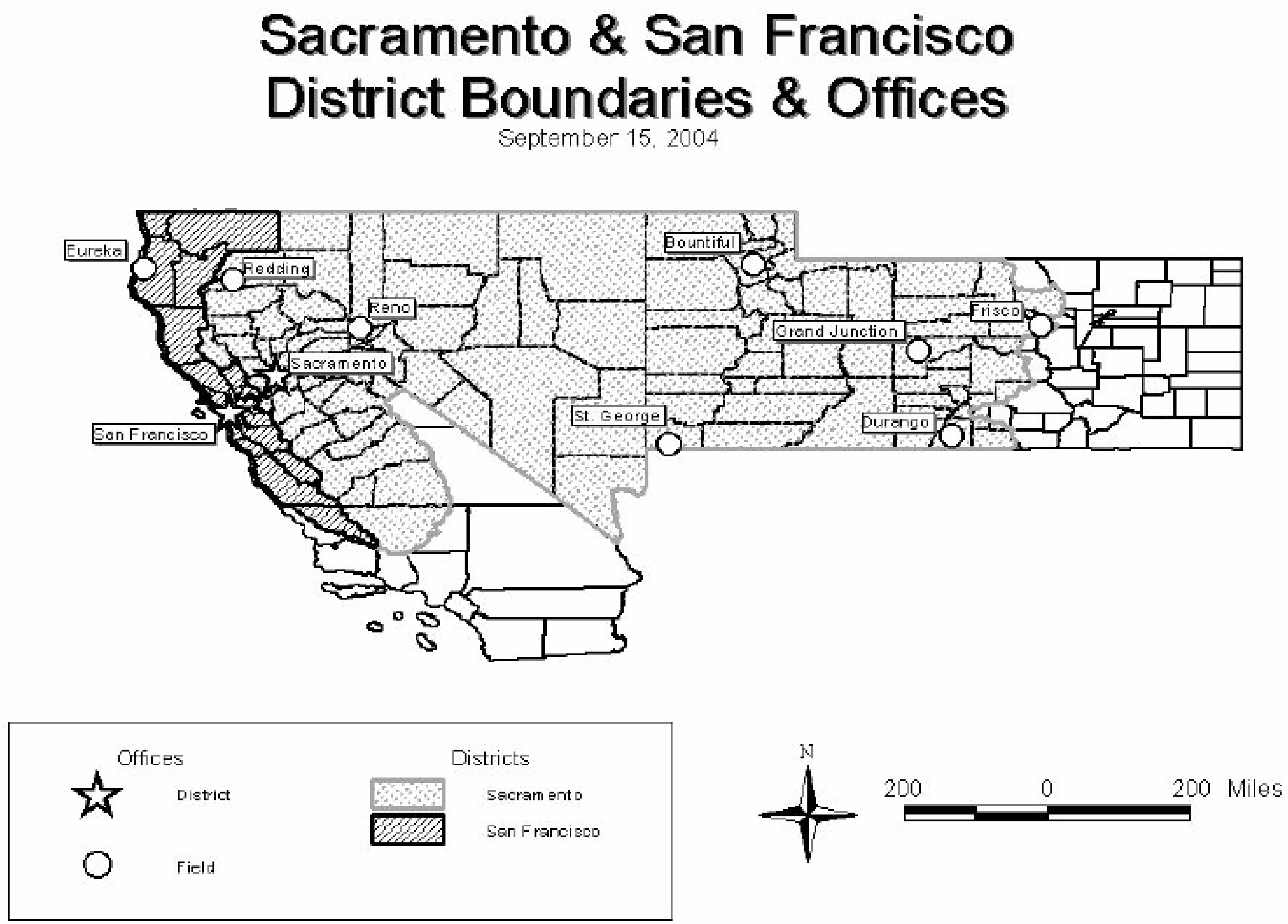
2. ***Management Plan***

   a. *Resource Manager*. Identify the entity that will provide the resource management for the site following mitigation sign-off.

   b. *Management Approach.* The long term management plan should describe any proposed grazing, fencing, fire-management activities, provisions for public access, invasive exotic plant control program (if applicable), annual reporting, and any other proposed activities.

3. ***Site Protection* -** Long-term site-protection mechanism (e.g., ownership by conservation organization, conservation easement, etc.) should be included. Indicate responsible parties and funding mechanism. A Property Analysis Record (PAR) analysis or similar method should also be used to determine how much money will be needed to manage the property over the long term. The long-term manager should be in agreement with the amount provided.

Map: Sacramento and San Francisco Districts



APPENDIX A1. RECOMMENDED PROPOSAL CONTENTS

A. Table of Contents

B. Responsible Parties

1. ***Applicant/Permittee***
2. ***Applicant's Designated Agent***
3. ***Preparer(s) of the Proposal/Plan***

C. Project Requiring Mitigation

1. ***Location***
2. ***Brief Summary of Overall Project***
3. ***Site Characteristics:***

   a. *Jurisdictional Areas*
   b. *Aquatic Functions*
   c. *Habitat Types*
   d. *Hydrology/Topography*
   e. *Soils/Substrate*
   f. *Vegetation*
   g. *Threatened/Endangered Species*

D. Mitigation Design

1. ***Location***
2. ***Basis for Design***
3. ***Characteristics of Design Reference Site (if different from impact site):***

   a. *Jurisdictional Areas*
   b. *Aquatic Functions*
   c. *Hydrology/Topography*
   d. *Soils/Substrate*
   e. *Vegetation*

4. ***Proposed Mitigation Site***

   a. *Location*
   b. *Ownership Status*
   c. *Jurisdictional Areas (if any)*
   d. *Aquatic Functions (if any)*
   e. *Hydrology/Topography*
   f. *Soils/Substrate*
   g. *Vegetation*
   h. *Present and Historical Uses of Mitigation Area*
   i. *Present and Proposed Uses of All Adjacent Areas*

5. Created/Restored Habitat(s)

a. Compensation Ratios
b. Long-Term Goal(s)
c. Aquatic Functions
d. Hydrology/Topography
e. Soils/Substrate
f. Vegetation

E. Success Criteria and Monitoring

1. Success Criteria
2. Monitoring

a. Methods
b. Monitoring Schedule
c. *Photo-Documentation*

F. Implementation Plan

1. Site Preparation

a. Grading Implementation
b. Avoidance Measures
c. Soil Disposal
d. Soil Treatment
e. Pest Plant Removal
f. Construction Monitor

2. Planting/Seeding

a. Planting Plan
b. Nature and Source of Propagules

3. Irrigation
4. Implementation Schedule

G. Maintenance during Monitoring Period

1. *Maintenance Activities*

a. Overall
b. *Pest Species Control*

2. Maintenance Schedule

H. Proposed Monitoring Reports

1. ***Due Dates***
2. ***As-Builts***
3. ***Annual Reports***

    a. *File Number*
    b. *Contents*
        i. Years of full monitoring
        ii. Years of partial monitoring, where required
        iii. Final monitoring report

I. Potential Contingency Measures

1. ***Initiating Procedures***
2. ***Contingency Funding Mechanism***

J. Completion of Mitigation Responsibilities

1. ***Notification***
2. ***Corps Confirmation***

K. Long-Term Management Plan

1. ***Property Ownership***
2. ***Management Plan***

    a. *Resource Manager.*
    b. *Management Approach.*

3. ***Site Protection***

APPENDIX A2. SUMMARY LIST OF MAPS, TABLES, AND SCHEDULES FOR SUBMISSION WITH PROPOSALS

(This is a minimum list. It is only necessary to submit the items that apply to your project. Add additional items as needed.)

A. Maps

1. Project Requiring Mitigation

a. Road Map
b. USGS Map
c. Approved Jurisdictional Map
d. Habitat Map

2. Mitigation Design – Reference Site

a. Road Map
b. USGS Map
c. Proposed Jurisdictional Map for Reference Site

3. Mitigation Design – Mitigation Site

a. Road Map
b. USGS Map
c. Proposed Jurisdictional Map
d. Vegetation/Habitat Map
e. Plan View Showing Distance to and Location of Nearest Structures

4. Mitigation Design - Created/Restored Habitat

a. Wetland Watershed Map
b. Grading Plan
c. Planting Plan

B. Tables

1. *Impact Acreage*
2. *Impact vs. Mitigation Acreage/Linear Feet*
3. *Success Criteria*
4. *Species to Be Planted*

C. Schedules

1. *Monitoring*
2. *Implementation*
3. *Maintenance Inspections*

APPENDIX B. FORMAT INFORMATION

A. Reports/Proposals

1. Headings

   All cover, title page, or letter headings must contain the Corps File Number and the date of the document.

2. Contributor Page

   List all persons who prepared plan, did monitoring, and/or wrote or edited the text.

3. Distribution Page

   List names, titles, and companies/agencies of all persons receiving a copy of the report.

4. Binding

   All reports and proposals should be single, stand-alone, separately bound documents. Except for full-size drawings, all materials submitted should be, or be folded to, 8 ½” x 11”. Do not submit reports in three-ring binders as they do not work with our filing system. Please bind your final submittal with this in mind.

B. Figure Format

All maps and plans submitted should be legible, complete, clear, and at the appropriate scale. Each should include the following:

1. Title Block.

2. Date of Preparation.

3. Date(s) of any Modifications.

4. 1” Margin at Top of Sheet.

5. North Arrow (Plan Views).

   The orientation of the map on the page (as it is read) should be the same for all maps submitted. By convention, North will normally be toward the top of the page.

6. Scale.

   Base topo maps should be full-sized (1 inch = 100 feet or less, 1 inch = 200 feet for very large projects).

7. Datum.

   Reference elevation datum must be indicated on both plan and section views.

8. Jurisdictional Boundaries

   Tidal waters – MLLW, MHW, HTL
   Non-tidal waters (stream channels) – OHW
   Wetlands – boundaries

9. Legend

   Identify all symbols, patterns or screens used. If color figures are used, information should be understandably presented in a form that is reproducible in black and white.

APPENDIX C. MONITORING REPORT OUTLINE

I. Monitoring Report Content

A. Project Information

1. Project name
2. Applicant name, address, and phone number
3. Consultant name, address, and phone number (if appropriate)
4. Corps permit file number
5. Acres of impact and type(s) of habitat impacted
6. Date project construction commenced
7. Indication of mitigation monitoring year (i.e. first, second, third, etc.)
8. Amount and information on any required performance bond or surety, if any

B. Compensatory Mitigation Site Information

1. Location of the site (regional map may be appropriate)
2. Specific purpose/goals for the compensatory mitigation site
3. Date mitigation site construction and planting completed
4. Dates summary of previous maintenance and monitoring visits
5. Name, address, and contact number of responsible parties for the site
6. Summary of remedial action, if any

C. Location Map

D. Site Map (usually no larger than 11 x 17 unless a different scale is requested by the project manager). The map should include the following information:

1. Habitat types as described in the approved mitigation plan
2. Locations of any photographic record stations
3. Landmarks
4. Location of sample points

E. List of Corps-Approved Success Criteria

F. Tabulated Results of Monitoring Visits, Including Previous Years, Versus Success Criteria

G. Summary of Field Data Taken to Determine Compliance with Success Criteria

H. Problems Noted and Proposed Remedial Measures

II. Appendices

A. ***Original Data Sheets and Technical Appendices***, as required by the Corps project manager
B. ***Photographic Record of the Site*** during most recent monitoring visit at record stations

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

SYSTEM / SUBSYSTEM / CLASS / Subclass

M - MARINE

- **1 - SUBTIDAL**
  - RB – ROCK BOTTOM: 1 Bedrock, 2 Rubble
  - UB – UNCONSOLIDATED BOTTOM: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
  - AB – AQUATIC BED: 1 Algal, 3 Rooted Vascular, 5 *Unknown Submergent*
  - RF - REEF: 1 Coral, 3 Worm
  - OW - *OPEN WATER/ Unknown Bottom*
- **2 - INTERTIDAL**
  - AB – AQUATIC BED: 1 Algal, 3 Rooted Vascular, 5 *Unknown Submergent*
  - RF– REEF: 1 Coral, 3 Worm
  - RS – ROCKY SHORE: 1 Bedrock, 2 Rubble
  - US - UNCONSOLIDATED SHORE: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic

E - ESTUARINE

- **1 - SUBTIDAL**
  - RB - ROCK BOTTOM: 1 Bedrock, 2. Rubble
  - UB – UNCONSOLIDATED BOTTOM: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
  - AB – AQUATIC BED: 1 Algal, 3 Rooted Vascular, 4 Floating Vascular, 5 *Unknown Submergent*, 6 *Unknown Surface*
  - RF – REEF: 1 Mollusc, 2 Worm
  - OW - *OPEN WATER/ Unknown Bottom*
- **2 - INTERTIDAL**
  - AB – AQUATIC BED: 1 Algal, 3 Rooted Vascular, 4 Floating Vascular, 5 *Unknown Submergent*, 6 *Unknown Surface*
  - RF– REEF: 1 Mollusc, 2 Worm
  - SB – STREAMBED: 1 Cobble Gravel, 2 Sand, 3 Mud, 4 Organic
  - RS - ROCKY SHORE: 1 Bedrock, 2 Rubble
  - US – UNCONSOLIDATED SHORE: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
  - EM -EMERGENT: 1 Persistent, 2 Nonpersistent
  - SS – SCRUB-SHRUB: 1 Broad-Leaved Deciduous, 2 Needle-Leaved Deciduous, 3 Broad-Leaved Evergreen, 4 Needle-Leaved Evergreen, 5 Dead, 6 *Deciduous*, 7 *Evergreen*
  - FO – FORESTED: 1 Broad-Leaved Deciduous, 2 Needle-Leaved Deciduous, 3 Broad-Leaved Evergreen, 4 Needle-Leaved Evergreen, 5 Dead, 6 *Deciduous*, 7 *Evergreen*

R - RIVERINE

- **SUBSYSTEM:** 1 – TIDAL; 2 – LOWER PERENNIAL; 3 – UPPER PERENNIAL; 4 – INTERMITTENT; 5 – *UNKNOWN PERENNIAL*
- **CLASS**
  - RB – ROCK BOTTOM: 1 Bedrock, 2 Rubble
  - UB – UNCONSOLIDATED BOTTOM: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic
  - *SB – STREAMBED: 1 Bedrock, 2 Rubble, 3 Cobble Gravel, 4 Sand, 5 Mud, 6 Organic, 7 Vegetated
  - AB – AQUATIC BED: 1 Algal, 2 Aquatic Moss, 3 Rooted Vascular, 4 Floating Vascular, 5 *Unknown Submergent*, 6 *Unknown Surface*
  - RS – ROCKY SHORE: 1 Bedrock, 2 Rubble
  - US – UNCONSOLIDATED SHORE: 1 Cobble-Gravel, 2 Sand, 3 Mud, 4 Organic, 5 Vegetated
  - **EM – EMERGENT: 2 Nonpersistent
  - OW – *OPEN WATER/ Unknown Bottom*

* STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM.
** EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS.

Classification of Wetlands and Deepwater Habitats of the United States
Cowardin ET AL. 1979 as modified for National Wetland Inventory Mapping Convention

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

SYSTEM: L- LACUSTRINE

SUBSYSTEM: 1 - LIMNETIC

CLASS	RB – ROCK BOTTOM	UB – UNCONSOLIDATED BOTTOM	AB – AQUATIC BED	OW – *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2. Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	

SUBSYSTEM: 2 - LITTORAL

CLASS	RB – ROCK BOTTOM	UB – UNCONSOLIDATED BOTTOM	AB – AQUATIC BED	RS – ROCKY SHORE	US – UNCONSOLIDATED SHORE	EM – EMERGENT	OW – *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2. Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2. Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

SYSTEM: P - PALUSTRINE

CLASS	RB – ROCK BOTTOM	UB – UNCONSOLIDATED BOTTOM	AB – AQUATIC BED	US – UNCONSOLIDATED SHORE	ML – MOSS-LICHEN	EM – EMERGENT	SS – SCRUB-SHRUB	FO – FORESTED	OW – *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2. Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	

MODIFIERS

In order to more adequately describe the wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME				WATER CHEMISTRY			SOIL	SPECIAL MODIFIERS	
Non-Tidal		**Tidal**		**Coastal Halinity**	**Inland Salinity**	**pH Modifiers for all Fresh Water**			
A Temporarily Flooded B Saturated C Seasonally Flooded D *Seasonally Flooded/ Well Drained* E *Seasonally Flooded/ Saturated* F Semipermanently Flooded G Intermittently Exposed	H Permanently Flooded J Intermittently Flooded K Artificially Flooded W Intermittently Flooded/Temporary Y Saturated/Semipermanent/ Seasonal Z Intermittently Exposed/Permanent U *Unknown*	K *Artificially Flooded* L Subtidal M Irregularly Exposed N Regularly Exposed P Irregularly Flooded	*S Temporary-Tidal *R Seasonal-Tidal *T Semipermanent-Tidal *V Permanent-Tidal U *Unknown* *These water regimes are only used in tidally influenced, freshwater systems.	1 Hyperhaline 2 Euthaline 3 Mixohaline *(Brackish)* 4 Polyhaline 5 Mesohaline 6 Oligohaline 0 Fresh	7 Hypersaline 8 Eusaline 9 Mixosaline 0 Fresh	a Acid t Circumneutral i Alkaline	g Organic n Mineral	b *Beaver* d *Partially Drained/Ditched* f Farmed	h *Diked/Impounded* r Artificial Substrate s *Spoil* x Excavated

NOTE: Italicized terms were added for mapping by the National Wetlands Inventory program.

APPENDIX B

CEQA Compliance Checklist
[to be inserted upon release of the Public Draft PEIR]

SPK-2006-00228

United States Department of the Interior

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

In Reply Refer To
08ESMF00-2013-F-0450

SEP 24 2013

RECEIVED
SEP 27 2013

Ms. Nancy Arcady Haley
Chief, California North Branch
U.S. Army Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95814

Subject: Formal Consultation on the California Department of Water Resources Small Erosion Repair Program, Sacramento, Solano, Sutter, Yolo, Butte, and Colusa Counties, California (Corps File Number SPK-2006-00228)

Dear Ms. Haley:

This is in response to the U.S. Army Corps of Engineers (Corps) February 25, 2013, request for consultation with the U.S. Fish and Wildlife Service (Service) on the proposed California Department of Water Resources (DWR) Small Erosion Repair Program (SERP) in Sacramento, Solano, Sutter, Yolo, Butte, and Colusa Counties, California. At issue are effects of the proposed project on the federally-threatened: delta smelt (*Hypomesus transpacificus)* (smelt) and its critical habitat; valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*); and giant garter snake (*Thamnophis gigas*). The proposed project is not within critical habitat for the valley elderberry longhorn beetle; therefore, none will be affected. Your request was received in our office on February 28, 2013. This response is provided under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.) (Act).

This biological opinion is based on information provided in the Corps' letter requesting consultation and the biological assessment. A complete administrative record is on file at the Sacramento Fish and Wildlife Office.

<u>Valley Elderberry Longhorn Beetle</u>

Valley elderberry longhorn beetles rely on elderberry shrubs for feeding, breeding, and reproduction. The majority of their life span is spent within the stems of the elderberry shrubs. While shrubs may occur on project sites, DWR has incorporated avoidance measures which will protect shrubs in place, provide a buffer around shrubs, and avoid working when adult valley elderberry longhorn beetles have emerged from the elderberry shrubs. Therefore, effects to the beetle due to activities around elderberry shrubs will be insignificant and/or discountable. We concur with your determination that the proposed SERP project is not likely to adversely affect valley elderberry longhorn beetle.

CONSULTATION HISTORY

February 2007: The Service, DWR, California Department of Fish and Wildlife (DFW), Corps, and National Marine Fisheries Service (NMFS) began meeting to discuss developing a program which will repair erosion damage to levees while the eroded sites are small. This group has met regularly between then and now. During these meetings the methods of repairing sites and conservation measures were discussed and developed.

April 27, 2010: A draft biological assessment was provided to the Service, NMFS, Corps, and DFW for review and comment. The Service responded with edits and revisions to the draft document.

May 17, 2011, and June 8, 2011: Meetings were held with the Service, NMFS, DFW, and DWR to discuss comments on and changes to the draft biological assessment.

February 25, 2013: The Corps initiated section 7 consultation with the Service.

BIOLOGICAL OPINION

Description of the Action

DWR is proposing to implement a program to improve current erosion repair practices, and thus maintain the necessary level of flood risk reduction while seeking to minimize and in some cases benefit aquatic and terrestrial fish and wildlife resources, including habitat for sensitive species. As part of the program, DWR and the SERP Subcommittee of the Interagency Flood Collaborative Group have developed the SERP Manual (Appendix A), which describes the various elements of the program. Programmatic permits and project approvals are being requested from the Corps, Service, NMFS, DFW, and the Central Valley Regional Water Quality Control Board (RWQCB), all of which are partner agencies on the subcommittee and currently responsible for permitting individual erosion repair projects.

Identification and Characterization of Erosion Repair Projects - Implementation of SERP will begin with DWR maintenance staff conducting annual maintenance surveys each spring to identify small erosion sites. DWR engineering, environmental, and archaeological staff members will conduct a baseline assessment at each site and complete a Baseline Assessment Checklist (see Section B of the SERP Manual in Appendix A). The completed checklist will include information about existing soil, levee, and vegetation conditions and potential habitat for special-status species at the site.

A maximum of 15 individual repair projects will be implemented annually under the SERP. To ensure that SERP projects are unconnected, single, and complete actions (and not part of a larger action that will exceed SERP's size and placement limits), each project must demonstrate independent utility. A SERP project will be considered to have independent utility if it will be constructed absent the construction of other projects in the project area.

Potential SERP repairs will be categorized into two tiers based on the size of the project disturbance area. The Tier 1 site definition is as follows:

> *A site can be considered for Tier 1 if the footprint of new bank protection materials, including any additional vegetated area that will be disturbed by equipment during construction, is 0.1 acre or less with a maximum linear foot limit of 264 feet. A separation of 500 feet between sites repaired in the same year is required.*

The Tier 2 site definition is as follows:

> *A site can be considered for Tier 2 if the footprint of new bank protection materials, including any additional vegetated area that will be disturbed by equipment during construction, is 0.5 acre or less with a maximum linear foot limit of 1,000 feet.*

For each proposed site, DWR will select as a guide one of the seven SERP design templates created by the collaborating agencies (see Section C of Appendix A) to apply to the site. For purposes of this biological opinion, DWR and the Service are assuming that all sites constructed in a given year will be Tier 2 sites, thus the maximum amount of erosion repair that could be done in any given year will be 15,000 linear feet and 7.5 acres.

DWR will notify the applicable permitting agencies - Corps, Service, NMFS, DFW, the Central Valley RWQCB, and the Central Valley Flood Protection Board (CVFPB) – of the proposed small erosion repair projects by bundling and submitting the required notification materials for up to 15 projects to the agencies as a package each spring (by June 1). The notification package (see the SERP Project Pre-construction Notification Form in Section F of Appendix A) will include documentation that each site is consistent with the findings and parameters of this project description and the SERP Manual. Upon receipt of the annual notification package, the Service will review the projects and determine whether the projects qualify under this SERP biological opinion. If so, the resource agencies will respond with their agreement and DWR may proceed with the repairs in accordance with the applicable conservation measures. This process should shorten the permitting time frame for those projects qualifying for SERP authorization, allowing for timely implementation of the necessary repairs while providing full consideration and protection of environmental resources.

Each repair will also be entered into a geographic information system database developed by DWR to monitor the progress of the SERP. The database will be made available to the Service.

<u>Construction Process, Staging, Sequencing, and Equipment</u> - Construction activities will take place at individual sites throughout each summer and fall during the 5-year project life. Each site

will require no more than 1–4 weeks of active construction, not including revegetation (e.g., planting of willow stakes). All work will take place during daylight hours, and no nighttime lighting will be required. Heavy equipment and vehicles used during construction may include the following:

- a large bulldozer(s),
- trucks (pick-ups, end dumps, flatbeds, water trucks, and hydroseeders),
- a small bulldozer(s),
- a barge with crane,
- a cement mixer with extended arm (for use in depositing soil), and
- excavators.

Site preparation will consist of manual vegetation removal and trimming. The site will have some minor grading to allow access to the lower portion of the site and facilitate rock placement. A trench will be constructed and filled with rock at the toe of the rock prism. This will allow for rock to be placed and keep it within the repair section. Revetment will be placed by cranes mounted on barges or, in locations where this is not possible, from adjacent landside areas using excavators. A cement mixer with an extended arm could be used to deliver soil where the design template calls for soil to be intermixed with rock in the repair. This will be compacted to allow soil to fill as many of the voids as possible while still allowing for root penetration. Waterside placement of rock will occur where it minimizes noise, traffic, and vegetation disturbances. The construction contractor or DWR maintenance yards will use adjacent disturbed landside areas, maintenance toe roads, or the crown roads for staging of vehicles, plant materials, and other associated construction equipment, as necessary. Staging areas will be no more than 0.5 acre in size.

Bank reconstruction will, in most cases, incorporate plantings into the revetment in accordance with the bioengineering techniques outlined in the program design templates (see Section C of the Appendix A). The upper bank will be seeded and may be covered with biodegradable materials to control erosion and stabilize the bank. Willow cuttings and other native vegetation will be installed during placement of the revetment or after construction during the appropriate planting season.

<u>Maintenance</u> - The templates have been designed with the intent that once repaired, the erosion sites will require little or no additional upkeep or maintenance. During the initial vegetation establishment period, maintenance activities for planted areas are anticipated to include removing invasive vegetation, pruning planted vegetation to comply with Corps vegetation management requirements for levees, and replacing dead plantings. Once the final success criteria are achieved, the vegetation should be self-maintaining. Maintenance activities that focus on maintaining restoration plantings, in particular woody vegetation plantings, will be conducted for 5 years or longer as necessary until the final success criteria are met. DWR will be responsible for establishing and maintaining healthy plantings, in accordance with the monitoring and success criteria section of the SERP Manual (Appendix A), including meeting specific success criteria for vegetation establishment.

Design Alternatives - To maintain the Sacramento River Flood Control Project (SRFCP) levee system, erosion repairs are needed on a continual basis. The following seven design templates will be used when designing SERP repair sites:

1. Bank fill rock slope with live pole planting
2. Willow wattle with rock toe
3. Branch layering
4. Rock toe with live pole planting
5. Soil and rock fill at the base of a fallen tree (including root wad revetment option)
6. Bank fill rock slope with native grass planting
7. Bank fill rock slope with emergent vegetation planting.

Plans and descriptions of the seven design templates are included in Section C of the SERP Manual (Appendix A).

A site-specific cross-section, plan view, and planting plan/species list will be developed for each SERP project based on the design template selected for the repair. This information will be provided to the agencies along with the project notification materials in the annual SERP notification packages. The site-specific design plans will be prepared as a coordinated effort by DWR maintenance, engineering, and environmental staff and will show plan view details (e.g., spacing, location, depth). Minor changes to the program design templates may be recommended for specific projects based on detailed knowledge of the sites.

Monitoring and Success Criteria - Through application of the seven design templates, or bioengineering erosion control methodologies, SERP projects are intended to off-set the effects to biological resources. SERP project sites will be considered successful if the establishment of plantings incorporated into the project design restores or enhances the biological function of the existing conditions at the erosion sites.

Monitoring and reporting requirements and success criteria for SERP projects are presented in Section H of the SERP Manual (Appendix A). Monitoring of individual repair sites will be conducted for 5 years, or longer as necessary, until the final success criteria are achieved and the agencies have provided written approval. An annual report package that includes the monitoring results from multiple SERP project sites will be submitted to the Service by November 30 of each year. The information in the reports will be used to assess progress toward meeting the annual performance goals and final success criteria and will include recommended remedial actions to address any performance shortfalls.

Pre- and post-construction site visits from Service personnel may occur at any time to determine the effectiveness of this program and whether contingency actions and/or adjustments to the established success criteria should be made. Success of the design templates will be a key factor in determining whether the SERP is extended beyond these initial 5 years.

Conservation Measures

Measures have been identified that will be applicable to all SERP project sites, including timing restrictions to avoid work during key life history stages of various special-status species, measures to avoid vegetation and habitat disturbance, hazard prevention measures, erosion control measures, and other mandatory construction measures.

Resource-specific conservation measures have also been developed by the SERP Subcommittee for the following resources, species, and habitats:

- sensitive biological resources,
- giant garter snake habitat,
- valley elderberry longhorn beetle,
- delta smelt,
- Swainson's hawk,
- burrowing owl,
- bank swallow,
- nesting birds/migratory birds,
- raptors,
- woody shaded riverine habitat, and
- cultural resources.

As part of the project notification materials, DWR will select and include a list of those resource-specific and, if appropriate, supplemental conservation measures that are applicable to a specific site, and the permitting agencies will have an opportunity to revise the list for each project.

Measures that will apply to all projects are identified and listed below. Resource-specific measures are also provided and will be applied as determined necessary by DWR in coordination with the Service, DFW, NMFS, and any other appropriate agencies. Resource-specific measures applied to each particular project will be listed on the project notification form included in Section F, "Notification Requirements," of the SERP Manual (see Appendix A). In completing the notification form, DWR will reference the applicable numbers for the resource-specific conservation measures and will provide the text of the referenced measures. The only exception to this practice will be for the conservation measures that will be applied to all SERP projects. If DWR proposes implementation of conservation measures not identified in this manual, those measures will be labeled as "Supplemental Conservation Measures" on the project notification form for clarification to the SERP agencies.

Upon receipt of a SERP project notification, agency staff will review the conservation measures listed on the notification form and respond to DWR with any additional conservation measures required for project authorization by their agency.

Mandatory Conservation Measures to Be Applied to All SERP Projects

The following measures will apply to all SERP projects unless deletion or revision of a measure is approved in writing by all the agencies. Revised conservation measures will be listed as "Supplemental Conservation Measures" on the project notification form.

Timing Restrictions

- **Region 1: Delta–Sacramento River and Major Tributaries River Mile (RM) 0 to RM 60**

  Major tributaries include:
  - Putah Creek from the Yolo Bypass to the upstream limit of the SRFCP levees,
  - Sacramento Bypass,
  - portions of Sacramento River downstream of RM 60, and
  - Yolo Bypass as identified in Figure 1.

CM-1(a) All in-water construction will occur from August 1 to November 30. The time period for completing work outside the active stream channel is April 15 to October 15 (dates determined by SERP agency collaboration).

- **Region 2: Mainstem Sacramento River and Major Tributaries RM 60 to RM 143**

  Major tributaries include:
  - Butte Creek,
  - Cherokee Canal,
  - Colusa Bypass,
  - northern portion of Colusa Main Drain as identified in Exhibit 3-1,
  - portions of Feather River as identified in Exhibit 3-1,
  - portions of Sacramento River between RM 60 and RM 143,
  - Sutter Bypass,
  - Tisdale Bypass,
  - Wadsworth Canal, and
  - East and West Interceptor Canals.

CM-1(b) All in-water construction will occur from July 1 to October 15. With rare exception, no extensions will be granted on this timing window. The time period for completing work outside the active stream channel is April 15 to October 15 (dates determined by SERP agency collaboration). Note that for projects occurring within 200 feet of drainage or irrigation canals that may support giant garter snake, conservation measure GGS-6, which stipulates that all project work be completed May 1 to October 1, may be applicable as determined through coordination with the Service.

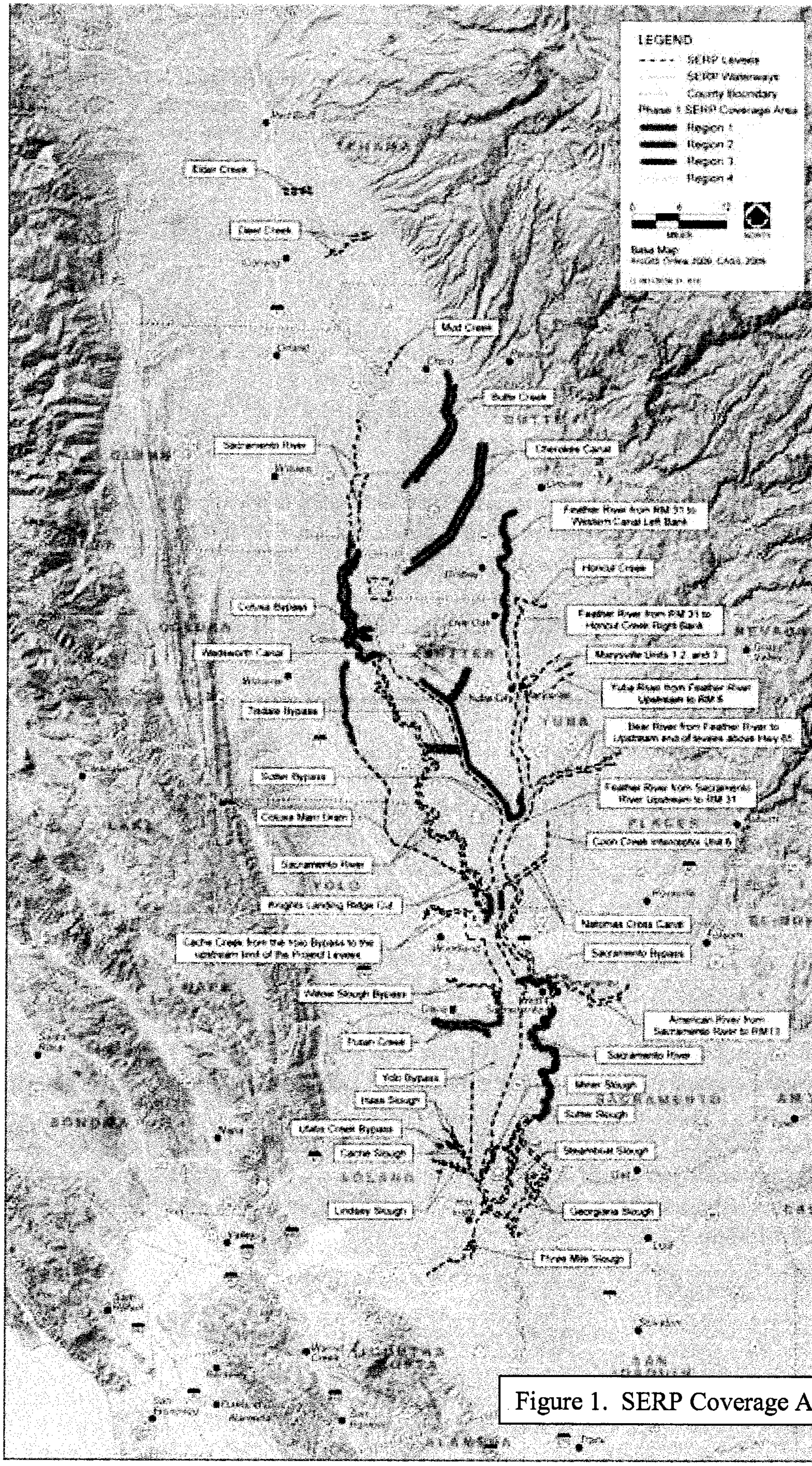


Figure 1. SERP Coverage Area

- **Region 3: Upper Sacramento and Major Tributaries RM 143 to RM 194**
  Major tributaries include:
  - Portions of the Sacramento River between RM 143 and RM 194.

CM-1(c) All in-water construction will occur from July 1 to August 31. The time period for completing work outside the active stream channel is April 15 to October 15 (dates determined by SERP agency collaboration).

- **Region 4: Nonanadromous SERP Waterways Including:**
  - Willow Slough Bypass and
  - Cache Creek from the Yolo Bypass to the upstream limit of the SRFCP levees.

CM-1(d) All in-water construction will occur from April 15 to October 1. The time period for completing work outside the active stream channel is April 15 to October 15 (dates determined by SERP agency collaboration). Note that for projects occurring within 200 feet of drainage or irrigation canals that may support giant garter snake, conservation measure GGS-6, which stipulates that all project work be completed May 1 to October 1, may be applicable as determined through coordination with the Service.

CM-1(e) All work within the floodway will occur from April 15 to November 1. The CVFPB, on prior written request, may allow work to be done during flood season within the floodway, provided that in the judgment of the CVFPB, forecasts for weather and river conditions are favorable. For SERP, this written request may be in the form of an e-mail request. Revegetation and erosion control work that do not involve the use of heavy equipment are not confined to the above timing windows.

CM-2 Requests for extensions on the above timing windows may be considered by the SERP agencies on a project-by-project basis upon written request from DWR. Requests for timing extensions must include a justification for the request and any additional information deemed necessary by the agencies. Modifications to the established timing windows may be made only with written concurrence from the Service and other resource agencies.

CM-3 Construction activities will be timed to avoid precipitation and increases in stream flow. If there is a chance of rain within 48 hours, the project site will be prepared with adequate erosion control measures to protect against wind and water erosion. Within 24 hours of any predicted storm event, construction activities within the stream zone will cease until all reasonable erosion control measures, inside and outside of the stream zone, have been implemented.

Other Restrictions

CM-4 Disturbance to existing grades and native vegetation will be limited to the actual site of the project, necessary access routes, and staging areas. The number of access routes, the size of staging areas, and the total area of the project activity will be limited to the minimum necessary to achieve the project goal. All roads, staging areas, and other facilities will be placed to avoid and limit disturbance to streambank or stream channel habitat as much as possible. When possible, existing ingress or egress points will be used and/or work will be performed from the top of the levee or from barges on the waterside of the project levee. Following completion of the work, the contours of the river bed and river flows will be returned to preconstruction conditions or improved to provide increased biological functions.

CM-5 If removal of vegetation is required within project access or staging areas, the disturbed areas will be replanted with native species and monitored and maintained to ensure the revegetation effort is successful.

CM-6 If erosion control fabrics are used in revegetated areas; they will be slit in appropriate locations as necessary to allow for plant root growth.

CM-7 To minimize ground and vegetation disturbance during project construction, prior to beginning project activities, DWR will establish and clearly mark the project limits, including the boundaries of designated equipment staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; and equipment exclusion zones.

CM-8 Disturbance or removal of vegetation will not exceed the minimum necessary to complete operations. Except for the trees specifically identified for removal in the notification, no native trees with a trunk diameter at breast height in excess of three (3) inches will be removed or damaged without prior consultation with and approval by a Service, NMFS, and DFW representative. Using hand tools (e.g., clippers, chain saw), trees may be trimmed to the extent necessary to gain access to the work sites. Work will be done in a manner that ensures that, to the extent feasible, living native riparian vegetation within the vegetation-clearing zones is avoided and left undisturbed where this can reasonably be accomplished without compromising basic engineering design and safety.

CM-9 The amount of rock riprap and other materials used for bank protection will be limited to the minimum needed for erosion protection.

CM-10 All invasive species (e.g., giant reed, *Arundo donax*) will be completely removed from the project site, destroyed using approved protocols, and disposed of in an appropriate upland disposal area.

CM-11 All pesticides/herbicides (pesticides) used to control nonnative vegetation will be used in accordance with label directions. Methods and materials used for herbicide application will be in accordance with DWR's most current guidelines on herbicide use and with laws and regulations administered by the Department of Pesticide Regulation.

NOTE: Improper application of any pesticides near water can affect fish species and may result in "take" of protected fish as defined under the ESA. To aid in protection of these species, NMFS emphasizes caution and awareness of the following when working near water:

- Label is the law: read and follow the pesticide label.
- Check wind/weather conditions hourly (minimum) or at any observed change.
- Avoid drift: wind can cause drift; adhere to label requirements for wind speed.
- Do not allow spray to drift off target.

- Avoid spraying over or in the water.
- When spraying near the water's edge, spray should be directed away from the water toward the targeted plant.
- Keep all sprayed materials out of the water.
- Use caution and be aware of adjoining areas with potential liability as listed on any attachments.

CM-12 Construction materials such as portable equipment, vehicles, and supplies, including chemicals, will be stored at designated construction staging areas and on barges, exclusive of any riparian or wetland areas.

CM-13 Barges will be used to stage equipment and construct the project when practical to reduce noise and traffic disturbances and effects on existing landside vegetation. When barge use is not practical, construction equipment and plant materials will be staged in designated landside areas adjacent to the project sites. Existing staging sites, maintenance toe roads, and crown roads will be used to the maximum extent possible for project staging and access to avoid affecting previously undisturbed areas.

CM-14 Stockpiling of soil and grading spoils will occur in designated areas on the landside of the levee reaches or on offshore barges. Sediment barriers (e.g., silt fences, fiber rolls, straw bales) will be installed around the base of stockpiles to intercept runoff and sediment during storm events. If necessary, stockpiles will be covered to provide further protection against wind and water erosion.

CM-15 There will be no site dewatering activities, including temporary diversion of flows around the work area unless deemed necessary by the Service and DFW to avoid impacts to giant garter snake. (NOTE: If dewatering is deemed necessary by the Service and DFW, dewatering activities must be conducted in a manner that does not result in the discharge of fill material into waters of the United States or waters of the State).

CM- 16 Erosion control measures (best management practices) that minimize soil or sediment from entering waterways and wetlands will be installed, monitored for effectiveness, and maintained throughout construction operations.

CM-17 If use of erosion control fabrics is necessary, only non-monofilament, wildlife-safe fabrics will be used.

CM-18 DWR will ensure sand, sediment, or sediment-water slurry does not enter the stream channel.

CM-19 No material will be placed in a manner that or location where it can be eroded by normal or expected high flows. Jute netting or another non-monofilament erosion control fabric will be used to cover soil that is placed over or mixed into riprap or other revetment materials.

CM-20 Adequate erosion control supplies (e.g., gravel, straw bales, and shovels) will be kept at all construction sites during all construction and maintenance activities to ensure that sand and sediments are kept out of any water bodies.

CM-21 Precautions to minimize turbidity/siltation will be taken into account during project planning and will be implemented at the time of construction. This may require placing silt fencing, well-anchored sandbag cofferdams, coir logs, coir rolls, straw bale dikes, or other siltation barriers so that silt and/or other deleterious materials are not allowed to erode into downstream reaches. These barriers will be placed at all locations where the likelihood of sediment input exists and will be in place during construction activities, and afterward if necessary. If any sediment barrier fails to retain sediment, corrective measures will be taken immediately. The sediment barrier(s) will be maintained in good operating condition throughout the construction period and, if necessary, the following rainy season. Maintenance includes, but is not limited to, removing or replacing these barriers. DWR is responsible for removing non-biodegradable silt barriers (such as plastic silt fencing) after the disturbed areas have been stabilized with vegetation (usually after the first growing season). Upon determination by any of the SERP agencies that turbidity/siltation levels resulting from project-related activities constitute a threat to aquatic life, activities associated with the turbidity/siltation will be halted until effective control devices approved by the determining agency are installed or abatement procedures are initiated.

CM-22 DWR will inspect performance of sediment control barriers at least once each day during construction to ensure they are functioning properly. Should a control barrier not function effectively, it will be immediately repaired or replaced. Additional controls will be installed as necessary.

CM-23 Sediment will be removed from sediment control barriers once the sediment has reached one-third of the exposed height of the control. Sediment collected in these devices will be disposed of away from the collection site at designated upland disposal sites. The location of the sediment disposal site for the project will be shown on the site plan diagram submitted to the SERP agencies with the project notification.

CM-24 All disturbed soils will undergo appropriate erosion control treatment (e.g., sterile straw mulching, seeding, planting) prior to the end of the construction season, or prior to October 15th, whichever comes first.

CM-25 All debris, sediment, rubbish, vegetation, or other material removed from the project site or access or staging areas will be disposed of at an approved disposal site. There will be no sidecasting of material into any waterway.

CM-26 All work pads and other construction items will be removed upon project completion.

CM-27 Upon completion of the construction phase and installation of erosion control materials, the work area within the stream zone will be digitally photographed to document the completed state of the repair site.

CM-28 DWR will exercise every reasonable precaution to protect streams and other waters from pollution with fuels, oils, bitumens, calcium chloride, and other harmful materials.

CM-29 Petroleum products, chemicals, fresh cement, and construction by-products containing, or water contaminated by, any such materials will not be allowed to enter flowing waters and will be collected and transported to an authorized upland disposal area. DWR will identify the location of the hazardous materials disposal site as part of the project description information contained in the project notification.

CM-30 Gas, oil, or other petroleum products, or any other substances that could be hazardous to aquatic life and resulting from project-related activities will be prevented from contaminating the soil and/or entering waters of the State and/or waters of the United States. Any of these materials placed by DWR or any party working under contract or with the permission of DWR below the ordinary high-water mark (OHWM) or within the adjacent riparian zone, or where they may enter these areas, will be removed immediately. In the event of a spill, work will stop immediately and the Service, DFW, Central Valley RWQCB, NMFS, and Corps will be notified within 24 hours. DWR will implement the spill prevention and control plan and consult with these agencies regarding any additional cleanup procedures. Any such spills, and the success of the cleanup efforts, will also be reported in an incident report prepared for the project and submitted to the SERP agencies.

CM-31 Safer alternative products (such as biodegradable hydraulic fluids) will be used where feasible.

CM-32 A written spill prevention and control plan (SPCP) will be prepared, and the SPCP and all material necessary for its implementation will be accessible on-site prior to initiation of project construction and throughout the construction period. The SPCP will include a plan for the emergency cleanup of any spills of fuel or other material. Employees will be provided the necessary information from the SPCP to prevent or reduce the discharge of pollutants from construction activities to waters and to use the appropriate measures should a spill occur.

CM-33 No solid petroleum products, such as asphalt, will be used.

CM-34 No concrete or similar rubble will be used.

CM-35 Construction vehicles and equipment will be properly maintained to prevent contamination of soil or water from external grease and oil or from leaking hydraulic fluid, fuel, oil, and grease.

CM-36 Heavy equipment will be checked daily for leaks. If leaks are found, the equipment will be removed from the site and will not be used until the leaks are repaired.

CM-37 Equipment other than barges will be refueled and serviced at designated refueling and staging sites located on the crown or landside of the levee and at least 50 feet from active stream channels or other water bodies. All refueling, maintenance, and staging of equipment and vehicles will be conducted in a location where a spill will not drain directly toward aquatic habitat. Appropriate containment materials will be installed to collect any discharge, and adequate materials for spill cleanup will be maintained on-site throughout the construction period.

CM-38 Storage areas for construction material that contains hazardous or potentially toxic materials will have an impermeable membrane between the ground and the hazardous material and will be bermed to prevent the discharge of pollutants to groundwater and runoff water.

CM-39 Water (e.g., trucks, portable pumps with hoses) will be used to control fugitive dust during temporary access road construction.

CM-40 All materials placed in streams, rivers or other waters will be nontoxic. Any combination of wood, plastic, cured concrete, steel pilings, or other materials used for in-channel structures will not contain coatings or treatments or consist of substances deleterious to aquatic organisms that may leach into the surrounding environment in amounts harmful to aquatic organisms.

CM-41 No materials will be placed in any location or in any manner that will impair the flow of surface water into or out of any wetland area.
CM-42 No fill material other than silt-free gravel or riprap will be allowed to enter the live stream.

CM-43 Water containing mud or silt from construction activities will be treated by filtration, or retention in a settling pond, adequate to prevent muddy water from entering live streams.

CM-44 Screens will be installed on water pump intakes as directed by NMFS salmonid-screening specifications. Where delta smelt may be present, the intake for water pumps must meet a 0.2 feet per second approach velocity standard.

CM-45 All litter, debris, unused materials, equipment, and supplies that cannot reasonably be secured will be removed daily from the project work area and deposited at an appropriate disposal or storage site. All trash and construction debris will be removed from the work area immediately upon project completion.

<u>Resource-Specific Conservation Measures to Be Applied as Necessary to SERP Projects</u>
The following measures are resource-specific and will be applied to SERP projects as determined necessary by DWR in coordination with the appropriate SERP agencies. DWR will identify and list the applicable resource-specific measures for each project on the project notification form, which is included in Section F of the SERP Manual (Appendix A). Any conservation measures that are changed will be listed as "Supplemental Conservation Measures" on the project notification forms.

Sensitive Biological Resources

SBR-1 A qualified biologist will provide environmental awareness training to workers before project activities begin and will be the on-site biological monitor. The awareness training will include a description of the relevant species and their habitats that are known to occur in the project vicinity and will describe the guidelines that will be followed by all construction personnel to avoid impacts on the species during project activities. A set of guidelines will be provided to the DWR maintenance crew foreman or contractor(s) participating in the project, and the crew foreman and on-site biological monitor will be responsible for ensuring that crew members comply with the guidelines.

SBR-2 Construction barrier fencing or stakes and flags will be placed around sensitive biological resources located in and within the project site boundaries and will remain in place until all project work involving heavy equipment is complete to ensure that construction activities avoid disturbing these resources. The size of the fenced buffer area will be determined on a project-specific basis through coordination with DFW, the Service and/or other relevant resource or regulatory agencies.

SBR-3 A qualified biologist will monitor all construction activities in and within 100 feet of the project site boundaries to ensure that no unauthorized activities occur within the project area. The 100-foot distance may be increased at the direction of the Service or other agency representative. The biological monitor will be empowered to stop construction activities that threaten to cause unanticipated and/or unpermitted project impacts. Project activity will not resume until the conflict has been resolved. DWR will notify the relevant agency(ies) if the stopped project activity is related to a provision of any SERP permit/authorization.

Giant Garter Snake

GGS-1 To the extent possible, construction activities will be avoided 200 feet from the banks of giant garter snake aquatic habitat, including marshes, sloughs, ponds, irrigation canals, drainage ditches, flooded rice fields, and associated uplands. Movement of heavy equipment in these areas will be confined to existing roadways, where feasible, to minimize habitat disturbance.

GGS-2 Vegetation clearing will be confined to the minimal area necessary to facilitate construction activities. Giant garter snake habitat, including marshes, sloughs, ponds, irrigation canals, drainage ditches, and flooded rice fields, adjacent to the project site will be flagged and designated as environmentally sensitive areas. These areas will be avoided by all construction personnel.

GGS-3 Work crews and contractors will be given environmental awareness training before beginning work on the project site. This training will instruct workers to recognize giant garter snake and their habitats and explain the penalties of noncompliance with the giant garter snake conservation measures.

GGS-4 No more than 24 hours prior to construction activities, the project area will be surveyed for giant garter snake by a qualified biologist. Surveys will cover all upland habitat within 200 feet of giant garter snake aquatic habitat, and will be repeated if a lapse in construction activity of 2 weeks or greater occurs. If construction activities are proposed within aquatic habitat, a qualified biologist will determine whether the habitat can support giant garter snake and, if so, implement measures to exclude giant garter snake from the work area (NOTE: Dewatering must be conducted in a manner that does not result in the discharge of fill material into waters of the United States or waters of the State). A giant garter snake-exclusion plan can include measures such as installation of a snake exclusion fence or dewatering the work area. Any proposed giant garter snake-exclusion plan will be reviewed and approved by DFW, Service, and NMFS before implementation. If a giant garter snake is encountered during construction, activities will cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed. DWR will report any sighting and/or any incidental take to the Service immediately by telephone at (916) 414-6600 and to DFW at (916) 358-4353.

GGS-5 Any temporary fill and construction debris will be removed after completion of construction activities, and, wherever feasible, disturbed areas will be restored to preproject conditions. Restoration work may include replanting banks or emergent vegetation in the active channel. Restoration work beyond what is approved under the SERP must be approved by Service prior to implementation.

GGS-6 All construction activity within giant garter snake habitat, including marshes, sloughs, ponds, irrigation canals, drainage ditches, and flooded rice fields and the aquatic habitats associated uplands, will occur from May 1 to October 1. This includes in-water construction and work outside the active stream channel.

GGS-7 For sites where the erosion repair will disturb the slope transition between potential giant garter snake aquatic habitat and upland habitat, an environmental scientist will prepare documentation for the SERP notification package, including an assessment of levee vegetation and substrate at the erosion site and 500 feet upstream and downstream. Where feasible, the assessment also will include a determination of the flood elevation on the levee slope. Based on this assessment, DWR will coordinate with DFW and the Service to avoid loss of potential giant garter snake overwintering habitat.

Valley Elderberry Longhorn Beetle

VELB-1 DWR work crews and contractors will be given environmental awareness training that will emphasize the identification of elderberry shrubs, the need to avoid damaging the elderberry shrubs, and the possible penalties of noncompliance with the conservation measures below.

VELB-2 Signs will be erected every 50 feet along the edge of elderberry avoidance areas. The signs will include 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." The signs must be clearly readable from a distance of 20 feet and will be maintained throughout the construction period.

VELB-3 Avoidance areas for valley elderberry longhorn beetle will be temporarily fenced or flagged to serve as a visual boundary and keep people, vehicles, and other sources of disturbance from crossing into the area.

VELB-4 No insecticides, herbicides, fertilizers, or other chemicals that might harm the elderberry shrub or beetle will be used within 100 feet of any elderberry shrub having one or more stems measuring 1.0 inch or greater in diameter at ground level unless written approval for encroachment within the 100-foot buffer has been secured from Service. For projects where the application of insecticides, herbicides, fertilizers, or other chemicals may encroach upon the 100-foot buffer from an elderberry shrub, a description of that encroachment, including methods of application and chemicals to be used, will be specified in the project description section of the project notification form (Section F, "Notification Requirements"), for Service review and approval.

VELB-5 Where possible DWR will maintain a 100-foot (or wider) buffer around elderberry plants. In circumstances where a smaller buffer is necessary, DWR will create as large a buffer as possible with none of the work encroaching on the dripline of the elderberry shrub. A biological monitor will be on-site to ensure that no take of the beetle or damage to its habitat occurs when work is within 20 feet of the elderberry shrub dripline. Erosion controls will be installed and revegetation with appropriate native seed or plants will be completed on the disturbed areas.

VELB-6 DWR will avoid working within 100 feet of an elderberry shrub during the flight season of the valley elderberry longhorn beetle (March 15 through June 15). If work during the flight season becomes necessary, DWR will coordinate with the Service to determine if the project avoids effects to the valley elderberry longhorn beetle.

Delta Smelt

DS-1 DWR work crews and contractors will be given environmental awareness training that will emphasize the identification of delta smelt, their habitat needs, and the possible penalties of working outside of the delta smelt work window.

Woody Shaded Riverine Habitat

WSRH-1 All remaining, shaded riverine aquatic (SRA) habitat will be avoided or preserved to the maximum extent practicable.

WSRH-2 Woody riparian and SRA habitat will be replaced at a 3:1 ratio on an area or linear-foot basis, as determined appropriate by DWR in coordination with NMFS.

WSRH-3 Species chosen for replanting will reflect native species lost during the permitted activity or native species usually found in the riparian and SRA zones of the project location.

WSRH-4 Plantings will be installed during the optimal season for the species being planted. Therefore, completion of the planting effort may not occur at the same time as the erosion repair activity .

WSRH-5 Maintenance of revegetated sites will continue for at least three growing seasons to allow the vegetation to establish. Maintenance will be continued as necessary until the final performance criteria are met.

Nesting Birds/Migratory Birds

NB-1 It is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird except as otherwise provided by the Fish and Game Code. Without prior consultation and approval of a DFW representative, no trees that contain active nests of birds will be disturbed until all eggs have hatched and young birds have fledged. Under the Migratory Bird Treaty Act (MBTA), it is unlawful to pursue, hunt, attempt to take, take, capture, or kill, any migratory bird, or possess any part, nest, or eggs of any such bird. Because incidental take coverage is not authorized under the MBTA, incidental take of a migratory bird should be avoided. If it is necessary to remove trees for purposes of the project, it is recommended that the trees that are identified for removal be removed during the non-nesting period of August 31 to February 1. If tree removal must occur during the period of February 1 to August 31, a qualified biologist will conduct a preconstruction survey for bird nests or nesting activity within 500 feet of the project boundaries. If any active nests or nesting behaviors are found, DFW and the Service will be notified before further action. DWR may be required to create exclusion zones of between 75 feet and 0.25 mile, depending on the species observed. The exclusion zone will be maintained until birds have fledged or the nest is abandoned. The survey results will be provided to DFW and the Service before removal of any trees.

Description of Action Area

The Sacramento River's hydrology has been altered by dam, weir, and levee construction. The flood management facilities that DWR maintains are located within the valley floor of the watershed. The valley drainages include the Feather River, American River, Sutter Bypass, Yolo Bypass, and Sacramento River. Local maintaining agencies (LMA), including DWR's maintenance yards, maintain the levees along the waterways listed below. Only DWR's maintenance yard managed areas within the waterways below will be eligible for inclusion in the SERP. The initial focus (Phase 1) of the SERP represents approximately 300 miles of levees (in four separate regions) maintained exclusively by DWR and represents an initial 5-year effort. Following the Phase 1 implementation period, the program's success will be evaluated and, if warranted, SERP may be extended and expanded in the future (following additional environmental review) to include other sites, outside those in the Phase 1 SERP coverage area (i.e., the action area) that will be repaired by the LMA throughout the Sacramento–San Joaquin Drainage District.

The term "levees" as used in this document is broadly defined to include levees and associated waterside slopes within the levee prism that are part of the SRFCP and addressed in operations and maintenance manuals for identified flood management facilities maintained by DWR or other LMA.

The Phase 1 SERP coverage area includes all or portions of the following waterways:
Butte Creek,
Cache Creek from the Yolo Bypass to the upstream limit of the SRFCP levees,
Cherokee Canal,
Colusa Bypass,
Colusa Main Drain (Figure 1),
Feather River (Figure 1),
Putah Creek from the Yolo Bypass to the upstream limit of the SRFCP levees,
Sacramento Bypass,
Sacramento River (Figure 1),
Sutter Bypass,
Tisdale Bypass,
Wadsworth Canal,
Willow Slough Bypass,
Yolo Bypass (Figure 1), and
East and West Interceptor Canals.

Notification Package

In March of each year, DWR will provide the Service with a list of sites that they will be evaluating the potential of including in the annual packet. This early list will allow the Service an opportunity to review potential sites and work with DWR in developing the list of species and site specific conservation measures. A completed notification packet will be provided to the Service no later than June 1. Projects included in the packet will be consistent with the project description given above and consistent with the following criteria:

1. Effects to delta smelt habitat will be temporary, no more than 4,500 linear feet/2.25 acres of delta smelt channel margin will be disturbed per year.

2. Effects to giant garter snake habitat will be temporary and no more than 7.5 acres of habitat will be disturbed per year.

3. Elderberry shrubs will be avoided and work will not occur during the flight season of the valley elderberry longhorn beetle, therefore effects to the valley elderberry longhorn beetle will be avoided.

Sites within the packet will be considered for inclusion in this biological opinion if the Service finds that the effects are similar to those described herein. Sites that do not match with the effects described within this biological opinion will not be included and the Service will alert DWR of these sites and the reasons they do not fit within the biological opinion. The following will be included in the yearly package provided to the Service:

1. Completed Notification Form which includes maps of the sites, design cross sections, project description, habitat descriptions, and discussion of effects to federally-listed species.

2. Discussion of monitoring data for previously constructed sites, including any remediation that may be needed and a discussion of how it will be accomplished.

3. List of Conservation Measures that will be followed for each site.

The Service will review new information that may reveal effects not considered previously and review the information provided to determine whether the activity meets the criteria for this biological opinion including whether a separate biological opinion is necessary, and if minimization measures proposed are sufficient. If the Service determines that the sites are appropriate for this biological opinion, the Service will provide a letter to the Corps and DWR concurring with the inclusion of the sites under the biological opinion.

Analytical Framework for the Jeopardy Analysis

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analyses in this biological opinion rely on four components: (1) the *Status of the Species*, which evaluates the giant garter snake's and delta smelt's range-wide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of these listed species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the giant garter snake and delta smelt; and (4) the *Cumulative Effects*, which evaluates the effects of future, non-federal activities in the action area on these species.

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 giant garter snake's and delta smelt's current status, 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 both the survival and recovery of these 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 giant garter snake and delta smelt and the role of the action area in their survival and recovery 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 delta 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 impacts 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) Cummulative 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 the delta 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 delta smelt.

The analysis in this biological opinion places an emphasis on using the intended range-wide recovery function of delta 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* (Service 2012) for the current status of the species.

Delta Smelt

Listing Status- The Service proposed to list the delta smelt (*Hypomesus transpacificus*) as threatened with proposed critical habitat on October 3, 1991 (56 FR 50075). The Service listed the delta smelt as threatened on March 5, 1993 (58 FR 12854), and designated critical habitat for this species on December 19, 1994 (59 FR 65256). The delta 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 delta smelt was completed on March 31, 2004 (Service 2004). The 2004 review affirmed the need to retain the delta smelt as a threatened species. A 12-month finding on a petition to reclassify the delta smelt was completed on April 7, 2010 (75 FR 17667). After reviewing all available scientific and commercial information, the Service determined that re-classifying the delta smelt from a threatened to an endangered species was warranted, but precluded by other higher priority listing actions (Service 2010).

Distribution- The delta 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 delta 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 within the Osmeridae family (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 (*H. transpacificus*) 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) (DFW 2011b) 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 delta smelt spawning is derived from laboratory observations and observations of related smelt species. Delta smelt eggs are 1 mm 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. 2003; Wang 2007). Spawning over gravel or sand can also aid in the oxygenation of delta 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. Lindberg et al. (2003) reported high hatching rates of delta smelt eggs in the laboratory at 15° C, and 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 delta smelt is constrained by mouth gape and status of fin development. Larval delta 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 delta smelt are visual feeders and their ability to see prey in the water is enhanced by turbidity (Baskerville-Bridges et al. 2004). Thus, delta smelt diets are largely comprised of small crustacea that inhabit the estuary's turbid, low-salinity, open-water habitats (i.e., zooplankton). Larval delta 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 delta smelt larvae are largely restricted to the larval stages of these copepods; older, larger life stages of the copepods are increasingly targeted as the delta 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 (ppt) isohaline (X2), where X2 is scaled as the distance in kilometers from the Golden Gate Bridge (Jassby et al. 1995). Young-of-the-year delta 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 long 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 delta 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- DFW conducts several long-term monitoring surveys that have been used to index the relative abundance of delta smelt. The 20-mm Survey (DFW 2011a) has been conducted every year since 1995 and samples April-June, targeting late-stage delta 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 delta smelt. The Fall Midwater Trawl Survey (FMWT) has been conducted nearly every year since 1967, and like the TNS, the survey targets age-0 striped bass but collects delta smelt > 40 mm in length. The FMWT samples from September through December. The delta 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 et al. 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 delta 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 (pers. comm. 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.

It is now recognized that delta smelt abundance plays an important role in subsequent abundance (Bennett 2005; Maunder and Deriso 2011). Bennett (2005) assessed data from DFW'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).

Threats

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 (CVP) and the State Water Project (SWP) 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 FMWT survey were captured at statistically significantly higher salinities than what would 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 (Peggy Lehman, pers comm), and this has been suggested as an explanation for the anomaly in the distribution of delta smelt relative to water salinity levels (Reclamation 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.

Aquatic Macrophytes- 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). Now, 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.

Predators- 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 would 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 2002; 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).

Competition- 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 1995) 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 1986). 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.

Contaminants- 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 (58 FR 65256). The geographic area encompassed by the designation includes all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the existing contiguous waters contained within the legal Delta (as defined in section 12220 of the California Water Code) (Service 1994). 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 psu (parts per thousand salinity) (Kimmerer 2004). The 2 psu isohaline is a specific point within the LSZ where the average daily salinity at the bottom of the water is 2 psu (Jassby eta al. 1995). By local convention the location of the LSZ is described in terms of the distance from the 2 psu

isohaline to the Golden Gate Bridge (X2); 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 2002). 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 the more frequently and further the LSZ moves upstream, toward the confluence.

Environmental Baseline

Giant Garter Snake

The *Draft Recovery Plan for the Giant Garter Snake* (Service 1999) subdivides the range of the species into four recovery units. The action area for the proposed project is located within the Sacramento Valley and Mid-Valley Recovery Units.

The Sacramento Valley Unit includes three populations: (1) Butte Basin, (2) Sutter Basin, and (3) Colusa Basin. These are relatively large, stable populations supported by protected habitat on state and federal wildlife refuges and unprotected habitat in the form of waterways for irrigation and drainage of agricultural lands and rice farming.

The Mid-Valley Recovery Unit includes seven populations, three of which are in the Action Area: (1) American Basin, (2) Yolo Basin-Willow Slough, and (3) Sacramento Area. American Basin includes snakes in the Natomas area as well as in Sutter County which have a mix of protected habitat and unprotected habitat. Snakes have been found in Yolo Basin at Conaway Ranch, the Davis Wetlands Complex, and the Yolo Wildlife Area. These areas are a combination of protected and unprotected lands.

According to the 2012, 5-year review (Service 2012) the abundance and distribution of giant garter snakes has not changed significantly. Within the Action Area (Sacramento Valley and Mid-Valley Recovery Units) habitat loss and fragmentation is the most significant threat to the giant garter snake. Urbanizing areas within the Action Area include Chico, Woodland, Yuba City, Marysville, Sacramento, and West Sacramento. Habitat loss through water transfers and rice fallowing also negatively affects giant garter snakes. In the Sacramento Valley rice has served as a substitute for the large amounts of historical wetlands that used to exist in the Central Valley. Loss of this habitat has been shown to reduce or exclude giant garter snakes compared to areas which are actively irrigated in rice (Wylie et al. 2002a, b, 2004).

Flood control maintenance and agricultural activities can reduce and prevent the establishment of vegetation and burrows needed by the giant garter snake for cover and shelter on canals, levees, and agricultural ditches. This can also reduce the prey base for giant garter snake, affecting their feeding. Additionally, clearing, scraping and/or re-contouring canals, ditches, and levees, destroys burrows and crevices that are used as over-wintering habitat and during the summer to for thermoregulation, shedding, and giving birth. These activities are being conducted by LMA and farmers throughout the Action Area.

Other factors which effect the giant garter snake population in the Action Area include vehicular mortality particularly where canals or aquatic habitat are bordered by roads such as the crown of the levees. Non-native predators such as game fish, bull frogs (*Rana catesbiana*), and domestic cats can affect giant garter snake populations (Service 1999). This can be particularly detrimental to young and juvenile giant garter snakes. All of the Action Area has non-native predators occurring in it.

Areas within the Action Area that will be affected by the SERP will be irrigation or drainage canals adjacent to levees. These areas are important as the snake uses them for feeding, breeding, sheltering, and as movement corridors.

<u>Delta Smelt</u>

The delta smelt's LSZ ecosystem has been changing and has changed very rapidly on several occasions during the past several decades. First, suitable land area was reduced, then water diversions increased, then the temporal overlap of low-salinity water with the best remaining landscape was reduced, then the food web began dramatically changing, then the turbidity delta smelt are assumed to use to see their food as larvae (Baskerville-Bridges et al. 2004) and use to hide from predators at later life stages (sensu Gregory and Levings 1998) lessened. Water temperatures are expected to rise (Dettinger 2005), which can only generate greater areas of stressful or even lethal temperature conditions for longer periods. Modeled future conditions suggest difficult conservation challenges and choices lie ahead (Feyrer et al. 2011; Brown et al. unpublished data 2011). Within the Action Area activities such as flood control maintenance and operation continue to occur and affect delta smelt and their habitat.
The areas within the Action Area that coincide with the range of the delta smelt are either riverine edge habitat or habitat within the Yolo Bypass. Delta smelt use these areas for breeding and foraging. Delta smelt occur in these areas during late winter through summer.

<u>Delta Smelt Critical Habitat</u>

Delta smelt are an open-water, or pelagic, species. They do not associate strongly with structure. They may use nearshore habitats for spawning (PCE #1), but free-swimming life stages mainly occupy offshore waters (PCE #2). Thus, the distribution of the population is strongly influenced by river flows through the estuary (PCE #3) because the quantity of fresh water flowing through the estuary changes the amount and location of suitable low-salinity, open-water habitat (PCE #4). This is true for all life stages. During periods of high river flow into the estuary, delta smelt distribution can transiently extend as far west as the Napa River and San Pablo Bay. Delta smelt distribution is highly constricted near the Sacramento-San Joaquin river confluence during periods of low river flow into the estuary (Feyrer et al. 2007). In the 1994 designation of critical habitat, the best available science held that the delta smelt population was responding to variation in spring X2. In the intervening 14 years, the scientific understanding of delta smelt habitat has improved. The current understanding is that X2 and the combined water flows of the Old River and Middle River both must be considered to manage entrainment and that X2 indexes important habitat characteristics throughout the year.

Alterations to Estuarine Bathymetry (PCE # 1) (~ 1850-present)

The first major change in the LSZ was the conversion of the landscape over which tides oscillate and river flows vary (Nichols et al. 1986). The ancestral Delta was a large tidal marsh-floodplain habitat totaling approximately 300,000 acres. Most of the wetlands were diked and reclaimed for agriculture or other human use by the 1920s. The physical habitat modifications of the Delta and Suisun Bay were mostly due to land reclamation and urbanization. Water conveyance projects and river channelization have had some influence on the regional physical habitat by armoring levees with riprap, building conveyance channels like the Delta Cross Channel, storage reservoirs like Clifton Court Forebay, and by building and operating temporary barriers in the south Delta and permanent gates and water distribution systems in Suisun Marsh.

In the 1930s to 1960s, the shipping channels were dredged deeper (~12 m) 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 Sacramento-San Joaquin river confluence region 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 deeper landscape created to support shipping and flood control requires more freshwater outflow to maintain the LSZ in the large Suisun Bay/river confluence region than was once required (Gartrell 2010).

Seasonal salinity intrusion reduces the temporal overlap of the LSZ (indexed by X2) with the Suisun Bay region, especially in the fall (Feyrer et al. 2007, 2010). Thus, the second major change has been in the frequency with which the LSZ is maintained in Suisun Bay for any given amount of precipitation (CDFG 2010). This metric showed a step-decline 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). As such this alteration of PCE # 1 also affects the other PCEs, particularly PCE # 4. The major landscape factor affecting this interaction was the dredging of shipping channels.

Spawning delta smelt require all four PCEs, but spawners and embryos are the life stage that is believed to most require a specific structural component of habitat. Spawning delta smelt require sandy or small gravel substrates for egg deposition (Bennett 2005). The major invasive species effect on physical habitat is the dense growth of submerged aquatic vegetation in the Delta (described in more detail below). These plants carpet large areas in parts of the Delta such as Frank's Tract. The vegetation beds act as mechanical filters removing turbidity and possibly other water quality components as the tides and river flows move water over them (Hestir 2010). Thus, the proliferation of submerged aquatic plants has likely also reduced the area of nearshore habitat suitable for delta smelt spawning.

Alterations to Water (PCE # 2)

PCE # 2 is primarily referring to a few key water quality components (other than salinity) that influence spawning and rearing habitat suitability for delta smelt. Research to date indicates that water quality conditions are more important than physical habitat conditions for predicting where delta smelt occur (Feyrer et al. 2007; Nobriga et al. 2008) – probably because delta smelt is a pelagic fish except during its egg/embryo stage. However, the interaction of water quality and bathymetry is thought to generally affect estuarine habitat suitability (Peterson 2003) and there is evidence that delta smelt habitat is optimized when appropriate water quality conditions overlap the Suisun Bay region (Moyle et al. 1992; Hobbs et al. 2006; Feyrer et al. 2011). This is discussed further in the section about PCE # 4 (salinity).

Reduced turbidity (1999-present)

The next major change was a change in estuarine turbidity that culminated in an estuary-wide step-decline in 1999 (Schoellhamer 2011). For decades, the turbidity of the modified estuary had been sustained by very large sediment deposits resulting mainly from gold mining in the latter 19th century. The sediments continued to accumulate into the mid-20th century, keeping the water relatively turbid even as sediment loads from the Sacramento River basin declined due to dam and levee construction (Wright and Schoellhamer 2004). The flushing of the sediment deposits may also have made the estuary deeper overall and thus a less suitable nursery from the 'static' bathymetric perspective (Schroeter 2008). Delta smelt larvae require turbidity to initiate feeding (Baskerville-Bridges et al. 2004), and as explained above, older fish are thought to use turbidity as cover from predators. Thus, turbidity is an aspect of PCE # 2 which is a necessary water quality aspect of delta smelt's critical habitat.

Dams and armored levees have contributed to the long-term decline in sediment load to the estuary (Wright and Schoellhamer 2004) and to the clearing of estuary water. This is a long-term effect that stemmed from building and maintaining infrastructure. Opportunities to substantively address this change are limited due to the extreme Central Valley flood and water supply risks that will result from decommissioning dams or removing levees.

Alterations of River Flows (PCE # 3)

This PCE refers to the transport flows that help guide young delta smelt from spawning habitats to rearing habitats, and to flows that guide adult delta smelt from rearing habitats to spawning habitats. Delta outflow also has some influence on delta smelt's supporting food web (Jassby et al. 2002; Kimmerer 2002) and it affects abiotic habitat suitability as well (Feyrer et al. 2007; 2011). The latter is expanded upon in the discussion of PCE # 4. The environmental driver with the strongest influence on PCE # 3 is highly dependent on the time-scale being considered. The tide has the largest influence on flow velocities and directions in delta smelt's critical habitat at very short timescales (minutes to days), whereas interannual variation in precipitation and runoff has the largest influence on flows into and through the Delta at very long timescales (years to decades), and sometimes at shorter time scales (days to weeks) during major storm events. Changes to flow regimes can have the largest influence on PCE #3 at timescales of weeks to seasons. This is particularly true during periods of low natural inflow, for instance during the fall and during droughts, and in the south Delta where Old and Middle River flows are often managed using changes in export flow rates.

Salinity (PCE # 4)

The core delta smelt habitat, is the LSZ (Moyle et al. 1992; Bennett 2005). The LSZ is where freshwater transitions into brackish water, and is defined as the area of the estuary where salinity ranges from 0.5-6.0 psu (parts per thousand salinity; Kimmerer 2004). This area is always moving due to tidal and river flow variation. The 2 psu isohaline is a specific location within the LSZ where the average daily salinity at the bottom of the water is 2 psu (Jassby and others 1995). By local convention, changes in the location of the LSZ are described in terms of the distance from the Golent Gate Bridge to the 2 psu isohaline (X2); X2 is an indicator of habitat suitability for many of the estuary's organisms and it is associated with variance in abundance of diverse components of the ecosystem (Jassby and others 1995; Kimmerer 2002b; Kimmerer and others 2009). The LSZ expands and moves downstream when river flows into the estuary are high (Kimmerer et al. 2009). Similarly, it contracts and moves upstream when river flows are low. During the past 40 years, monthly average X2 has varied from as far downstream of San Pablo Bay (45 km) to as far upstream as Rio Vista on the Sacramento River (95 km).

Larval delta smelt tend to reside somewhat landward (upstream) of X2 (Dege and Brown 2004), but the center of juvenile distribution tends to be very near X2 until the fish start making spawning migrations in the winter (Feyrer *et al.* 2011; Sommer *et al.* 2011). Because of this association between the distribution of salinity in the estuary and the distribution of the delta smelt population, the tidal and river flows that comprise PCE #3 affect PCE #4. The expansion and contraction of the LSZ affects the areal extent of abiotic habitat for delta smelt, both during spring (Kimmerer *et al.* 2009) and fall (Feyrer *et al.* 2007; 2011). In the spring, most delta smelt are larvae or young juveniles and the LSZ is typically maintained over the expansive Suisun Bay region. Thus, abiotic habitat "limitation" is unlikely and no consistent influence of spring X2 variation on later stage abundance estimates has been reported to date (Jassby et al. 1995; Bennett 2005; Kimmerer et al. 2009). In fact, historical maxima in juvenile abundance according to DFW's TNS occurred in low outflow years when abiotic habitat area was comparatively low (Kimmerer 2002; Kimmerer *et al.* 2009).

In contrast, during fall delta smelt are late stage juveniles and for the past decade or more, the LSZ has been persistently constricted by low Delta outflow. Fall habitat conditions affect delta smelt distribution and the concurrent FMWT abundance index (Feyrer *et al.* 2007; 2011). However, the quantitative life cycle models developed to date have not found evidence for a year over year effect of fall LSZ location on delta smelt population dynamics (Mac Nally *et al.* 2010; Thompson *et al.* 2010; Deriso 2011).

It is now recognized that some delta smelt occur year-round in the Cache Slough region including the Sacramento Deep Water Shipping Channel and Liberty Island (Kimmerer 2011; Miller 2011; Sommer *et al.* 2011). The latter has been a consistently available habitat only since 1997. This region is often lower in salinity than 0.6 psu – the lower formal limit of the LSZ as defined by

Kimmerer (2004). Delta smelt likely use it because it is one of the most turbid habitats remaining in the Delta (Nobriga *et al.* 2005). A recent population genetic study found no evidence that delta smelt inhabiting this region are unique compared to delta smelt using the LSZ-proper (Fisch *et al.* 2011), therefore it is likely that individual delta smelt migrate between the LSZ and the Cache Slough region. This is consistent with the high summer water temperatures observed there, which might compel individual delta smelt to seek out cooler habitats within and outside the Cache Slough region.

The portions of the Action Area that fall within delta smelt critical habitat include portions of the Sacramento River east levee, south of Sacramento and a small portion of the Yolo Bypass east levee. The action area contains components that can be used for feeding, rearing, and movement.

Effects of the Proposed Action

Giant Garter Snake

For purposes of evaluating the effects of the SERP in this biological opinion, DWR and the Service are assuming a worst cases scenario that all 15 repair sites will occur in giant garter snake habitat. Therefore, the maximum number of sites of the largest size that could be done each year is 15 sites for a total of 7.5 acres affected per year due to erosion control. Additional lands could be affected when used for staging and access. These lands will not be larger than 7.5 acres per year. As described in the project description, areas which will be used for staging will be previously disturbed sites such as levee crown roads, maintenance roads, or heavily compacted soil areas.

Construction activities at the 15 sites per year will affect both aquatic and upland giant garter snake habitat. Construction activities will include clearing the site of existing vegetation, grading the site, placing soil and rock on the site, and planting the site. These activities will occur in both upland and aquatic giant garter snake habitat. Effects include loss of cover and basking sites, filling or crushing of burrows or crevices, obstruction of snake movement, and may result in the direct disturbance, displacement, injury, and/or mortality of snakes. Because giant garter snakes utilize small mammal burrows and soil crevices as retreat sites, they may be crushed, buried, or otherwise injured from construction activities if they are in a burrow during construction. The disturbance from construction activities may also cause giant garter snakes to move into areas of unsuitable habitat where they will experience greater risk of predation or other sources of mortality. Snakes may disperse away from construction across existing paved and unpaved roadways, and could be killed or injured by vehicles or predation. Silting, fill, or spill of oil or other chemicals could cause loss of prey items in adjacent aquatic habitat.

Construction will temporarily affect (1 to 4 weeks) giant garter snake habitat. Upon completion the site will not resemble the pre-project conditions. Post-construction, the site will have a rock substrate of variable depth, some of which will have a soil mixed in to allow for native grasses to grow. Once the grasses establish cover will be restored to the site which will provide giant garter snakes cover from predators. Rock that does not have soil intermixed along the waterline will provide refugia for the snake from predators and for thermoregulation. This will offset the loss of burrows that will result from construction of the project.

Because staging areas will be previously disturbed they are likely only used by the giant garter snake for basking. These sites will be used for a few weeks and once construction is completed will be available to the snake again. Snakes could be crushed due to additional vehicle traffic on the roads, but the temporary use, speed limits, and worker awareness trainings should minimize this effect.

Delta Smelt

Construction effects are expected to be short-term in nature and will be limited to 4,500 linear feet per year within the range of delta smelt. Construction activities can cause increased sedimentation, removal of vegetation which can affect primary productivity and the supply of food items, and release of gasoline, lubricants, or other construction-related toxic substances into the water column. Rock placement may also change the bathymetry of the channel edge.

The primary effect to water quality is the liberation of sediments during placement of riprap and fill. Periods of localized, high suspended sediment concentrations and turbidity owing to channel disturbance can result in a reduction of feeding opportunities for delta smelt, and clogging and abrasion of gill filaments. However, this should be avoided as construction will occur when delta smelt are further downstream in the estuary. Adverse effects on water quality are minimized because DWR will use erosion control measure BMPs to prevent soil or sediment from entering the river. The BMPs will be maintained until all areas disturbed during construction were adequately revegetated and stabilized.

These areas are also highly productive in terms of prey species for delta smelt. All shallow, open water areas existing along the sites will be permanently altered, due to riprap placement. Delta smelt use shallow water habitat for rearing and breeding. Some of the productivity may be effectively replaced by planting with riparian species. Vegetation loss will be compensated for at all sites by on-site plantings.

Delta Smelt Critical Habitat

This opinion on the critical habitat for the delta smelt 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 statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in *Gifford Pinchot Task Force v. U. S. Fish and Wildlife Service* (No. 03-35279) to complete the following analysis with respect to the proposed critical habitat.

Implementation of the proposed project will not affect any of the PCEs as described under the environmental baseline section above. The placement of rock should not affect water quality, flows, or the LSZ. Any loss of shallow water habitat would be minimal in comparison to the size of the Sacramento River and limited on an annual basis. It is expected that planting the sites post-construction will increase primary productivity and benefit delta smelt through the increase of prey items within the Sacramento River adjacent to shallow water habitat.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions affecting listed species that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed SERP project are not considered in this section; they require separate consultation pursuant to section 7 of the Act.

Giant Garter Snake

The Service is aware of other projects currently under review by the State, county, and local authorities where biological surveys have documented the occurrence of federally-listed species. These projects include such actions as urban expansion, water transfer projects that may not have a federal nexus, and continued agricultural development. The cumulative effects of these known actions pose a significant threat to the eventual recovery of the species. Additionally, an undetermined number of future land use conversions and routine agricultural practices are not subject to federal permitting processes and may alter the habitat or increase incidental take of snakes, and are, therefore, cumulative to the proposed project. For example other cummulative effects include: (1) unpredictable fluctuations in aquatic habitat due to water management and diversions; (2) dredging and clearing of vegetation from irrigation canals; (3) discing or mowing upland habitat; (4) increased vehicular traffic on access roads adjacent to aquatic habitat; (5) use of burrow fumigants on levees and other potential upland refugia; (6) human intrusion into habitat; (7) use of inappropriate plastic erosion control netting (Stuart *et al.* 2001); (8) rip-rapping or lining of canals and stream banks; (9) fluctuations in acreages of rice production due to market conditions or water availability; (10) ornamental cultivation; (11) routine grounds maintenance of upland habitat; (12) contaminated runoff from agriculture and urbanization; (13) maintenance of non-federal flood control structures; and (14) predation by feral animals and pets. Specific cumulative effects related to the proposed project include maintenance activities and/or an increased potential for vandalism, which may degrade or destroy habitat or cause unpredictable fluctuations in habitat.

Delta Smelt

Within the action area, non-federal diversions of water (e.g., municipal and industrial uses, as well as diversions through intakes serving numerous small, private agricultural lands) are on-going and likely to continue into the foreseeable future. These non-federal diversions are not likely to entrain many delta smelt based on the results of a study by Nobriga *et al.* (2004). This study reasoned that the littoral location and low-flow operational characteristics of these diversions reduced their risk of entraining delta smelt. A study of the Morrow Island Distribution System by DWR produced similar results, with one demersal species and one species that associates with structural environmental features together accounting for 97-98% of entrainment; only one delta smelt was observed to be entrained during the two years of the study

(DWR 2007). Although these non-federal diversions do not appear to entrain large numbers of delta smelt, they are a source of entrainment for delta smelt.

Local levee maintenance may also destroy or adversely affect delta smelt spawning or rearing habitat and interfere with natural, long term spawning habitat-maintaining processes. Operation of flow-through cooling systems on the electrical power generating plants that draws water from and discharge into the action area may also adversely affect delta smelt in the form of entrainment and locally increased water temperatures.

Additional cumulative effects result from the impacts of point and non-point source chemical contaminant discharges. These contaminants include but are not limited to selenium and numerous pesticides and herbicides as well as oil and gasoline products associated with discharges related to agricultural and urban activities. Implicated as potential sources of mortality for smelt, these contaminants may adversely affect fish 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.

Ammonia loading in the Bay-Delta has increased significantly in the last 25 years (Jassby 2008). Effects of elevated ammonia levels on fish range from irritation of skin, gills, and eyes to reduced swimming ability and mortality (Wicks *et al.* 2002). Delta smelt have shown direct sensitivity to ammonia at the larval and juvenile stages (Werner *et al.* 2008). Connon *et al.* (2011) investigated the sublethal effects of ammonia exposure on the genes of juvenile delta smelt and found that ammonia altered gene transcription including specific genes related to cell membrane integrity, energy metabolism, and cellular responses to environmental stimuli. The study supports the possibility of ammonia exposure-induced cell membrane destabilization that would affect membrane permeability and thus enhance the uptake of other contaminants. Ammonia can be toxic to several species of copepods important to larval and juvenile fishes (Werner *et al.* 2010; Teh *et al.* 2011).

Effects of climate change could be particularly profound for aquatic ecosystems and include increased water temperatures and altered hydrology, along with changes in the extent, frequency, and magnitude of extreme events such as droughts, floods, and wildfires (Reiman and Isaak 2010). Numerous climate models predict changes in precipitation frequency and pattern in the western United States (IPCC 2007). Projections indicate that temperature and precipitation changes will diminish snowpack, changing the availability of natural water supplies (USBR 2011). Warming may result in more precipitation falling as rain and less storage as snow. This would result in increased rain or snow events and increase winter runoff as spring runoff decreases (USBR 2011). Earlier seasonal warming increases the likelihood of rain-on-snow events, which are associated with mid-winter floods. Smaller snowpacks that melt earlier in the year result in increased drought frequency and severity (Reiman and Isaak 2010). These changes may lead to increased flood and drought risk during the 21st century (USBR 2011).

It is uncertain how a change in the timing and duration of freshwater flows will affect delta smelt. The melting of the snowpack earlier in the year could result in higher flows in January and February, ahead of peak spawning and hatching months for delta smelt. This could alter the timing or magnitude of migration and spawning cues, and potentially result in decreased spawning success. As the freshwater boundary moves farther inland into the Delta with increasing sea level and reduced flows, adults will need to migrate farther into the Delta to spawn, increasing the risk of predation and the potential for entrainment into water export facilities and diversions for both themselves and their progeny.

We expect warmer estuary temperatures to be yet another significant conservation challenge based on climate change models. Typically, the bulk of delta smelt spawning occurs as water temperatures between 7 and 15°C (44.6 and 59 °F), although spawning has been observed at both lower and higher temperatures (Wang 1986, Moyle 2002). Mean annual water temperatures within the upper Sacramento River portion of the Bay-Delta estuary are expected to approach or exceed 14 °C (57.2 °F) during the second half of this century (Cloern *et al.* 2011). Warmer water temperatures could increase delta smelt mortality and constrict suitable habitat throughout the Delta during the summer months. Due to warming temperatures, delta smelt are projected to spawn between ten and twenty-five days earlier in the season depending on the location (Brown *et al.* 2013). Higher temperatures would shrink delta smelt distribution into the fall, limiting their presence to Suisun Bay and in waters with less than optimal salinities (Brown *et al.* 2013). Water temperatures are presently 20 °C (68 °F) for most of the summer in core habitat areas, sometimes even exceeding the nominal lethal limit of 25 °C (77 °F) for short periods.

Other cumulative effects could include: the dumping of domestic and industrial garbage that decreases water quality; construction and maintenance of golf courses that reduce habitat and introduce pesticides and herbicides into the environment; oil and gas development and production that may affect aquatic habitat and may introduce pollutants into the water; and agricultural activities, including burning or removal of vegetation and livestock grazing on levees that reduce riparian and wetland habitats that contribute to the quality of habitat used by delta smelt. These cumulative effects further contribute to reducing the respective environmental baselines for the delta smelt.

Conclusion

After reviewing the current status of the giant garter snake and delta smelt, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects on these species, it is the Service's biological opinion that the proposed SERP project, as described herein, is not likely to jeopardize the continued existence of these species. We base this conclusion on the following: the short duration of construction, the small size of the repairs, the work windows proposed for construction, and the increased vegetative cover that would result from the repairs.

After reviewing the current status of delta smelt critical habitat, the environmental baseline of critical habitat in the action area, the effects of the proposed action, and the cumulative effects on the critical habitat, it is the Service's biological opinion that the proposed SERP project, as described herein, is not likely to result in the destruction or adverse modification of delta smelt critical habitat. We base this conclusion on the following: the relatively small amount of habitat that would be affected, the conservation measures included within the project description, and the inclusion of vegetation which will benefit delta smelt through contributing to primary productivity and hence their food supply.

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 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 as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral 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 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 nondiscretionary for listed species in this opinion and must be implemented by the Corps and DWR in order for the exemption in section 7(o) (2) to apply. The Corps has a continuing duty to regulate the activity that is covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions, or (2) fails to require DWR 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 or DWR 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

Giant Garter Snake

The Service anticipates that incidental take of the snake will be difficult to detect or quantify for the following reasons: snakes are cryptically colored, secretive, and known to be sensitive to human activities. Snakes may avoid detection by retreating to burrows, soil crevices, vegetation, and other cover. Individual snakes are difficult to detect unless they are observed, undisturbed, at a distance. Most close-range observations represent chance encounters that are difficult to predict. It is not possible to make an accurate estimate of the number of snakes that will be harassed during construction activities, including in staging areas and roads carrying vehicular traffic. In instances when take is difficult to detect, the Service may estimate take in numbers of species per acre of habitat lost or degraded as a result of the action as a surrogate measure for quantifying individuals. Therefore, the Service anticipates the number of giant garter snakes that may be found in 15 acres of aquatic and upland habitat per year for 5 years (75 acres for the 5 years) will be disturbed, harassed, or killed as a result of habitat modification due to the proposed project.

Delta Smelt

Construction of the erosion protection at sites downstream of Sacramento River RM 80, will result in the incidental take of the delta smelt. The Service anticipates that finding an injured or dead 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 Sacramento River generally coincides with turbid flow conditions, which makes their detection difficult; and additionally, their presence in flooded vegetation makes them difficult to detect. Therefore, it is not possible to provide precise numbers of smelt that will be harassed, harmed, or killed during and/or after construction. In such instances, where take is otherwise difficult to detect and/or quantify, the Service may quantify take in terms of some aspect of the species' habitat that may be diminished or removed, as a surrogate measure for quantifying individuals.

Accordingly, the Service is quantifying take incidental to the project as the linear feet of shallow water habitat affected by the proposed action. Take will be primarily in the form of harm to the species through permanent and temporary loss of its nearshore breeding and feeding habitat. Therefore, the Service estimates that all delta smelt along 4,500 linear feet of river bank per year for 5 years (22,500 linear feet for the 5 years) are subject to incidental take as a result of the proposed action.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the giant garter snake or delta smelt, and will not result in the destruction or adverse modification of designated critical habitat for the delta smelt.

Reasonable and Prudent Measures

The Service has determined that the following reasonable and prudent measure(s) are necessary and appropriate to minimize impacts of incidental take of giant garter snake and delta smelt.

1. The Corps shall implement the project as proposed in the biological assessment and this biological opinion.

2. Minimize adverse effects to giant garter snakes and their habitat in the action area.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps shall ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. The following terms and conditions implement reasonable and prudent measure one (1):

   a. The Corps shall minimize the potential for incidental take of the giant garter snake and delta smelt resulting from the project related activities by implementation of the project description as described in the biological assessment and the project description of this biological opinion.

   b. If requested, the Corps or their representative shall allow access to the project site by the Service or the DFW to assess the effects of the project on the listed species.

2. The following terms and conditions implement reasonable and prudent measure two (2):

   a. The project proponents shall minimize the potential for harm or harassment of the snake resulting from project-related activities by implementation of the conservation measures as described in DWR's Biological Assessment and appearing in the project description of this biological opinion.

   b. The applicants shall include a copy of this biological opinion within its solicitations for design and construction of the proposed project making the primary contractor responsible for implementing all requirements and obligations included within the biological opinion, and to educate and inform all other contractors involved in the project as to the requirements of the biological opinion.

   c. At least 30 calendar days prior to initiating construction activities, the project proponents shall submit the names and resume of the biological monitor(s) for the proposed project.

   d. For projects that anticipate work will be required past the end of the snakes' active season (October 1st) and into their inactive season, additional measures must be implemented by DWR. This is with the understanding that work to flood control structures such as levees needs to be completed by November 1, the beginning of the flood season. Work after November 1 would likely consist of planting, hydroseeding, or demobilization. All of the following minimization measures must be implemented in order for work to continue past the October 1st deadline:

      - The applicant shall contact the Service on or before August 15, to determine if any additional measures are needed to minimize effects to the snake. Work will only continue past October 1 once the Corps and DWR have received notification from the Service that the conservation measures are acceptable.

- 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 1st 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.

e. Project-related vehicles shall observe a 20-mile-per-hour speed limit within construction areas, except on County roads and State and federal highways. This is particularly important during periods when the snake may be sunning or moving on roadways.

f. To avoid attracting snake predators, all food-related trash items, such as wrappers, cans, bottles, and food scraps, must be disposed of in closed containers and removed at least once a day from the entire project site.

g. The Corps shall ensure compliance with the reporting requirements.

Reporting Requirements

In order to monitor whether the amount or extent of incidental take anticipated from implementation of the project is approached or exceeded, DWR shall adhere to the following reporting requirements. Should this anticipated amount or extent of incidental take be exceeded, the Corps must reinitiate formal consultation as per 50 CFR 402.16.

1. The Service must be notified within one (1) working day of the finding of any injured or dead listed species or any unanticipated damage to its habitat associated with the proposed project. Notification will be made to the Habitat Conservation Division Chief at the Sacramento Fish and Wildlife Office at (916) 414-6600 and Assistant Field Supervisor of the ESA/Regulatory Division at the Bay Delta Fish and Wildlife Office at (916) 930-5603, and must include the date, time, and precise location of the individual/incident clearly indicated on a U.S. Geological Survey 7.5 minute quadrangle or other maps at a finer scale, as requested by the Service, and any other pertinent information. When an injured or dead individual of the listed species is found, the Corps shall follow the steps outlined in the Disposition of Individuals Taken section below.

2. A post-construction compliance report prepared by the monitoring biologists shall be forwarded to the Service within 60 calendar days of the completion of construction activity for that calendar year. This report shall detail: (i) dates that construction occurred; (ii) pertinent information concerning the success of the Project in meeting

compensation and other conservation measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on federally-listed species, if any; (v) occurrences of incidental take of federally-listed species, if any; and (vi) other pertinent information.

3. An annual monitoring report shall be provided to the Service yearly during the 5 years of this program by November 30. This report shall include site information, performance goals and success criteria, data from the sites collected that year and compared against previous years, and a discussion of any remedial action if necessary.

Disposition of Individuals Taken

Injured listed species must be cared for by a licensed veterinarian or other qualified person(s), such as a Service-approved biologist. Dead individuals must be sealed in a resealable plastic bag containing a paper with the date and time when the animal was found, the location where it was found, and the name of the person who found it. The bag containing the specimen must be frozen in a freezer located in a secure site, until instructions are received from the Service regarding the disposition of the dead specimen. The Service contact persons are the Habitat Conservation Division Chief at the Sacramento Fish and Wildlife Office at (916) 414-6600; the Assistant Field Supervisor of ESA/Regulatory Division at the Bay Delta Fish and Wildlife Office at (916) 930-5603; and the Resident Agent-in-Charge of the Service's Office of Law Enforcement at (916) 569-8444.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of 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 and data bases.

1. The Service recommends the Corps and DWR develop and implement restoration measures in areas designated in the Delta Fishes Recovery Plan (Service 1996).

2. The DWR should make set-back levees integral, proactively implemented components of the Central Valley Flood Protection Plan. This would minimize the need for maintenance in the floodway while providing ecosystem benefits.

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

REINITIATION - CLOSING STATEMENT

This concludes formal consultation with the Corps on the SERP Project. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the proposed action 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 listed species or critical habitat that was not considered in this opinion; or (4) a new species or critical habitat is designated that may be affected by the proposed action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

If you have any questions regarding this biological opinion on the SERP Project, please contact Jennifer Hobbs at (916) 414-6541 or Doug Weinrich, Deputy Assistant Field Supervisor at (916) 414-6600.

Sincerely,

Jennifer M. Norris
Field Supervisor

Enclosure
cc:
Mike Hendrick, National Marine Fisheries Service, Sacramento, CA
Kelley Barker, California Department of Fish and Wildlife, Rancho Cordova, CA
Jeff Schuette, California Department of Water Resources, Sacramento, CA

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Appendix A

California Department of Resources Small Erosion Repair Program Manual

SPK-2006-228

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

OCT 29 2013

In Response Refer To:
2013/9493

Nancy Arcady Haley
Chief, California North Branch
Department of the Army
U.S. Army Engineer District, Sacramento
Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Dear Ms. Haley:

This letter is in response to your letter dated April 8, 2013, requesting the initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), concerning the Small Erosion Repair Program (SERP). The enclosed biological opinion (BO) (Enclosure 1) is based on information provided in the Biological Assessment (BA) and Essential Fish Habitat Assessment for the SERP Phase 1 Project, discussions between NMFS, U.S. Army Corps of Engineers (Corps), and California Department of Water Resources (DWR) staff.

SERP is a collaborative interagency (including NMFS) effort to develop a streamlined regulatory review and authorization process that will facilitate implementation of annual repairs of small erosion sites on Sacramento River Flood Control Project (SRFCP) area levees. SERP plans to use programmatic authorizations to streamline the process for implementation of small erosion repairs in accordance with conservation-based design and monitoring standards. SERP proposed projects would be designed to minimize effects on listed fish species, and to protect and enhance the existing aquatic and riparian habitats comprising the riverine corridor.

Based on the best available scientific and commercial information, the BO concludes that the Project 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 (CCV) steelhead distinct population segment (DPS) (*O. mykiss*), or threatened Southern DPS of North American green sturgeon (*Acipenser medirostris*), and is not likely to destroy or adversely modify their designated critical habitats. NMFS has also 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.

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.*; Enclosure 2). The document concludes that the Project will adversely affect the EFH of Pacific salmon in the action area and adopts the ESA reasonable and prudent measures and associated terms and conditions from the BO as the EFH conservation recommendations.

The 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 proposed action and the measures needed to avoid, minimize, or mitigate such effects.

Please contact Michael Hendrick at (916) 930-3605, or via e-mail at Michael.Hendrick@noaa.gov if you have any questions or require additional information concerning this project.

Sincerely,

Maria Rea
for William W. Stelle, Jr.
Regional Administrator

Enclosures (2)

cc: Copy to file – ARN151422SWR2013SA00055
NMFS, PRD, Long Beach, CA

BIOLOGICAL OPINION

ACTION AGENCY:	United States Army Corps of Engineers, Sacramento District
ACTIVITIES:	Small Erosion Repair Program
CONSULTATION CONDUCTED BY:	National Marine Fisheries Service, Southwest Region
FILE NUMBER:	151422SWR2013SA00055
DATE ISSUED:	OCT 29 2013

I. BACKGROUND AND CONSULTATION HISTORY

The SERP is a collaborative interagency effort to develop a streamlined regulatory review and authorization process that will facilitate implementation of annual repairs of small erosion sites on levees within the SRFCP area while minimizing, avoiding, and mitigating impacts to listed species and their habitats. The SRFCP contains approximately 900 to 1,000 miles of levees. For the initial 5-year (Phase 1) SERP effort, the coverage area is a subset of the SRFCP and represents approximately 300 miles of levees maintained by DWR.

To maintain the design integrity of the existing flood management system and to maintain or enhance fish and wildlife resources, levees with erosion damage that may lead to further loss of soil or potential failure should be repaired in a timely manner. To address this problem, the SERP Subcommittee was formed at the direction of the Interagency Flood Management Collaborative Program Group (Interagency Collaborative Group) on January 17, 2007. The subcommittee includes representatives from DWR, California Department of Fish and Wildlife (DFW), Central Valley (CV) Flood Protection Board (CVFPB), CV Regional Water Quality Control Board (CVRWQCB), Corps, U.S. Fish and Wildlife Service (USFWS), and NMFS. This group of Federal and state resource agency representatives was charged with defining what constitutes a small erosion repair and determining appropriate repair designs that will adequately protect the levee system while avoiding substantial adverse effects on environmental resources.

USFWS and NMFS have been actively involved in the development of the SERP Manual by reviewing and commenting on individual sections of the manual. Both agencies have reviewed and approved at the staff level on the final draft manual. Agency involvement and concurrence is critical to the successful implementation of the SERP because efficient and effective annual selection and repair of individual erosion sites will require that DWR obtain agency agreement on which projects will be covered by the SERP and on the specifics of measures to minimize environmental effects on listed species (contained within the SERP Manual). The SERP Manual provides details on the SERP design templates and is included as Attachment A. The SERP Manual represents the collaborative work of the agencies in the development of the program and is described in more detail in Chapter 3, "Description of the Proposed Action".

On April 27, 2010, a draft version of this *Biological Assessment and Essential Fish Habitat Assessment for the Small Erosion Repair Program Phase 1 Project* (BA/EFHA) was sent to NMFS for review and comment. Comments were subsequently discussed at interagency meetings held on May 17, 2011, and June 8, 2011, and in follow-up electronic and telephone communications.

NMFS received a request for initiation of consultation on February 28, 2013. However, the initial request did not contain an appropriate effects determination by the Corps. After phone conversations and meetings the Corps agreed to send out a revised initiation letter, dated April 8, 2013. The BA was included as part of the February 28, 2013, initiation letter and was not amended as part of the April 8, 2013, initiation letter.

On March 10, 2013, NMFS received a letter requesting a review of the draft Environmental Impact Report (EIR) for the SERP. A NMFS comment letter on the draft EIR was completed and delivered on May 3, 2013.

A complete administrative record of this consultation is on file at the NMFS Central Valley Office.

II. DESCRIPTION OF THE PROPOSED ACTION

A. Description of the Proposed Action

The Corps is proposing to permit DWR to establish the SERP, which would facilitate implementing repairs of small erosion sites on levees maintained by DWR within the SRFCP area. SERP proposes to provide a streamlined program for DWR to identify, obtain regulatory authorization for, and construct small levee repairs on levees maintained by DWR within the SRFCP area, while minimizing environmental impacts. The SERP also seeks to achieve a cumulative net benefit to fish and wildlife resources, including habitat for sensitive species.

SERP proposes to use programmatic authorizations, issued by Federal and State agencies with regulatory obligations associated with erosion repair projects to streamline the process for implementing small erosion repairs in accordance with conservation-based design and monitoring standards established by the SERP Subcommittee. Projects that qualify under the SERP are eligible to receive authorization within a shortened time frame because they are designed to minimize effects on fish and wildlife resources, including listed species, and to protect and enhance the existing aquatic and riparian habitats comprising the riverine corridor.

The SERP is one of many efforts being developed and implemented under the FloodSAFE California Initiative. The FloodSAFE vision is a sustainable integrated flood management and emergency response system throughout California that improves public safety, protects and enhances environmental and cultural resources, and supports economic growth by reducing the probability of destructive floods, promoting beneficial floodplain processes, and reducing the damages caused by flooding.

B. Background and Need for the Project

Levees that sustain erosion damage during winter periods of high flows may undergo further erosion, soil loss, and removal of riparian vegetation over time that could lead to levee failure and consequent substantial flood damage in both urban and nonurban environments. Such erosion sites need to be repaired in a timely manner to maintain the design integrity of the existing flood management system, and levees with erosion damage that may lead to further loss of soil or potential failure. Currently, small erosion repair projects require permits to be issued on a project-by-project basis. The multiple layers of agency authorizations and level of interagency coordination required for individual site repairs has generally resulted in long-term project delays up to several years, posing a potential public safety hazard and often leaving the eroded areas susceptible to further damage, greater repair costs, and loss of riparian vegetation.

To address this problem, the SERP Subcommittee was formed. The subcommittee consists of a group of Federal and state resource agency representatives charged with defining what constitutes a small erosion repair and determining appropriate repair designs that will adequately protect the levee system while avoiding substantial adverse effects on environmental resources. Through more than four years of meetings and collaboration, the subcommittee has developed a program intended to improve current erosion repair practices, and thus maintain the necessary level of flood risk reduction while seeking to achieve a cumulative net benefit to fish and wildlife resources, including habitat for sensitive species. As part of this program, the subcommittee has developed the SERP Manual (Attachment A), which provides the general guidelines under which the program would operate. The subcommittee has developed guidelines in several areas such as project design, conservation measures, monitoring and reporting requirements, and a California Environmental Quality Act (CEQA) compliance checklist to ensure that, for each project site, repairs conducted under the SERP would comply with CEQA.

B. ACTION AREA

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR § 402.02). The action area, for the purposes of this programmatic biological opinion (BO), includes the waterways listed below and all areas that will be directly and indirectly impacted by all the potential SERP projects. Flood management facilities that DWR maintains are located within the valley floor of the watershed. The valley drainages include the Feather River watershed, American River watershed, Sutter Bypass watershed, Yolo Bypass watershed, and Sacramento River watershed. For Phase 1 of SERP the coverage area would be a subset of SRFCP, representing approximately 300 miles of levees maintained by DWR in Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Yolo, and Yuba counties. The following waterways are proposed for eligibility for inclusion in Phase 1(Figure 1):

(1) Butte Creek;
(2) Cache Creek from the Yolo Bypass to the upstream limit of the SRFCP levees;
(3) Cherokee Canal;
(4) Colusa Bypass;
(5) Northern portion of Colusa Main Drain;
(6) Portions of Feather River;
(7) Putah Creek;
(8) Sacramento Bypass
(9) Portions of Sacramento River;
(10) Sutter Bypass Tisdale Bypass;
(11) Wadsworth Canal;
(12) Willow Slough Bypass;
(13) Portions of Yolo Bypass; and
(14) East and West Interceptor Canals.

D. SERP IMPLEMENTATION PROCESS

Implementation of SERP would begin with DWR conducting annual maintenance surveys each spring to identify small erosion sites that need repairs within the Phase 1 SERP coverage area. A maximum of 15 individual repair projects could be implemented annually. For each proposed site, DWR would select as a guide, one of seven SERP design templates created by the collaborating agencies and identified in the SERP Manual. By June 1 of each year, DWR would notify the applicable permitting agencies; the Corps, USFWS, NMFS, DFW, and the CVRWQCB, of the proposed small erosion repair projects.

Upon receiving agency verification of SERP authorization, DWR would proceed with the repairs in accordance with the applicable conservation measures and any additional terms or conditions for approval that the permitting agencies may require. Construction activities would take place at individual sites throughout each summer and fall during the 5-year Phase 1 period. The program design templates have been developed with the intent that once repaired the erosion sites would require little or no additional upkeep or maintenance.

Identification and Characterization of Erosion Repair Projects

DWR maintenance staff would conduct annual spring surveys to identify small erosion sites. DWR engineering, environmental, and archaeological staff members would conduct a baseline assessment at each site and complete a Baseline Assessment Checklist (Section B of the SERP Manual, Attachment A). The completed checklist would include information about existing soil, levee, and vegetation conditions and potential habitat for special-status species at the site. There will be one checklist per proposed SERP repair site. The checklist will be a part of the annual notification package that will be sent to all the appropriate agencies, including NMFS. In addition to the checklist, the notification package will include and introductory memo, maps, and pertinent permitting information. Each SERP project would be an unconnected, single, and complete actions (and not part of a larger action that will exceed the SERP's size and placement limits).

For each proposed site, DWR would select as a guide one of the seven SERP design templates created by the collaborating agencies (see Section C of the SERP Manual, Attachment A) to apply to the site.

Upon receipt of the annual SERP notification package, NMFS would review the projects and independently respond to DWR, indicating whether the projects qualify under their programmatic SERP authorizations, including any additional terms or conditions required to obtain authorization. NFMS will respond to the notification package with an official letter that will indicate approval status per proposed SERP erosion repair site. Upon receiving the agencies' verification of SERP authorization, DWR may proceed with the repairs in accordance with the applicable conservation measures. DWR will develop a geographic information system database to monitor the progress of the SERP. The database will be made available to the agencies involved in authorizing SERP projects.

Site Repairs

Phase 1 construction activities would take place at individual sites throughout each summer and fall. Each site would require no more than one to four weeks of active construction, not including revegetation. All work would take place during daylight hours. Heavy equipment and vehicles used during construction may include the following:

(1) Large bulldozer(s);
(2) Trucks (pick-ups, end dumps, flatbeds, water trucks, and hydro-seeders);
(3) Small bulldozer(s);
(4) Barge with crane;
(5) Cement mixer with extended arm (for use in depositing soil); and
(6) Excavators.

Revetments would be placed by cranes mounted on barges or, in locations where this is not possible, from adjacent landside areas using excavators. A cement mixer with an extended arm could be used in some instances where the design template calls for soil to be intermixed with rock in the repair. Waterside construction would occur where it minimizes noise, traffic, and vegetation disturbances. For Phase 1, the construction contractor will be the DWR maintenance yard. They would use adjacent landside areas, maintenance toe roads, or the crown roads for staging of vehicles, plant materials, and other associated construction equipment, as necessary.

Bank reconstruction would, in most cases, incorporate plantings into the revetment in accordance with the bioengineering techniques outlined in the program design templates (see Attachment A). The upper bank would be seeded and may be covered with biodegradable materials to control erosion and stabilize the bank. Willow cuttings and other native vegetation would be installed during placement of the revetment or after construction during the appropriate planting season.

The templates have been designed with the intent that once repaired; the erosion sites would require little or no additional maintenance. During the initial vegetation establishment period, maintenance activities for planted areas are anticipated to include removing invasive vegetation, pruning planted vegetation to comply with the Corps vegetation management requirements for levees, and replacing dead plantings. These activities will comply with levee vegetation standars outlined in the Central Valley Flood Protection Plan. It is important to note that revegetated sites will be irrigated to ensure final success criteria are met. Final success criteria are outlined in Section H of the SERP Manual (Attachment A). Once the final success criteria are achieved, the vegetation should be self-maintaining. Maintenance activities that focus on maintaining restoration plantings, in particular woody vegetation plantings, would be conducted for five years or longer as necessary until the final success criteria are met. DWR will be responsible for establishing and maintaining healthy plantings, in accordance with the monitoring and success criteria section of the SERP Manual.

SERP is intended to be a self-mitigating program. The SERP subcommittee decided to use a guide of seven design templates (Section C of SERP Manual, Attachment A):

(1) Bank fill rock slope with live pole planting;

(2) Willow wattle with rock toe;

(3) Branch layering;

(4) Rock toe with live pole planting;

(5) Soil and rock fill at the base of a fallen tree (including root wad revetment option);

(6) Bank fill rock slope with native grass planting; and

(7) Bank fill rock slope with emergent vegetation planting.

A site-specific cross-section, plan view, and planting plan would be developed for each project based on the design template selected for the repair. This information would be provided to NMFS along with the project notification materials in the annual SERP notification packages. Minor changes to the program design templates may be recommended for specific projects based on detailed knowledge of the sites.

Through application of the seven design templates SERP projects are intended to achieve "self-mitigation" for impacts to biological resources. SERP project sites would be considered "self-mitigating" if the successful establishment of vegetation plantings incorporated into the project design would restore or enhance the biological function of the existing conditions at the erosion sites.

Monitoring and reporting requirements and success criteria for SERP projects are presented in the SERP Manual. Monitoring of individual repair sites would be conducted for five years, or longer as necessary, until the final success criteria are achieved and NMFS provides written approval. DWR will submit an annual report package that includes the monitoring results by November 30. The information in the reports would be used to assess progress toward meeting the annual performance goals and final success criteria and would include recommended remedial actions to address any performance shortfalls. Post-construction site visits from NMFS personnel may occur at any time to determine the effectiveness of this program and whether contingency actions or adjustments to the established success criteria should be made.

E. SERP Conservation and Mitigation Measures

The SERP Subcommittee developed conservation measures. Measures have been identified that would be applicable to all SERP project sites, including timing restrictions to avoid work during key life history stages of various special-status species, measures to avoid vegetation and habitat disturbance, hazard prevention measures, erosion control measures, and other mandatory construction measures.

The SERP Subcommittee developed resource-specific conservation measures for the following resources, species, and habitats:

(1) sensitive biological resources,
(2) giant garter snake (*Thamnophis gigas*) habitat;
(3) valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*);
(4) delta smelt (*Hypomesus transpacificus*);
(5) Swainson's hawk (*Buteo swainsoni*);
(6) burrowing owl (*Athene cunicularia*);
(7) bank swallow (*Riparia riparia*);
(8) nesting birds/migratory birds;
(9) raptors;
(10) woody shaded riverine habitat; and
(11) cultural resources.

As part of the project notification materials, DWR would select and include a list of those resource-specific and, if appropriate, supplemental conservation measures that are applicable to a specific site, and the permitting agencies would have an opportunity to revise the list for each project.

This section describes the conservation measures to be applied by DWR to SERP projects to avoid and minimize impacts on sensitive resources, including NMFS federally listed species. Measures that would apply to all projects are identified and listed below. Resource-specific measures provided in this section would be applied as determined necessary by DWR in coordination with USFWS, DFW, NMFS, and any other appropriate agencies. Resource-specific measures applied to each particular project will be listed on the project notification form. In completing the notification form, DWR will reference the applicable resource-specific conservation measures. If DWR proposes implementation of conservation measures not previously identified, those measures would be labeled as "Supplemental Conservation Measures" on the project notification form for clarification. Upon receipt of a SERP project notification, NMFS staff will review the conservation measures and respond to DWR with any additional conservation measures required for project authorization.

The following measures will apply to all SERP projects unless deletion or revision of a measure is approved in writing by NMFS and the other SERP agencies.

Timing Restrictions

(1) Region 1: Delta–Sacramento River and Major Tributaries River Mile (RM) 0 to RM 60

a. Putah Creek from the Yolo Bypass to the upstream limit of the SRFCP levees,
b. Sacramento Bypass,
c. portions of Sacramento River downstream of RM 60, and
d. Yolo Bypass as identified in Figure 1.

(2) Region 2: Mainstem Sacramento River and Major Tributaries RM 60 to RM 143

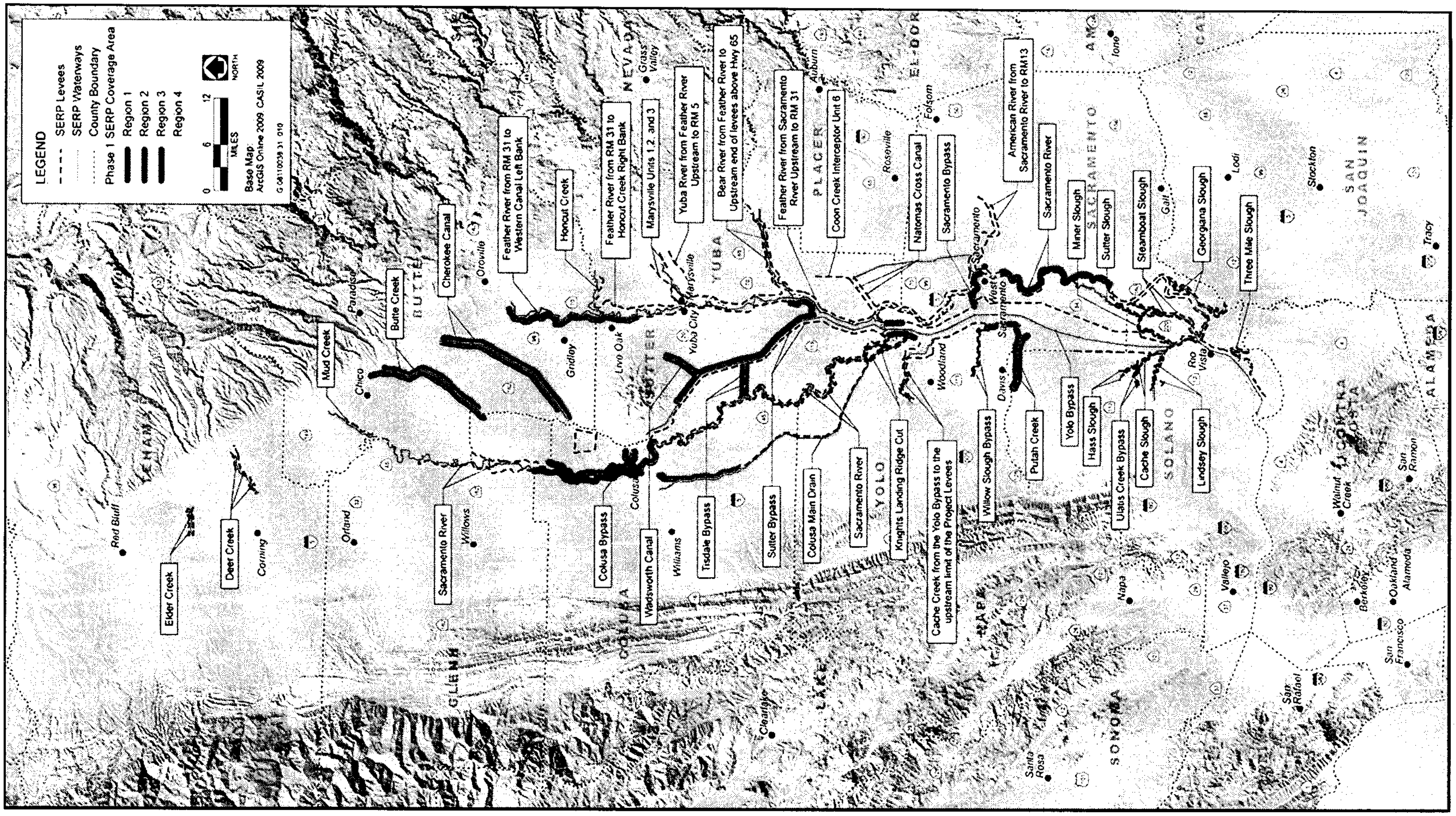
a. Butte Creek,
b. Cherokee Canal,
c. Colusa Bypass,
d. northern portion of Colusa Main Drain as identified in Figure 1,
e. portions of Feather River as identified in Figure 1,
f. portions of Sacramento River between RM 60 and RM 143,
g. Sutter Bypass,
h. Tisdale Bypass,
i. Wadsworth Canal, and
j. East and West Interceptor Canals.

(3) Region 3: Upper Sacramento and Major Tributaries RM 143 to RM 194

a. Portions of Sacramento River between RM 143 and RM 194.

(4) Region 4: Nonanadromous SERP Waterways, Including:

a. Willow Slough Bypass and
b. Cache Creek from the Yolo Bypass to the upstream limit of the SRFCP levees.



Source: Adapted by AECOM 2009

Figure 1: SERP Phase I Action Area

For Region 1, all in-water construction would occur from August 1 to November 30. The time period for completing work outside the active stream channel is April 15 to October 15. For Region 2 all in-water construction would occur from July 1 to October 15. The time period for completing work outside the active stream channel is April 15 to October 15. For Region 3 all in-water construction would occur from July 1 to August 31. The time period for completing work outside the active stream channel is April 15 to October 15. For Region 4 all in-water construction would occur from April 15 to October 1. The time period for completing work outside the active stream channel is April 15 to October 15. There are exceptions to these time frames in order to adhere to giant garter snake conservation requirements, but as a result this makes the timing more restrictive, thus will have no bearing on fish resources. Revegetation and erosion control work that do not involve the use of heavy equipment are not confined to the above timing windows.

Work windows alternations or timing extensions may be considered by NMFS on a project-by-project basis upon written request from DWR (these changes will also have to be approved by the other Resource Agencies). If DWR requests any timing changes they must include a justification for the request and any additional information deemed necessary by NMFS or other agencies. Modifications to the established timing windows may be made only with written concurrence. Construction activities would be timed to avoid precipitation and increases in water flow. If it has been forecasted that there is a chance of rain within 48 hours, the project site will be prepared with adequate erosion control measures to protect against wind and water erosion. Within 24 hours of any forecasted storm event, construction activities within the stream zone would cease until all reasonable erosion control measures, inside and outside of the stream zone, have been implemented.

<u>Vegetation and Habitat Disturbance</u>

Disturbance to existing land grades and native vegetation would be limited to the actual site of the project, necessary access routes, and staging areas. The number of access routes, the size of staging areas, and the total area of the project activity would be limited to the minimum necessary. When possible, existing ingress or egress points will be used and work will be performed from the top of the creek banks or from barges on the waterside of the project levee.

If removal of vegetation is required within project access or staging areas, the disturbed areas would be replanted with native species and monitored, maintained and replanted if necessary to ensure the revegetation effort is successful. If erosion control fabrics are used in revegetated areas, they would be slit in appropriate locations as necessary to allow for plant root growth. To minimize ground and vegetation disturbance during project construction, prior to beginning project activities, DWR would establish and clearly mark the project limits, including the boundaries of designated equipment staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; and equipment exclusion zones.

Disturbance or removal of vegetation would not exceed the minimum necessary to complete operations. Except for the trees specifically identified for removal in the notification, no native trees with a trunk diameter at breast height in excess of three inches would be removed or damaged without prior consultation with and approval by NMFS. Work will be done in a manner that ensures that, to the extent feasible, living native riparian vegetation within the vegetation-clearing zones is avoided and left undisturbed. The amount of rock riprap and other materials used for bank protection would be limited to the minimum needed for erosion protection. Invasive species, to the extent practicable, would be removed from the proposed project site, destroyed using approved protocols, and disposed of in an appropriate upland disposal area.

All pesticides and herbicides used to control invasive vegetation would be used in accordance with label directions. Methods and materials used for herbicide application would be in accordance with DWR's most current guidelines on herbicide use and with laws and regulations administered by the Department of Pesticide Regulation.

NOTE: Improper application of any pesticides near water can affect fish species and may result in "take" of protected fish as defined under the ESA. To aid in protection of these species, DWR will emphasize caution and awareness of the following when working near water:

(1) The label is the law: read and follow the pesticide label.
(2) Check wind and weather conditions hourly (at a minimum) or at any observed change.
(3) Avoid drift: wind can cause drift; adhere to label requirements for wind speed.
(4) Do not allow spray to drift off target.
(5) Avoid spraying over or in the water.
(6) When spraying near the water's edge, spray should be directed away from the water toward the targeted plant.
(7) Keep all sprayed materials out of the water.
(8) Use caution and be aware of adjoining areas with potential liability as listed on any attachments.

Construction Equipment Staging

Construction materials such as portable equipment, vehicles, and supplies, including chemicals, would be stored at designated construction staging areas and on barges, exclusive of any riparian or wetland areas. Barges would be used to stage equipment and construct the project when practical to reduce noise and traffic disturbances and effects on existing landside vegetation. When barge use is not practical, construction equipment and plant materials would be staged in designated landside areas adjacent to the project sites. Existing staging sites, maintenance toe roads, and crown roads would be used to the maximum extent possible for project staging and access to avoid affecting previously undisturbed areas.

Material Stockpiling

Stockpiling of soil and grading spoils would occur in designated areas on the landside of the levee reaches or on offshore barges. Sediment barriers (e.g., silt fences, fiber rolls, and straw bales) would be installed around the base of stockpiles to intercept runoff and sediment during storm events. If necessary, stockpiles would be covered to provide further protection against wind and water erosion.

Erosion Control During Construction

There would be no dewatering activities (unless deemed necessary by DFW and USFWS to avoid impacts to giant garter snake). If dewatering is deemed necessary, dewatering activities must be conducted in a manner that does not result in the discharge of fill material into waters of the United States or waters of the State. As such, no dewatering will occur in any anadromous bearing waters.

Erosion control measures that minimize soil or sediment from entering waterways and wetlands would be installed, monitored for effectiveness, and maintained throughout construction operations. If use of erosion control fabrics is necessary, only nonmonofilament, wildlife-safe fabrics would be used. DWR would ensure sand, sediment, or sediment-water slurry does not enter the stream channel. No material would be placed in a manner or location, where it can be eroded by normal or expected high flows.

Precautions to minimize turbidity and siltation would be taken into account during project planning and will be implemented at the time of construction. This may require placing silt fencing, anchored sandbag cofferdams, coir logs, coir rolls, straw bale dikes, or other siltation barriers so that silt and other deleterious materials are not allowed to erode into downstream reaches. These barriers would be placed at all locations where there is potential for sediment input and would be in place during construction activities, and afterward if necessary. If any sediment barrier fails to retain sediment, corrective measures would be taken immediately. The sediment barrier(s) would be maintained in good operating condition throughout the construction period and, if necessary, the following rainy season. DWR would be responsible for removing nonbiodegradable silt barriers (such as plastic silt fencing) after the disturbed areas have been stabilized with vegetation. Upon determination by NMFS or any of the other SERP agencies that turbidity levels resulting from project-related activities constitute a threat to aquatic life, activities associated with the turbidity would be halted until effective control devices approved by the determining agency are installed or abatement procedures are initiated.

DWR would inspect performance of sediment control barriers at least once each day during construction to ensure they are functioning properly. Should a control barrier not function effectively, it will be immediately repaired or replaced. Sediment would be removed from sediment controls once the sediment has reached one-third of the exposed height of the control. Sediment collected in these devices would be disposed of away from the collection site at designated upland disposal sites. The location of the sediment disposal site for the project would be shown on the site plan diagram. All disturbed soils would undergo appropriate erosion control treatment prior to the end of the construction season, or prior to October 15, whichever comes first.

All debris, sediment, rubbish, vegetation, or other material removed from the project site or access or staging areas would be disposed of at an approved disposal site. There would be no side casting of material into any waterway. All construction related items would be removed upon project completion. Upon completion of the construction phase and installation of erosion control materials, the work area within the stream zone would be digitally photographed to document the completed state of the repair site.

Hazardous Materials

DWR would exercise reasonable precaution to protect streams and other waters from pollution with fuels, oils, bitumens, calcium chloride, and other harmful materials. Petroleum products, chemicals, fresh cement, and construction by-products containing, or water contaminated by, any such materials would not be allowed to enter flowing waters and would be collected and transported to an authorized upland disposal area. DWR would identify the location of the hazardous materials disposal site as part of the project description information contained in the project notification. Gas, oil, or other petroleum products, or any other substances that could be hazardous to aquatic life and resulting from project-related activities will be prevented from contaminating the soil and/or entering waters of the State and/or waters of the United States.

Any of these materials placed by DWR or any party working under contract or with the permission of DWR below the ordinary high-water mark (OHWM) or within the adjacent riparian zone, or where they may enter these areas, would be removed immediately. In the event of a spill, work will stop immediately and DFW, USFWS, CVRWQCB, NMFS, and the Corps would be notified within 24 hours. DWR would implement their spill prevention and control plan and consult with these agencies regarding any additional cleanup procedures. Any such spills, and the success of the cleanup efforts, would also be reported in an incident report prepared for the project and submitted to the SERP agencies.

DWR would prepare a written spill prevention and control plan (SPCP). The SPCP and all material necessary for its implementation would be accessible on-site prior to initiation of project construction and throughout the construction period. The SPCP would include a plan for the emergency cleanup of any spills of fuel or other material. Employees would be provided the necessary information from the SPCP to prevent or reduce the discharge of pollutants from construction activities to waters and to use the appropriate measures should a spill occur. No concrete or similar rubble would be used. Construction vehicles and equipment would be properly maintained to prevent contamination of soil or water from external grease and oil or from leaking hydraulic fluid, fuel, oil, and grease.

Heavy equipment would be checked daily for leaks. If leaks are found, the equipment would be removed from the site and would not be used until the leaks are repaired. Equipment other than barges would be refueled and serviced at designated refueling and staging sites located on the crown or landside of the levee and at least 50 feet from active stream channels or other water bodies. All refueling, maintenance, and staging of equipment and vehicles would be conducted in a location where a spill would not drain directly toward aquatic habitat. Appropriate containment materials would be installed to collect any discharge, and adequate materials for spill cleanup would be maintained on-site throughout the construction period. Storage areas for construction material that contains hazardous or potentially toxic materials would have an impermeable membrane between the ground and the hazardous material and would be bermed to prevent the discharge of pollutants to groundwater and runoff water.

Other Mandatory Conservation Measures

Water (e.g., trucks, portable pumps with hoses) would be used to control fugitive dust during temporary access road construction. All materials placed in streams, rivers or other waters would be nontoxic. Any combination of wood, plastic, cured concrete, steel pilings, or other materials used for in-channel structures would not contain coatings or treatments or consist of substances deleterious to aquatic organisms that may leach into the surrounding environment in amounts harmful to aquatic organisms.

No materials would be placed in any location or in any manner that would impair the flow of surface water into or out of any wetland area. No fill material other than silt-free gravel or riprap would be allowed to enter the live stream. Water containing mud or silt from construction activities would be treated by filtration, or retention in a settling pond, adequate to prevent muddy water from entering live streams. Screens would be installed on water pump intakes as directed by NMFS salmonid-screening specifications.

All litter, debris, unused materials, equipment, and supplies that cannot reasonably be secured would be removed daily from the project work area and deposited at an appropriate disposal or storage site. All trash and construction debris would be removed from the work area immediately upon project completion.

Resource Specific Conservation Measures to be Applied as Necessary to SERP Projects
DWR would identify and list the applicable resource-specific measures for each project on the project notification form. If DWR includes any additionally conservation measures they would be listed as "Supplemental Conservation Measures" on the project notification forms.

Environmental awareness training will be provided to workers before project activities begin and would appoint a crew member to act as an on-site biological monitor. The awareness training would include a description of the relevant species and their habitats that are known to occur in the project vicinity and would describe the guidelines that would be followed by all construction personnel to avoid impacts on the species during project activities.

Construction barrier fencing or stakes and flags would be placed around sensitive biological resources located in and within the project site boundaries and would remain in place until all project work involving heavy equipment is complete to ensure that construction activities avoid disturbing these resources. The size of the fenced buffer area would be determined on a project-specific basis.

All construction activities will be monitored in and within at least 100 feet of the project site boundaries to ensure that no unauthorized activities occur within the project area. The biological monitor would be empowered to stop construction activities that threaten to cause unanticipated or unpermitted project impacts. Project activity would not resume until the conflict has been resolved.

All remaining, natural woody riparian or shaded riverine aquatic habitat would be avoided or preserved to the maximum extent practicable. Woody riparian and shaded riverine aquatic habitat would be replaced at a 3:1 ratio on an area or linear-foot basis, as determined appropriate by NMFS in coordination with DWR. Species chosen for replanting would reflect native species lost during the permitted activity or native species usually found in the riparian and shaded riverine aquatic habitat zones of the project location. Plantings would be installed during the optimal season for the species being planted. Therefore, completion of the planting effort may not occur at the same time as the erosion repair activity. Maintenance of revegetated sites would continue for at least three growing seasons to allow the vegetation to establish. Maintenance would be continued as necessary until the final performance criteria are met.

F. SERP Repair Templates

Bank protection design would depend on site-specific conditions. Some of the criteria would include

(1) The type of bank failure such as sloughing, or wave wash;
(2) Hydraulic conditions in the area such as shear stress and slope angle; and
(3) Channel characteristics adjacent to the erosion site.

The design alternatives would meet the primary program objectives of providing both the necessary level of flood risk reduction and self-mitigation. In addition to these primary SERP objectives, the SERP subcommittee also considered the following evaluation factors:

(1) Types of levee damage that generally occur in the Phase 1 SERP coverage area,
(2) Long-term maintenance requirements,
(3) Wildlife hazards,
(4) Aesthetics,
(5) Difficulty of installation,
(6) Adequacy of the design in terms of potential vegetation coverage area, and
(7) Levee vegetation management strategy (VMS) set forth in DWR's 2012 CVFPP and associated Conservation Framework.

Based on the above criteria the seven design templates were selected (refer to Section II, D). The templates, which DWR will use as a guide to design repairs at individual SERP Phase I sites, are presented and detailed in the SERP Manual (Attachment A). Each design template includes:

(1) A cross-section of the design, plan view with details as needed, and general construction specifications; and
(2) An information box that describes the template's applicability and limitations (e.g., slope, flow velocity), planting zone descriptions, reference to the SERP rock-sizing chart and plant list (included below), and general construction notes and planting specifications such as rock placement locations relative to water levels, recommended distance between plantings and water table, recommended length of cuttings, etc.

The SERP design templates are generalized program-level diagrams that describe and outline the particular bank stabilization techniques that the SERP Subcommittee has determined are applicable to SERP erosion sites. The appropriate design template for individual SERP repair sites would be selected by DWR. DWR would provide its rationale for selecting an identified template. For each SERP project site, DWR would incorporate the planting, soil and rock placement, and other technique-specific information from the program design templates into the project specific cross-section and plan-view diagrams. This would help ensure that DWR correctly applies the agreed-on bank stabilization techniques. The intention of the program design templates is to provide framework descriptions of applicable bank stabilization methodologies that can be applied to SERP project sites to increase the potential to achieve a successful outcome.

III. Status of the Species and Critical Habitat

A. Endangered Species Act Listing Status and Critical Habitat

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 Evolutionarily Significant Units (ESU)** (*Oncorhynchus tshawytscha*) endangered (January 4, 1994, 59 FR 440)
>
> **Sacramento River winter-run Chinook salmon designated critical habitat** (June 16, 1993, 58 FR 33212)
>
> **Central Valley Spring-run Chinook salmon ESU** (*O. tshawytscha*) threatened (June 28, 2005, 70 FR 37160)
>
> **Central Valley Spring-run Chinook salmon designated critical habitat** (September 2, 2005, 70 FR 52488)
>
> **California Central Valley steelhead DPS** (*O. mykiss*) threatened (January 5, 2006, 71 FR 834)
>
> **California Central Valley steelhead designated critical habitat** (September 2, 2005, 70 FR 52488)
>
> **Southern DPS of North American green sturgeon** (*Acipenser medirostris*) threatened (April 7, 2006, 71 FR 17757)
>
> **Southern DPS of North American green sturgeon critical habitat** (October 9, 2009, 74 FR 52300)

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 Review (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 and 2006 reviews and recommended that status be reassessed in two to three years as opposed to waiting another five years. The status reviews in 2005 and 2006 had also concluded that the species' status should remain as previously listed (70 FR 37160 and 71 FR 834).

B. Sacramento River winter-run Chinook salmon

In August 2011, NMFS completed a 5-Year status review of five Pacific Salmon ESUs, including the Sacramento River winter-run Chinook salmon ESU, and concluded that the species' status should remain as previously listed in 2005 (76 FR 50447). The 2011 Status Review (NMFS 2011a) additionally stated that although the listing will remain unchanged since the 2005 review, and from when it was originally reclassified from threatened to endangered in 1994 (59 FR 440), the status of the population has declined over the past five years (2005 – 2010). The ESU currently consists of only one population that is confined to the upper Sacramento River (downstream of Shasta and Keswick dams) in California's CV. The ESU was originally listed as threatened in 1989, under emergency provisions of the Endangered Species Act of 1973, as amended, and formally listed as threatened in 1990 (55 FR 46515). The ESU's reclassification from threatened to endangered in1994 (59 FR 440), was due to increased variability of run sizes, expected weak returns as a result of two small year classes in 1991 and 1993, and a 99 percent decline between 1966 and 1991. Hatchery winter-run Chinook salmon propagated at the Livingston Stone National Fish Hatchery (LSNFH) are considered essential for survival of the species and are included in the ESU (70 FR 37160).

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 RM 302 to Chipps Island (RM 0) at the westward margin of the 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. Riparian zones are considered essential for the conservation of winter-run Chinook salmon because they provide important areas for fry and juvenile rearing. NMFS limits "adjacent riparian zones" to only those areas above a streambank that provide cover and shade to the nearshore aquatic areas.

General Life History

Freshwater – Adult

Adult winter-run Chinook salmon enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate up the Sacramento River, past the former site of Red Bluff Diversion Dam (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 RBDD is now permanently open. Plans for full removal of the structure are underway. The timing of migration may vary somewhat due to changes in river flows, dam operations, and water year type (Table 1 in text; Yoshiyama *et al.* 1998, Moyle 2002).

Winter-run Chinook salmon 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-April to mid-August, with the peak activity occurring in May and June in the upper Sacramento River reach (50 miles) between Keswick Dam and RBDD (Vogel and Marine 1991). Winter-run Chinook salmon deposit and fertilize eggs in gravel beds known as redds excavated by the female who then guards the nest before dying.

Spawning Chinook salmon requirements for depth and velocities in spawning beds are broad and the upper preferred water temperature is between 55°F-57°F degrees (Snider 2001) The majority of winter-run Chinook salmon spawners return as three-years-olds.

Table 1. The temporal occurrence of adult (a) and juvenile (b) Sacramento River winter-run Chinook salmon in the Sacramento River. Darker shades indicate months of greatest relative abundance.

Winter run relative abundance	High				Medium				Low			
a) Adult freshwater												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento River basin[a,b]												
Sacramento River spawning[c]												
b) Juvenile migration												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento River@ Red Bluff[d]												
Sacramento River @ Knights Landing[e]												
Sacramento trawl @ Sherwood Harbor[f]												
Midwater trawl @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, DFW (1999-2011)); [f,g] Delta Juvenile Fish Monitoring Program(DJFMP), USFWS (1995-2012)

Upstream – eggs/Juvenile

Incubating eggs are vulnerable to adverse effects from floods, siltation, desiccation, disease, predation, poor gravel percolation, and poor water quality. The optimal water temperature for egg incubation ranges from 46°F to 56°F and a significant reduction in egg viability occurs in water temperatures over 57.5°F and total embryo mortality can occur at temperatures above 62°F (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-sac becomes depleted, winter-run Chinook salmon fry begin to emerge from the gravel and start exogenous feeding in their natal stream typically in late June to early July and continuing through October (Fisher 1994). Emigration of juvenile winter-run Chinook salmon past RBDD may begin as early as mid-July, typically peaks in September, and can continue through March in dry years (Vogel and Marine 1991, NMFS 1997).

Delta –Juvenile

Juvenile winter-run Chinook salmon occur in the Delta primarily from November through early May based on data collected from trawls in the Sacramento River at West Sacramento (RM 57; USFWS 2001a,b). The timing of migration 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 cubic feet per second (cfs) at Knights Landing (RM 90) (del Rosario *et al.* 2013). Residence time in the Delta for Winter-run Chinook salmon juveniles averages approximately 3 months based on median seasonal catch between Knights Landing and Chipps Island (RM 18). Residence time in the Delta tends to vary depending on when the first upstream flows exceeding 14,000 cfs occur, triggering abrupt emigration towards the Delta. In general, the earlier winter-run Chinook salmon juveniles arrive in the Delta the longer they stay as peak departure at Chipps Island regularly occurs in March (del Rosario *et al.* 2013). The Delta serves as an important rearing amd transition zone for winter-run Chinook salmon as they feed and physiologically adapt to marine waters. The majority of winter-run Chinook salmon juveniles are 104 to 128 millimeters (mm) (USFWS trawl data (1995-2012)) and can be from 5 to 10 months of age, by the time they depart the Delta (Fisher 1994, Myers *et al.* 1998).

Summary of Salmonid Population Viability (VSP)

Abundance

Historical winter-run Chinook salmon population estimates, were as high as 100,000 fish in the 1960s, but declined to less than 200 fish in the 1990s (Good *et al.* 2005). The period of 1998 to 2006 saw an increase in the population size (Figure 2 and Table 2), averaging 8,065, with 2006 having the highest escapement numbers since the late 1970's/early 1980's, at 17,304. However, from 2007 to 2012, numbers have shown a precipitous decline (66 percent), averaging 2,486 during this period, with a low of 827 in 2011 (Figure 2 and Table 2). This depressed trend may represent a combination of factors such as poor ocean productivity (Lindley *et al.* 2009), drought conditions in the CV (NMFS 2011a), and poor juvenile survival.

Lindley *et al.* (2007) had determined that the winter-run Chinook salmon population that spawns downstream of Keswick Dam were at a moderate extinction risk according to population viability analysis (PVA), and at a low risk according to other criteria (*i.e.*, population size, rate of decline, hatchery influence, and the risk of wide ranging catastrophe). However, since the winter-run Chinook salmon population has been in decline the last five years (2005- 2010) and the growth rate has been negative (Figure 3) the 5-Year Status review concluded that that the extinction risk had increased since the last review (NMFS 2011a).

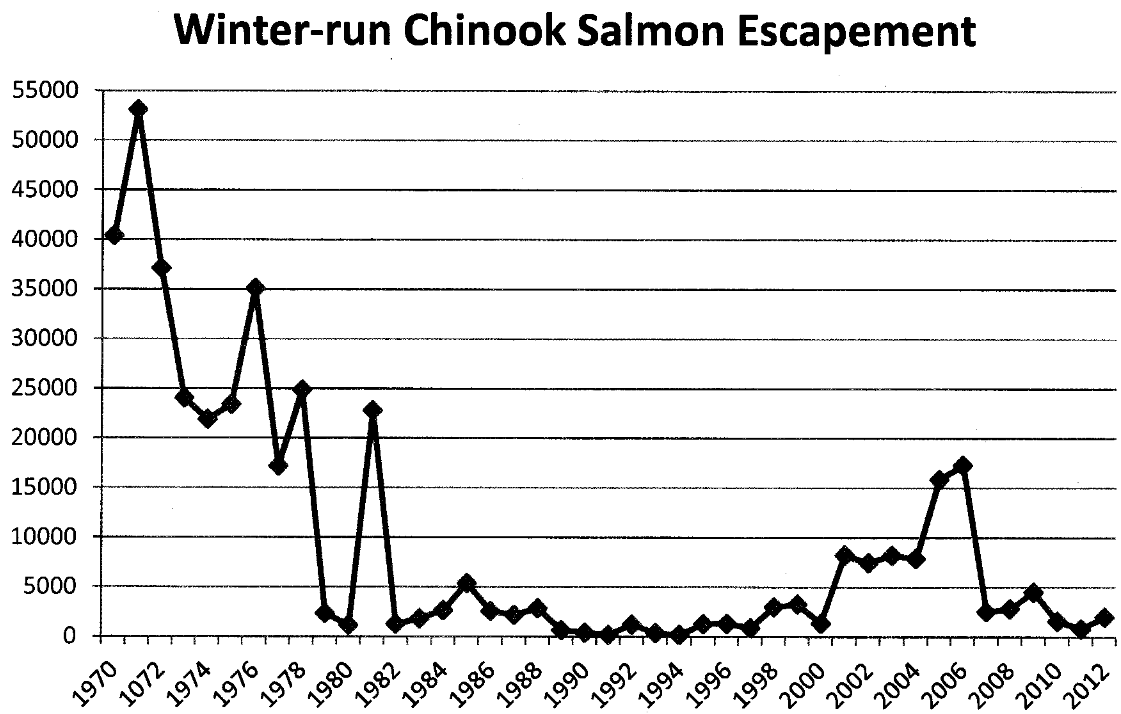


Figure 2. Winter-run Chinook Salmon Escapement numbers 1970 to 2012 including hatchery and tributaries, excluding sport catch. Ladder counts at RBDD used pre-2001, and carcass surveys used post 2001 (Grandtab 2012).

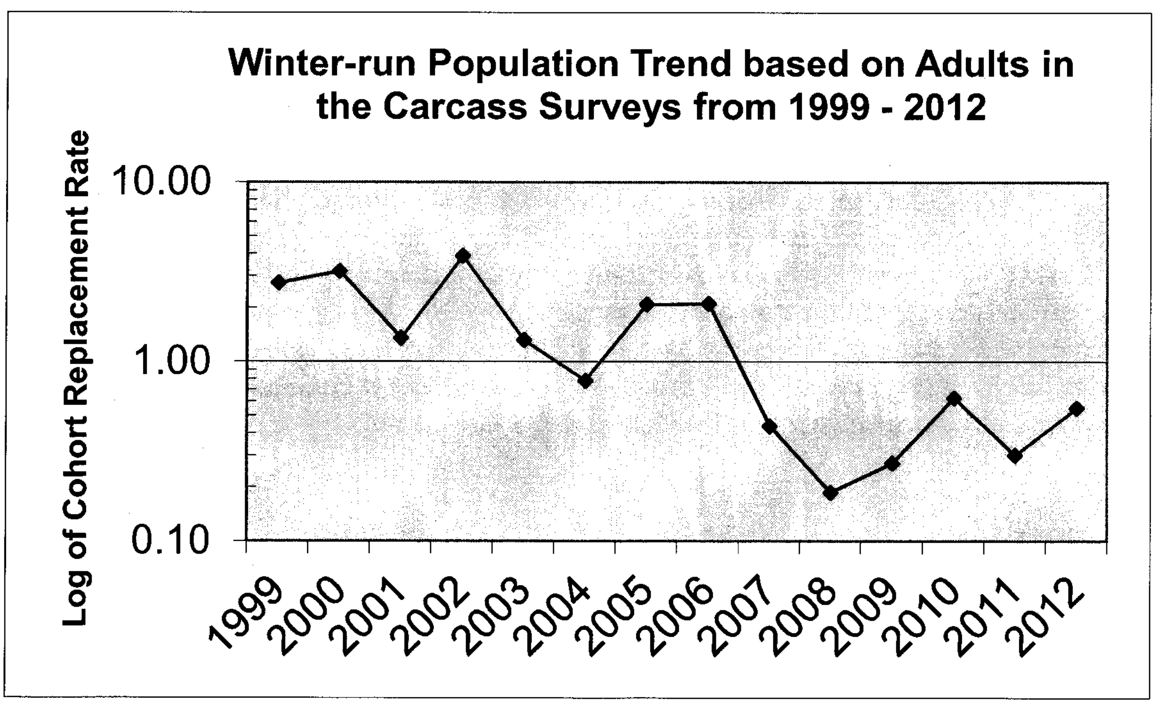


Figure 3. Population growth for winter-run Chinook salmon using cohort replacement rate derived from abundance estimates from 1999 to 2012.

Productivity

ESU productivity had been positive over the period of 1998 to 2006, and adult escapement and juvenile production had been increasing annually (Good *et al.* 2005) until 2007, when productivity became negative (Figure 3) with declining escapement estimates. Therefore, the long-term trend for the ESU remains negative as it consists of only one population that is subject to possible impacts from environmental and artificial conditions. The Cohort Replacement Rate (CRR) for six years from 2007 to 2012 suggests a reduction in productivity, and indicates that the winter-run Chinook salmon population is not replacing itself.

An age-structured density-independent model of spawning escapement by Botsford and Brittnacker (1998 as referenced in Good *et al.* 2005) assessing the viability of Sacramento River winter-run Chinook salmon 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 *et al.* (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 status of the winter-run Chinook salmon population had been improving until as recently as 2006, there is only one population, and it depends on cold-water releases from Shasta Dam, which could be vulnerable to a prolonged drought (Good *et al.* 2005). A recent 5-year status review found that the original listing factors are still impacting winter-run Chinook salmon, plus additional new factors such as climate change, ocean conditions, and recent drought years that put additional stressors on the population (NMFS 2011a). The winter-run Chinook salmon juvenile production estimate (JPE) entering the Delta has declined in recent years to a low of 162,051 in 2012 (Table 2). Recent studies using acoustic tags (Michel 2010) suggest that survival of juvenile winter-run Chinook salmon emigrating the 300 miles from Redding to the Golden Gate Bridge may be much lower than what is currently used. This means that the JPE may underestimate what is actually being produced.

Spatial Structure

The distribution of winter-run Chinook salmon spawning and rearing historically was limited to the upper Sacramento River (which was upstream Shasta Dam) in the McCloud and Pitt rivers, where spring-fed streams provided cold water throughout the summer, allowing for spawning, egg incubation, and rearing during the mid-summer period (Slater 1963, 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.*, the fish weir at the Coleman National Fish Hatchery (CNFH) and other small hydroelectric facilities situated upstream of the weir) (Moyle *et al.* 1989, NMFS 1997, 1998a,b), although the Battle Creek Salmon and Steelhead Restoration Project (BCSSRP) is currently being implemented, which would be opening up and restoring habitat for winter-run Chinook salmon. Approximately 299 miles of tributary spawning habitat in the upper Sacramento River is now inaccessible to winter-run Chinook salmon. Yoshiyama *et al.* (2001) estimated that in 1938, the Upper Sacramento River had a "potential spawning capacity" of approximately 14,000 redds. Most components of the winter-run Chinook salmon life history (*e.g.*, spawning, incubation, freshwater rearing) have been compromised by the construction of Shasta Dam.

Table 2. Winter-run Chinook salmon adult and juvenile population estimates from RBDD counts (1986 to 2001) and carcass counts (2001 to 2012), with corresponding 3-year-cohort replacement rates and medians(source: DFW Grand Tab 2012).

Year	Population Estimate[a]	5-Year Moving Average of Population Estimate	Cohort Replacement Rate[b]	5-Year Moving Average of Cohort Replacement Rate	NMFS-Calculated Juvenile Production Estimate (JPE)[c]
1986	2596				
1987	2185				
1988	2878				
1989	696		0.27		
1990	430	1,757	0.20		
1991	211	1,280	0.07		
1992	1240	1,091	1.78		40,100
1993	387	593	0.90	0.64	273,100
1994	186	491	0.88	0.77	90,500
1995	1297	664	1.05	0.94	74,500
1996	1337	889	3.45	1.61	338,107
1997	880	817	4.73	2.20	165,069
1998	2992	1,338	2.31	2.48	138,316
1999	3288	1,959	2.46	2.80	454,792
2000	1352	1,970	1.54	2.90	289,724
2001	8224	3,347	2.75	2.76	370,221
2002	7441	4,659	2.26	2.26	1,864,802
2003	8218	5,705	6.08	3.02	2,136,747
2004	7869	6,621	0.96	2.72	1,896,649
2005	15839	9,518	2.13	2.84	881,719
2006	17296	11,333	2.10	2.71	3,556,995
2007	2542	10,353	0.32	2.32	3,890,534
2008	2830	9,275	0.18	1.14	1,100,067
2009	4537	8,609	0.26	1.00	1,152,043
2010	1,596	5,760	0.63	0.70	1,144,860[e]
2011	827	2,466	0.29	0.34	332,012
2012	2,674	2,493	0.59	0.39	162,051
median	2,542	2,466	0.95	2.23	412,507

[a] Population estimates were based on RBDD counts until 2001. Starting in 2001, population estimates were based on carcass surveys.

[b] The majority of winter-run Chinook salmon return at age 3. NMFS calculated the CRR using the adult (age 3) spawning population of a given year, divided by the spawning population 3 years prior. Some years have a high number of 2 year old returns but these are not used for the CRR.

[c] JPE estimates include survival estimates from RBDD to the point where they enter the Delta (roughly Sacramento), but not through the Delta.

The greatest risk factor for winter-run Chinook salmon lies with their spatial structure (Good *et al.* 2005). The remnant population cannot access historical winter-run Chinook salmon habitat and must be artificially maintained in the Sacramento River by a regulated, finite cold-water pool behind Shasta Dam, limited to the upper 25-mile reach downstream of Keswick Dam. Winter-run Chinook salmon require cold water temperatures in 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, especially as the BCSSRP is implemented, and winter-run Chinook salmon can be reintroduced when it has been completed, which is planned for 2017. Additionally, the draft CV Recovery Plan includes criteria for recovering the winter-run Chinook salmon ESU, which includes reestablishing a population into historical habitats upstream of Shasta Dam (NMFS 2009b).

Diversity

The second highest risk factor for the winter-run Chinook salmon ESU has been the detrimental effects on its diversity. The present winter-run Chinook salmon population has resulted from the introgression of several stocks that occurred when Shasta Dam blocked access to the upper watershed. A second genetic bottleneck occurred with the construction of Keswick Dam; and there may have been several others after that (Good *et al.* 2005). Concerns of genetic introgression with hatchery populations are also increasing. Hatchery-origin winter-run Chinook salmon from LSNFH have made up more than five percent of the natural spawning run in recent years and in 2012, it exceeded 30 percent of the natural run (Figure 4). The average over the last 16 years (approximately five generations) has been 8.4 percent, still below the low-risk threshold for hatchery influence. However, in the last five years (2008-2012) the average has been greater than 13 percent due to a high (30.2 percent) return in 2012.

If the proportion of hatchery origin fish from the LSNFH exceeded 15 percent, Lindley *et al.* (2007) recommended reclassifying the winter-run Chinook population extinction risk from low to moderate, based on the impacts of the hatchery fish over multiple generations of spawners. Since 2005, the percentage of hatchery fish recovered at the LSNFH has been increasing but consistently below 15 percent, except for 2012 (Figure 4).

Summary

Recently, Lindley *et al.* (2007) determined that the Sacramento River winter-run Chinook salmon population that spawns downstream of Keswick Dam is at a moderate extinction risk according to population viability analysis (PVA), and at a low risk according to other criteria (*i.e.*, population size, population decline, and the risk of wide ranging catastrophe). Lindley *et al.* (2007) also states that the winter-run Chinook salmon population fails the "representation and redundancy rule" because it has only one population, and that population spawns outside of the ecoregion in which it evolved. In order to satisfy the "representation and redundancy rule," at least two populations of winter-run Chinook salmon would have to be re-established in the basalt- and porous-lava region of its origin. An ESU represented by only one spawning population at moderate risk of extinction is at a high risk of extinction over an extended period of time (Lindley *et al.* 2007).

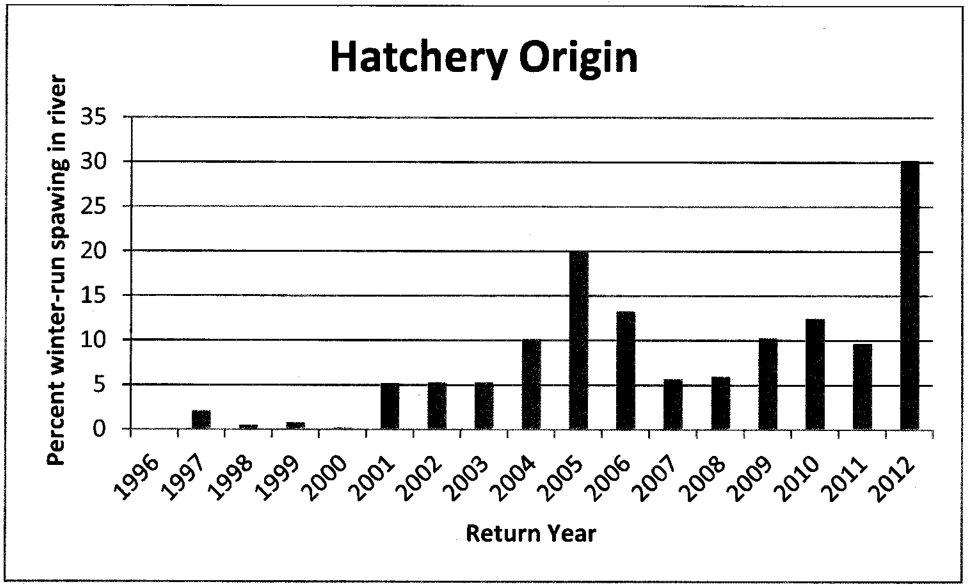


Figure 4. Percentage of winter-run Chinook salmon spawning in the Sacramento River that are of hatchery origin (1996-2012). Source: DFW carcass survey results 12-3-12.

Critical Habitat and Physical and Biological Habitat Features for Sacramento River winter-run Chinook Salmon

The designated critical habitat for Sacramento River winter-run Chinook salmon includes the Sacramento River from Keswick Dam (RM 302) to Chipps Island (RM 0) at the westward margin of Delta including Kimball Island, Winter Island, and Brown's Island; all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Estuary to the Golden Gate Bridge north of the San Francisco-Oakland Bay Bridge. In the Sacramento River, critical habitat includes the river water column, river bottom, and adjacent riparian zone used by fry and juveniles for rearing. In the areas westward of Chipps Island, critical habitat includes the estuarine water column and essential foraging habitat and food resources used by Sacramento River winter-run Chinook salmon as part of their juvenile emigration or adult spawning migration. Although not currently designated critical habitat, we also recognize that juvenile winter-run Chinook salmon utilize the bypasses when flooded and many tributaries of the Sacramento River for non-natal rearing.

Critical habitat for Sacramento River winter-run Chinook salmon is defined as specific areas that contain the Essential Features 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 Chinook salmon as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing (June 16, 1993, 58 FR 33218). It also includes the estuarine water column and essential foraging habitat and food resources used by winter-run Chinook salmon as part of their juvenile outmigration or adult spawning migration (June 16, 1993, 58 FR 33218).

The following are the physical and biological habitat features that are essential for the conservation of winter-run Chinook salmon (June 16, 1993, 58 FR 33216):

1. <u>Access to Spawning Areas in the Sacramento River</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 Chinook salmon generally migrate to spawning areas during the winter and spring. At that time of year, the migration route is mostly free of obstructions. Reasonable and Prudent Alternative (RPA) actions of the 2009 NMFS BO on the Long Term Operations of the Central Valley Project-State Water Project (CVP-SWP) provided a prescription for modified operations of the RBDD gates that reduced impacts on migrating winter-run Chinook salmon (NMFS 2009a). Beginning in 2012, the gates of the RBDD remained open year round.

2. <u>The Availability of Clean Gravel for Spawning Substrate</u>

Spawning habitat for winter-run Chinook salmon is restricted to the Sacramento River between Keswick Dam and RBDD; however, the vast majority of spawning occurs upstream of the Airport Road bridge in Anderson, a distance of only 13 miles of river. Available spawning habit is completely outside the historical range utilized by winter-run Chinook salmon for spawning. Because Shasta and Keswick dams preclude spawning gravel recruitment, the Bureau of Reclamation (Reclamation) injects spawning gravel into various areas of the Sacramento River. With the supplemented gravel injections, the above defined reach of the Sacramento River continues to support the current populations of winter-run Chinook salmon.

3. <u>Adequate River Flows for Successful Spawning, Incubation of Eggs, Fry Development and Emergence, and Downstream Transport of Juveniles</u>

All historical spawning habitats of Sacramento River winter-run Chinook salmon have been blocked by permanent and impassable barriers. Remaining spawning areas are outside of the historical range of winter-run Chinook salmon spawning, and are dependent on releases of cold water from Shasta Dam.

An April 5, 1960, Memorandum of Agreement (MOA) between Reclamation and the DFW originally established flow objectives in the Sacramento River for the protection and preservation of fish and wildlife resources. In addition, Reclamation complies with the flow releases required in Water Rights Order (WRO) 90-05. Additional measures to improve juvenile rearing habitat in the lower Sacramento River and northern Delta are required through the NMFS BO on the Long Term Operations of the CVP-SWP (NMFS 2009a).

4. <u>Water Temperatures for Successful Spawning, Egg Incubation, and Fry Development</u>

Summer flow releases from Shasta Reservoir for agriculture and other consumptive uses drive operations of Shasta and Keswick dams during the period of winter-run Chinook salmon migration, spawning, egg incubation, fry development, and emergence. However, cold water releases also benefit winter-run Chinook salmon. The extent to which winter-run Chinook salmon habitat needs are met depends on Reclamation's other operational commitments, including those to water contractors, State Water Resources Control Board Water Rights Decision 1641 (D-1641) regulations and criteria, and projected end of September storage volume. Based on these commitments and Reclamation's modeled February and subsequent monthly forecasts, Reclamation determines how far downstream 56°F can be maintained and sustained throughout the winter-run Chinook salmon spawning, egg incubation, and fry development stages. Although WRO 90-05 and 91-1 require Reclamation to operate Keswick and Shasta dams, and the Spring Creek Power Plant, to meet a daily average water temperature of 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. In every year since the State Water Resources Control Board issued WRO 90-05 and 91-1, operations plans have included modifying the RBDD compliance point to make best use of the cold water resources based on the location of spawning Chinook salmon. Once a TCP has been identified and established, it generally does not change, and therefore, water temperatures are typically adequate for successful egg incubation and fry development for those redds constructed upstream of the TCP. However, the annual change in TCP has degraded the conservation value of spawning habitat (based on water temperature). As part of the RPA for NMFS' BO on the Long Term Operations of the CVP-SWP, a year-round temperature and Shasta reservoir storage management program to minimize effects to winter-run Chinook salmon spawning, egg incubation, and rearing is included (NMFS 2009a).

5. <u>Habitat Areas and Adequate Prey that are not Contaminated</u>

Current water quality conditions are better than in previous decades, 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. 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. Exposure to these contaminated food sources may create delayed sublethal effects that reduce fitness. Contaminants are typically associated with areas of urban development 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.

6. <u>Riparian Habitat that Provides for Successful Juvenile Development and Survival</u>

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. Some complex, productive habitats with floodplains [*e.g.*, 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) remain in the system. Nevertheless, the current condition of riparian habitat for winter-run Chinook salmon is degraded.

7. Unobstructed emigration corridor from Spawning Grounds to the Pacific Ocean

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 mainstem of the Sacramento River.

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. Prior to 2012, when the gates were in, RBDD reduced the value of the migratory corridor for downstream migration. Predators of juvenile salmonids, such as striped bass (*Morone saxatilis*) and Sacramento pikeminnow (*Ptychocheilus grandis*) are concentrated downstream of dam structures, resulting in increased mortality of juvenile Chinook salmon.

Unscreened diversions that entrain juvenile salmonids are prevalent throughout the mainstem Sacramento River. Although actual entrainment rates are not known, the CVP-SWP operations BA provided calculations of estimated entrainment of salmonids through unscreened diversions along the Sacramento River (Reclamation 2008). According to the calculations, over 7,000 juvenile winter-run Chinook salmon are lost to unscreened diversions annually.

Emigrating juvenile salmonid are also affected by diversion into the interior Delta through the Delta Cross Channel (DCC). When the DCC gates are open during winter-run Chinook salmon outmigration, a portion of the flow, and therefore, a portion of the out-migrating winter-run Chinook salmon, is entrained through the DCC into the interior Delta, where their chances of survival and successful migration to San Francisco Bay and the Pacific Ocean are reduced. D-1641 provides for 45 days of discretionary gate closures of the DCC between November 1 and January 31, which leaves the DCC gates open half the time during those three months. Additional gate closures to keep young fish out of artificial channels and to allow them to migrate safely towards the Ocean are included in the RPA of NMFS' BO on the Long Term Operations of the CVP-SWP (NMFS 2009a).

Water pumping at the CVP-SWP export facilities in the South Delta causes reverse flows, further disrupting the emigration of juvenile winter-run Chinook salmon by attracting and diverting them to the inner Delta, where they are exposed to increased rates of predation and entrainment at pumping stations. NMFS' BO on the Long Term Operations of the CVP-SWP (NMFS 2009a) set limits to the strength of reverse flows in the Old and Middle rivers, thereby keeping salmon away from areas of highest mortality.

Based on impediments caused by the RBDD (up until 2012), unscreened diversions, the schedule of DCC gates operations, and reverse flows in the Delta, the current condition of the freshwater migration corridor in the Sacramento River is much degraded during the emigration of Sacramento River winter-run Chinook salmon.

8. Summary of the Conservation Value of Sacramento River Winter-run Chinook salmon Critical Habitat

Critical habitat for winter-run Chinook salmon is composed of physical and biological features that are essential for the conservation of winter-run Chinook salmon, including upstream and downstream access, and the availability of certain habitat conditions necessary to meet the biological requirements of the species. Currently, many of these physical and biological features are impaired, and provide limited conservation value. Additional factors degrading the quality of the migratory corridor for juveniles include unscreened diversions throughout the mainstem Sacramento River, open DCC gates during the outmigration of winter-run Chinook salmon, and reverse flows in the Delta.

In addition, the annual change in the TCP has degraded the conservation value of available spawning habitats (based on water temperature). The current condition of riparian habitat for winter-run Chinook salmon rearing is degraded by the channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento River system. However, some complex, productive habitats with floodplains remain in the system, including reaches of the Sacramento River with setback levees located upstream of the City of Colusa and flood bypasses (*i.e.*, Yolo and Sutter bypasses). Based on the impediments caused by unscreened diversions, annual changes to the temperature compliance point, diversions into the inner Delta when DCC gates are open, reverse flows in the Delta, and the degraded condition of spawning habitat and riparian habitat, the current condition of critical habitat of Sacramento River winter-run Chinook salmon is degraded, and has low value for the conservation of the species.

C. 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 (National Marine Fisheries Service 2011) 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, June 28, 2005). 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 project. 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.

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). DFW (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).

Table 3. 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]												
Sac. River mainstem[c]												
Mill Creek[d]												
Deer Creek[d]												
Butte Creek[d]												
(b) Adult Holding												
(c) Adult Spawning												
(d) Juvenile migration												
Location	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Sac. River Tribs[e]												
Upper Butte Creek[f]												
Mill, Deer, Butte Creeks[d]												
Sac. River at RBDD[c]												
Sac. River at KL[g]												
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)

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

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) 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, has 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 (Franks, personal communication, 2012), as well as the Yuba River. 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 3). 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.*

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).

Summary of Salmonid Population Viability (VSP)

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). The Mill Creek population of spring-run Chinook salmon is at moderate extinction risk according to the PVA model, but appears to satisfy the other viability criteria for low-risk status. However, 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. One large event could eliminate all three populations.

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, 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). However, after 1981, DFW ceased to estimate in-river spawning spring-run salmon because spatial and temporal overlap with fall-run spawners made it impossible to distinguish between the two races. 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 (Grandtab 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 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 (Table 4). 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. Additionally, 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. The declines in abundance from 2005 to 2011, place the Mill and Deer creek populations in the high extinction risk category due to the rate of decline, and in the case of Deer Creek, also the level of escapement (NMFS 2011b). Butte Creek has sufficient abundance to retain its low extinction risk classification, but the rate of population decline in the past several years is nearly sufficient to classify it as a high extinction risk based on this criteria. 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. The year 2012 appears to have been a good return year for most of the tributaries with some, such as Battle Creek, having the highest return on record (799).

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.

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 (Figure 5). 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 population downstream of Friant Dam in the San Joaquin River, as part of the San Joaquin River Settlement Agreement. Interim flows for this began in 2009 and spring-run are expected to be released in 2014. 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, and to facilitate passage of fish upstream of Englebright Dam on the Yuba River (NMFS 2009b).

Table 4. CV Spring-run Chinook salmon population estimates from DFW Grand Tab (2012) with corresponding cohort replacement rates for years since 1986.

Year	Sacramento River Basin Escapement Run Size[a]	FRFH Population	Tributary Populations	5-Year Moving Average Tributary Population Estimate	Trib CRR[b]	5-Year Moving Average of Trib CRR	5-Year Moving Average of Basin Population Estimate	Basin CRR	5-Year Moving Average of Basin CRR
1986	3,638	1,433	2,205						
1987	1,517	1,213	304						
1988	9,066	6,833	2,233						
1989	7,032	5,078	1,954		0.89			1.93	
1990	3,485	1,893	1,592	1,658	5.24		4,948	2.30	
1991	5,101	4,303	798	1,376	0.36		5,240	0.56	
1992	2,673	1,497	1,176	1,551	0.60		5,471	0.38	
1993	5,685	4,672	1,013	1,307	0.64	1.54	4,795	1.63	1.36
1994	5,325	3,641	1,684	1,253	2.11	1.79	4,454	1.04	1.18
1995	14,812	5,414	9,398	2,814	7.99	2.34	6,719	5.54	1.83
1996	8,705	6,381	2,324	3,119	2.29	2.73	7,440	1.53	2.03
1997	5,065	3,653	1,412	3,166	0.84	2.77	7,918	0.95	2.14
1998	30,534	6,746	23,788	7,721	2.53	3.15	12,888	2.06	2.23
1999	9,838	3,731	6,107	8,606	2.63	3.26	13,791	1.13	2.24
2000	9,201	3,657	5,544	7,835	3.93	2.44	12,669	1.82	1.50
2001	16,869	4,135	12,734	9,917	0.54	2.09	14,301	0.55	1.30
2002	17,224	4,189	13,035	12,242	2.13	2.35	16,733	1.75	1.46
2003	17,691	8,662	9,029	9,290	1.63	2.17	14,165	1.92	1.43
2004	13,612	4,212	9,400	9,948	0.74	1.79	14,919	0.81	1.37
2005	16,096	1,774	14,322	11,704	1.10	1.23	16,298	0.93	1.19
2006	10,948	2,181	8,767	10,911	0.97	1.31	15,114	0.62	1.21
2007	9,726	2,674	7,052	9,714	0.75	1.04	13,615	0.71	1.00
2008	6,368	1,624	4,744	8,857	0.33	0.78	11,350	0.40	0.69
2009	3,801	989	2,812	7,539	0.32	0.69	9,388	0.35	0.60
2010	3,792	1,661	2,131	5,101	0.30	0.54	6,927	0.39	0.49
2011	4,967	1,969	3,067	3,961	0.65	0.47	5,731	0.78	0.53
2012	18,275	7,465	10,810	4,713	3.84	1.09	7,441	4.81	1.34
Median	8,705	3,657	3,067	7,539	0.93	1.79	9,388	1.00	1.35

[a] NMFS is only including the escapement numbers from the Feather River Fish Hatchery (FRFH) and the Sacramento River tributaries in this table. Sacramento River Basin run size is the sum of the escapement numbers from the FRFH and the tributaries.
[b] Abbreviations: CRR = Cohort Replacement Rate, Trib = tributary

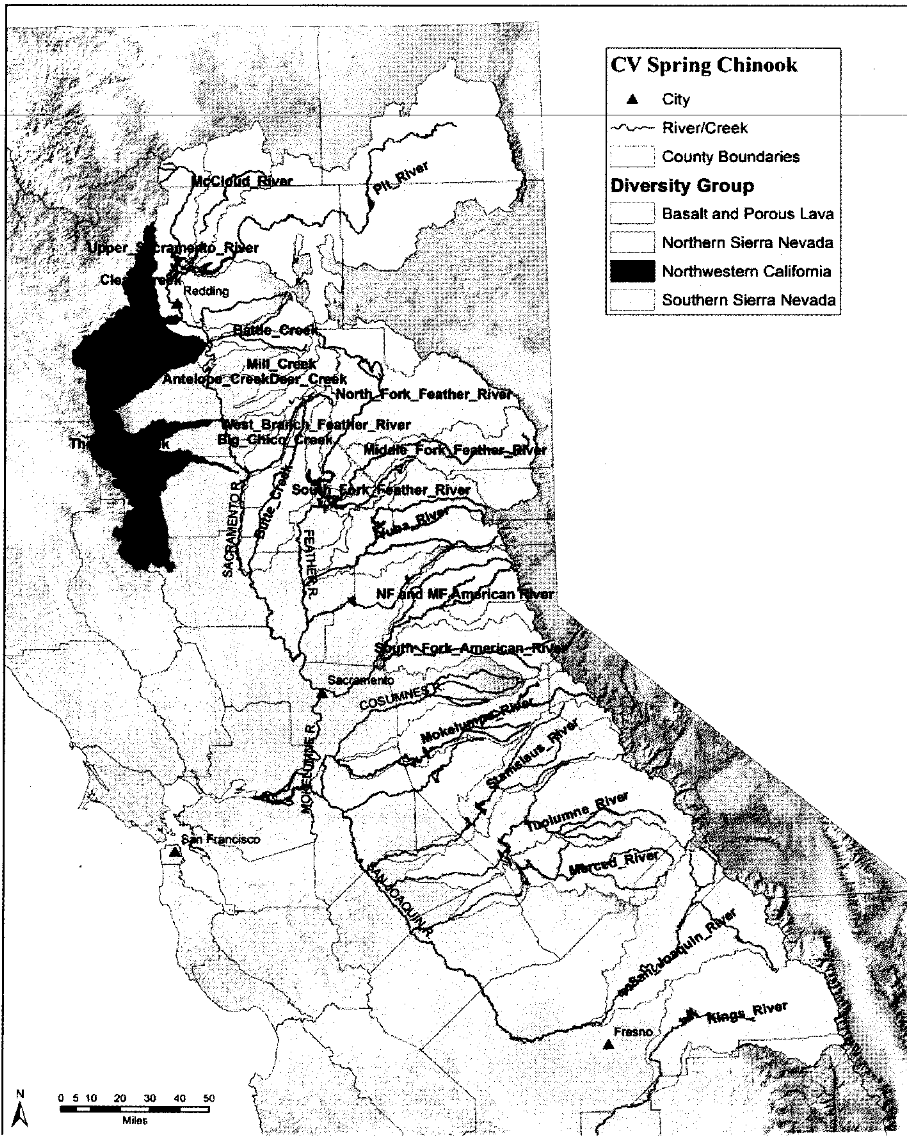


Figure 5. Diversity Groups for the CV spring-run Chinook salmon ESU.

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 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 CV spring-run.

Summary

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, and is at a moderate risk of extinction for the Mill Creek 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.

Critical Habitat and Primary Constituent Elements for CV Spring-Run

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) and physical habitat elements 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.

D. 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 and DPSs, the NMFS proposed that CCV steelhead remain listed as threatened (69 FR 33102). On January 5, 2006, the NMFS reaffirmed the threatened status of the CCV steelhead and applied the DPS policy to the species 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 critical habitat extends up the San Joaquin River up to the confluence with the Merced River.

Species Life History and Population Dynamics

<u>Migratory Forms Present in CV</u>
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 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).

<u>Age Structure</u>
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).

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 1996a).

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).

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).

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.

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).

Adult Run-Timing & 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 5; 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.

Table 5. 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												
[2,3]Sac R at Red Bluff												
[4]Mill, Deer Creeks												
[6]Sac R. at Fremont Weir												
[6]Sac R. at Fremont Weir												
[7]San Joaquin River												

(b) Juvenile migration

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[1,2]Sacramento River												
[2,8]Sac. R at KL												
[9]Sac. River @ KL												
[10]Chipps Island (wild)												
[8]Mossdale												
[11]Woodbridge Dam												
[12]Stan R. at Caswell												
[13]Sac R. at Hood												

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 & Stokes Associates, Inc., 2002; [12]S.P. Cramer and Associates Inc. 2000 and 2001; [13]Schaffter 1980, 1997.

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 CNFH since 1999 is about 3,900 eggs per female (USFWS 2011).

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).

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).

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). Because of the large resident *O. mykiss* population in 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.

DFW 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 DFW. A total of 17 *O. mykiss* were caught during the 2012 season (DFW 2013). 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 (Garza and Pearse, in prep).

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).

Critical Habitat Condition and Function for Species' Conservation

Critical Habitat for Central Valley 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 large woody material (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.

Summary of CCV Steelhead Population Viability

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.

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 DFW 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).

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).

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, Feather River Fish Hatchery, 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 mitigate 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.

<u>Summary</u>

The future of CCV steelhead is uncertain due to limited data concerning their status. However, Lindley *et al.* (2007), citing evidence presented by Yoshiyama *et al.* (1996); McEwan (2001); and Lindley *et al.* (2006), concluded that there is sufficient evidence to suggest that the DPS is at moderate to high risk of extinction. 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.

E. 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.

- Listed as threatened on June 6, 2006 (71 FR 17757)
- Critical habitat designated October 9, 2009 (74 FR 52300)

<u>General Life History</u>

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 (*Acipenser medirostris*) 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).

Information about larval sDPS green sturgeon in the wild is almost completely non-existent. Diet and habitat usage by the larvae are unknown. However, laboratory studies have provided some information about this initial life stage. 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 DFW 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 mysid shrimp (*Neomysis awatschensis)*, amphipods (*Corophium* sp.*)*, 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 6 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 *et al.* 2009).

Green sturgeon do not mature until they are at least 15–17 years of age (Beamesderfer *et al.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.

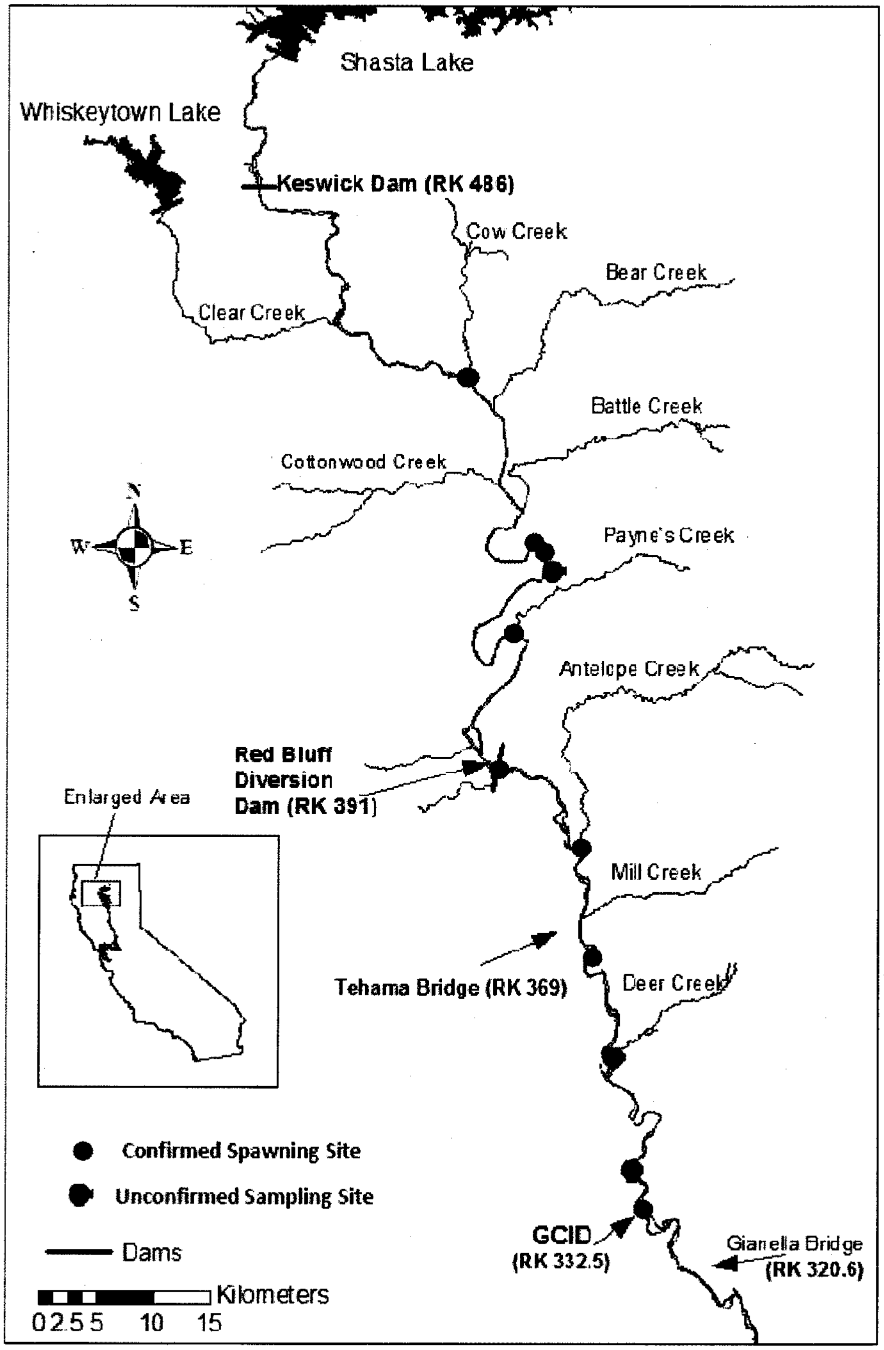


Figure 6: Green sturgeon spawning locations on the upper Sacramento River, as identified by USFWS during the 2008-2012 field sampling seasons. Source: Poytress *et al.* (2012)

Table 6. 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]												
SF Bay Estuary[d,h,i]												

(b) Larval and juvenile (≤10 months old)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RBDD, Sac River[e]												
GCID, Sac River[e]												

(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]												
Sac-SJ Delta[f]												
Sac-SJ Delta[e]												
Suisun Bay[e]												

(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]												

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)

Viability of the 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).

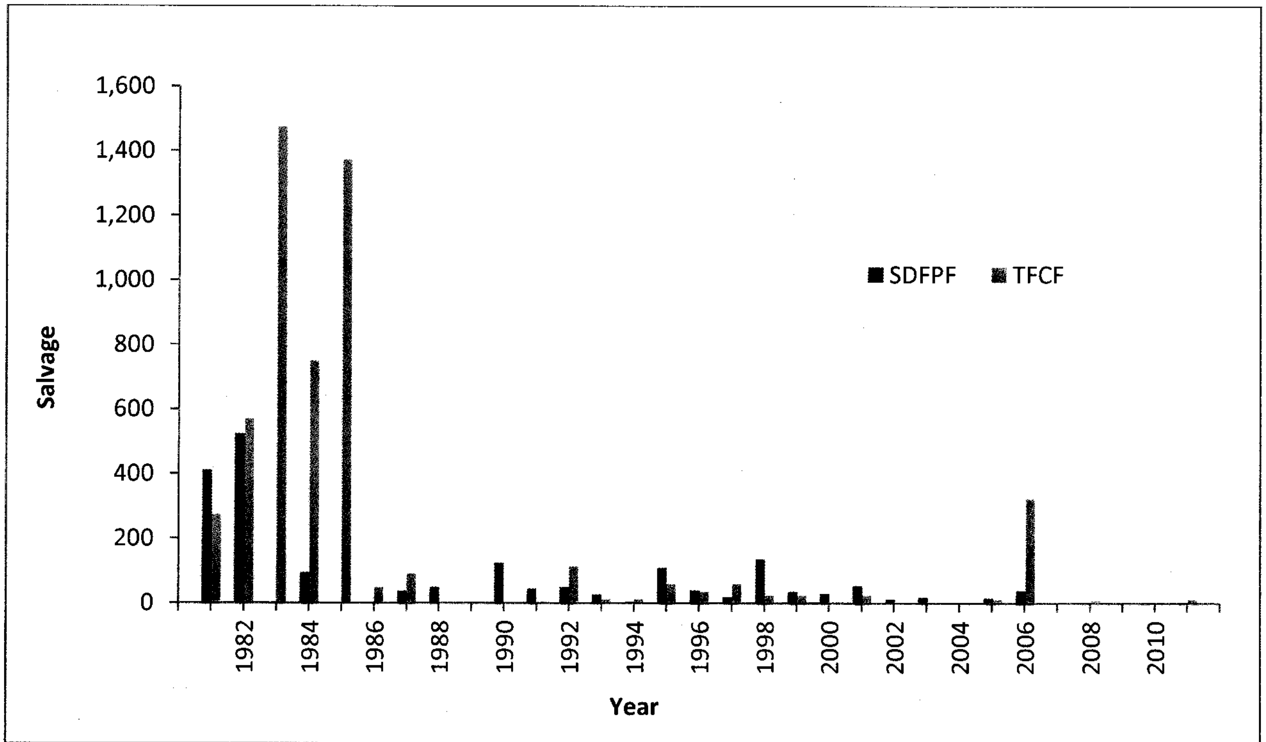


Figure 7. Annual salvage of green sturgeon for the SDFPF and the TFCF from 1981 to 2011. Data source: ftp://ftp.delta.dfg.ca.gov/salvage

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 (population growth rate)

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.

a. A nDPS consisting of populations originating from coastal watersheds northward of and including the Eel River (*i.e.* Klamath, Rogue, and Umpqua rivers) .
b. 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 *et al.* 2009).

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 Endangered Species Act, 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). Within the sDPS, little is known regarding how current levels of diversity (*e.g.*, genetic, life history) compare with historical levels.

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.

5. Summary

The sDPS of North American green sturgeon has not been analyzed to characterize the status and viability as has been done in recent efforts for Central Valley salmonid populations (Lindley *et al.* 2006, Good *et al.* 2005). NMFS assumes that the general categories for assessing salmonid population viability will also be useful in assessing the viability of the sDPS of green sturgeon. The above information has been compiled from the best available data and information on North American green sturgeon to provide a general synopsis of the viability parameters for this DPS.

Southern DPS of North American Green Sturgeon Critical Habitat

1. Delineation of 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.

2. <u>Critical Habitat and Primary Constituent Elements</u>

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. <u>Substrate Type or Size</u>

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 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 the 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. Prey species for juvenile, subadult, and adult green sturgeon within bays and estuaries primarily consist of benthic invertebrates and fish, including crangonid shrimp, callianassid shrimp, burrowing thalassinidean shrimp, amphipods, isopods, clams, annelid worms, crabs, sand lances, and anchovies. 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.

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. Currently, flows provide the necessary attraction to green sturgeon to enter the Sacramento River. Nevertheless, these flows are substantially less than what would have been available historically to stimulate the spawning migration.

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). As described above, adequate levels of DO are also required to support oxygen consumption by juveniles [ranging from 61.78 to 76.06 mg O_2 hr^{-1} kg^{-1}, Allen and Cech (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. Water quality in the areas such as the Stockton turning basin and Port of Stockton routinely have depletions of DO and episodes of first flush contaminants from the surrounding industrial and urban watershed. 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 the safe and 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. Rearing fish need the ability to freely migrate from the river through the estuarine waterways of the delta and bays and eventually out into the ocean. 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 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. Hydraulic dredging can result in the entrainment of fish into the dredger's hydraulic cutterhead intake. 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 ($\geq$ 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 to come.

Factors affecting the species and critical habitat
As described previously, the sDPS of green sturgeon is composed of only a single confirmed spawning population, with a possible second spawning population on the Feather River. This extremely limited population diverstiy gives the sDPS of green sturgeon little flexibility to cope with any potential adverse changes in the environment. Lindley *et al.* (2007) pointed out that a single fish species population at moderate risk of extinction is actually at a high risk of extinction over the long term. Much of the work done by Lindley on extinction risk focused on salmonids, which may spawn only a single time in their lifespan; green sturgoen, being iteroparous, have the advantage of multiple spawning opportunities over a relatively long life span, and this fact may give the species some resilience to temporally isolated impacts.

In considering the variety of factors that impact sDPS green sturgeon and their critical habitat, the topics below outline those items essential to the survival of the species.

1. Food Resources

Abundant prey resources are essential for green sturgeon rearing. Green sturgeon are benthic feeders that have a mouth evolved for feeding on bottom substrates. They feed 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 mysid shrimp (*Neomysis awatschensis*), amphipods (*Corophium sp.*), and other unidentified shrimp.

Invasive species are a concern because they may replace the natural food items consumed by green sturgeon. The Asian overbite clam 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 is necessary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds. Furthermore, 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. 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 parts per thousand - ppt) to salt water (33 ppt). Juvenile green sturgeon are able to tolerate full strength seawater by 1.5 years of age (Allen and Cech, 2007). Subadult and adult green sturgeon occupy a wide range of DO levels (Kelly *et al.* 2007, Moser and Lindley 2007). Adequate levels of DO are also required to support oxygen consumption by juveniles (ranging from 61.78 to 76.06 mg O_2 hr^{-1} kg^{-1} (Allen and Cech 2007). Suitable water quality also includes water free of contaminants (*e.g.*, organochlorine pesticides, selenium, methyl mercury, or 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. Regarding contaminants, selenium seems to be of particular concern to green sturgeon. Silvestre *et al.* (2010) noted developmental abnormalities and mortalities in larval green sturgeon exposed to selenium; additional research is needed to determine threshold levels of selenium in the environment and food chain that are dangerous to green sturgeon.

4. Migratory Corridor

Safe and unobstructed migratory pathways are necessary for the safe and 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. Rearing fish need the ability to freely migrate from the river through the estuarine waterways of the Delta and bays and eventually out into the ocean. 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.

5. Water Depth

A diversity of depths is necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages. Tagged adults and subadults within the San Francisco Bay estuary primarily occupied waters over shallow depths of less than 10 m, 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). Thus, a diversity of depths is important to support different life stages and habitat uses for green sturgeon within estuarine areas.

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.

F. Factors affecting the Current Status of Listed Species

Profound alterations to the riverine habitat of the CV began with the discovery of gold in the mid-1800s which resulted in stream bed alteration and increased sedimentation, reducing the quality and availability of spawning and rearing habitat from mining activities and other land uses. Subsequent human activities further contributed to the decline of CV anadromous salmonids and the sDPS of green sturgeon, eventually leading to listing the species under the ESA. These activities, which are ongoing and continue to affect the species and their habitats, include: (1) dam construction and continued use that blocks previously accessible spawning and rearing habitat; (2) water development activities that affect flow quantity, timing, and water quality; (3) land use activities such as agriculture, flood control, urban development, mining, and logging that degrade aquatic habitat and decrease prey abundance; (4) hatchery operation and practices; and (5) harvest activities. Although the life histories and geographic extent of winter-run and spring-run Chinook salmon, steelhead, and green sturgeon are different, much of their freshwater habitat overlap, and therefore, most of the factors responsible for their current statuses are similar. Unless specified, the following discussion of factors that have affected the current status of listed species applies to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and the sDPS of green sturgeon.

The construction of high dams for hydropower, flood control, and water supply resulted in the loss of vast amounts of upstream habitat (*i.e.*, approximately 80 percent, or a minimum linear estimate of over 1,000 stream miles), and often resulted in precipitous declines in affected salmonid populations. For example, the completion of Friant Dam in 1947 caused the extirpation of spring-run Chinook salmon in the San Joaquin River upstream of the Merced River within just a few years. The reduced populations that remain downstream of CV dams are forced to spawn in lower elevation tail-water habitats of the mainstem rivers and tributaries that were previously not used for this purpose. This habitat is entirely dependent on managing reservoir releases to maintain cool water temperatures suitable for spawning, and/or rearing of salmonids. This requirement has been difficult to achieve in all water year types and for all life stages of affected salmonid species. Steelhead, in particular, seem to require the qualities of small tributary habitat similar to what they historically used for spawning; habitat that is largely unavailable to them under the current water management scenario. Fish hatcheries were created to mitigate for impacts resulting from CV water management projects. The production of hatchery fish in mitigation hatcheries has been successful at providing fishing opportunities while causing unquantified impacts to natural salmonid populations from increased competition, genetic impacts, exposure to diseases, increased harvest, etc.

Land-use activities such as road and levee construction, urban development, logging, mining, agriculture, and recreation are pervasive and have significantly altered fish habitat quantity and quality for Chinook salmon and steelhead through alteration of streambank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWM; and removal of riparian vegetation resulting in increased streambank erosion. Human-induced habitat changes, such as alteration of natural flow regimes; installation of bank revetment; and building structures such as dams, bridges, water diversions, piers, and wharves, often provide conditions that both disorient juvenile salmonids and attract predators. Harvest activities, ocean productivity, and drought conditions provide added stressors to listed salmonid populations.

IV. Environmental Baseline

The environmental baseline provides information necessary to determine whether actions proposed under the SERP would jeopardize the continued existence of the federally listed species being considered. ESA regulations define the environmental baseline as "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 "effects of the action" include the direct and indirect effects of the proposed action and of interrelated or interdependent activities, "that will be added to the environmental baseline" (50 CFR 402.02); therefore, the environmental baseline provides a reference condition to which we add the effects of conducting the proposed action.

The environmental baseline describes the status of listed species and critical habitat in the proposed action area, to which we add the effects of the proposed action, to consider the effects of the proposed Federal actions within the context of other factors that impact the listed species. 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 proposed action 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 environmental baseline does not consider the effects of the Corps' Engineering Technical Letter No. 1110-2-571 regarding vegetation on flood management structures (levees) (Corps 2009), which prescribes removing woody vegetation throughout the coverage area to ensure levee integrity. How implementing this policy may affect the environmental baseline is unclear at this time because the draft policy paper assumes that removing vegetation is the responsibility of the local maintaining agencies. The existing environmental baseline considers California's Central Valley Flood Protection Plan vegetation standard. Should fully implementing the Corps vegetation policy necessitate that a different baseline be analyzed, that baseline will be analyzed under a separate consultation and may require reinitiation of this consultation.

For Phase 1 of SERP the coverage area would be a subset of SRFCP, representing approximately 300 miles of levees maintained by DWR in Butte, Colusa, Glenn, Placer, Sacramento, Solano, Sutter, Yolo, and Yuba counties.

Hydrology and Geomorphology

The Sacramento River watershed receives winter and early spring precipitation in the form of rain and snow. Before the construction and operation of 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. Much of the total runoff is now captured and stored in reservoirs for gradual release during summer and fall. High river flows occur during 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 southernmost portion of the SERP coverage area (Region 1) includes portions of the mainstem of the Sacramento River that are part of the Sacramento–San Joaquin Delta (Delta). Historically, the decrease in slope in the lower river valley and Delta caused flood flows to spread across the floodplain and to deposit fine-grained sediments, eventually building up enough sediment to form natural levees that confined water and sediment to the main river channel under low to intermediate flow conditions. The bank material consisted of cohesive clay deposits that eroded slowly, which also naturally limited the meander migration rates of the lower river reach (Fischer 1994, cited in The Bay Institute 1998). These natural levees supported extensive woody riparian vegetation, particularly where they were widest (The Bay Institute 1998). Upstream of the Delta, the flood basins supported large nontidal wetlands (primarily tule marshes) (The Bay Institute 1998). Human-made infrastructure to manage flooding took advantage of some of these natural features to create the current system of levees and bypass channels that serve to contain and divert flood flows. Currently, hydrogeomorphic processes of erosion and deposition are affected by the confinement of the channel network by levees and armoring of the banks (including most of the sloughs), and by the function of the bypass channels, which spread floodwater across a large area and divert it around the main river channel.

The portion of the Sacramento River from the Delta to the confluence with the Feather River is confined by levees and bank protection structures of various types, such as cobble and angular quarry stone revetments and wing-dikes. These reaches are interspersed with natural bank areas, such as occasional outcrops of cemented alluvial deposits (Modesto Terrace) that historically provided natural constraints to lateral migration. Bank modifications have been implicated in habitat simplification through the loss of erosional and depositional features (Li *et al.* 1984; Jungwirth *et al.* 1993). However, other modifications, such as flow regulation, clearing of riparian vegetation, levee and bypass construction, reservoir operations, and gravel mining, also contribute to major changes in geomorphic and riparian community processes (Jones & Stokes

2000). Thus, most reaches downstream of Colusa exhibit lower sinuosity, fewer overbank flows, and an altered pattern of channel migration and meander cutoff than was present in the 1900s (Brice 1977).

In the Sacramento River from the confluence of the Feather River to Colusa (Region 2), constrained reaches alternate with unconstrained ones where levees are set back over 500 feet from the high-water channel edge. Upstream of Colusa (Region 3), levees are set back farther, often more than 2,000 feet from the channel's edge. These areas are somewhat less constrained; therefore, lateral migration and the formation of back channels and oxbows occur, though rarely, in these areas. In areas with natural banks, the presence of oxbows, floodplains, point bars, islands, and in-channel woody material (IWM) provides evidence that river meander, migration, and erosion still occur, providing more dynamic and diverse habitat. For example, point bars formed by active channel migration provide shallow water and important aquatic invertebrate habitat. During channel adjustments, large woody material can be dislodged from adjacent riparian forests and deposited in the channel as IWM, creating another habitat feature.

Open Water

Historically, reaches in the southern portion of the SERP coverage area had variable seasonal and interannual salinity (Lund *et al.* 2007) caused by the influence of tides, wind waves, and freshwater discharge from tributary rivers (Moyle 2002). However, there is currently debate over where and how much variability existed in the past (Lund *et al.* 2007). Today, water diversions and regional pumping stations in the Delta allow the southern reaches of the SERP coverage area to support freshwater conditions year-round in most years (Moyle 2002).

Reaches throughout the Phase I SERP action area historically provided both shallow and deeper water habitat; however, levees that confine channels 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 (Moyle 2002). As a consequence of habitat alterations and the introduction of nonnative species and pollutants, some native fish species are now extinct while most others are reduced in numbers and range (Moyle 2002).

Presently, several native and nonnative fish species occur in CV streams and rivers, including river lamprey (*Lampetra ayresi*), striped bass, American shad (*Alosa sapidissima*), largemouth bass (*Micropterus salmoides*), and several species of minnows (family Cyprinidae), sunfish (family Centrarchidae), and catfish (family Ictaluridae). In general, native species, such as Sacramento pikeminnow, hardhead (*Mylopharodon conocephalus*), Sacramento sucker (*Catostomus occidentalis*), and California roach (*Lavinia symmetricus*), spawn early in spring. With some exceptions, nonnative species, such as green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), white catfish (*Ameiurus catus*), channel catfish (*Ictalurus punctatus*), and largemouth bass, spawn in late spring and summer. Many of the nonnative fish species are more tolerant of warm water, low DO, and disturbed environments than native species. In general, they are adapted to warm, slow-moving, and nutrient-rich waters (Moyle 2002).

Vegetation

Historical precipitation and runoff patterns resulted in up to 500,000 acres of riparian forest bordering the Sacramento River and valley oak woodland covering the higher river terraces (Katibah 1984). However, human activities of the 1800s and 1900s 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.

Seven vegetation cover type categories are used to describe the existing vegetation in the Phase 1 SERP action area. The area that has been classified includes lands between the high-water channel edge (the line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in soil characteristics, destruction of terrestrial vegetation, or the presence of litter and debris) and the levee crest and a 100-foot buffer along the high-water channel edge (for areas with no levees). Several types of sensitive plant communities are located within the Phase 1 SERP action area. Sensitive natural plant communities are defined as vegetation cover types that are especially diverse, regionally uncommon, or of special concern to federal, State, and local agencies. Riparian Forest and Riparian Scrub/Shrub communities qualify as sensitive natural communities, while the Riparian Herbaceous community generally does not (DFG 2003). The seven vegetation cover types used in this assessment are described below.

(1) Riparian Forest

This vegetation cover type includes the Great Valley Cottonwood Riparian Forest, Great Valley Mixed Riparian Forest, Young Cottonwood Forests, and Valley Oak Forest plant community types delineated by the Sacramento River Riparian Vegetation project (Nelson *et al.* 2000). Riparian forest habitat is composed of mature native and nonnative trees. Trees and shrubs are interspersed, with heights ranging from a few feet to almost 100 feet above the ground or shoreline. Vegetation in a riparian forest provides habitat with overhead and instream shaded riverine aquatic cover for aquatic species. The riparian forest along the Sacramento River consists primarily of a tall overstory of deciduous broadleaf trees, with Fremont cottonwood (*Populus fremontii*) and Valley oak (*Quercus lobata*) being the most prevalent species. These species may contain California wild grape (*Vitis californica*) and Colorado Desert mistletoe (*Phoradendron macrophyllum*). Nonnative riparian forest species also contribute to the overstory composition in many areas. The most prevalent nonnatives are blue gum (*Eucalyptus* spp.), black locust (*Robinia pseudoacacia*), and English walnut (*Juglans regia*). Shrub species present in the understory of the riparian forest habitat can include native and nonnative species, such as California and Himalayan blackberry (*Rubus ursinus* and *R. discolor*), California rose (*Rosa californica*), Pacific poison oak (*Toxicodendron diversilobum*), common buttonbush (*Cephalanthus occidentalis* var. *californicus*), and blue elderberry (*Sambucus mexicana*). Elderberry is a species of concern because it is a host plant for the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). Elderberry is usually found along the upper elevations of the floodplain.

(2) Riparian Scrub/Shrub

This vegetation cover type includes areas delineated as Blackberry Scrub and Great Valley Riparian Scrub (Nelson *et al.* 2000). The Riparian Scrub/Shrub vegetation cover type primarily occurs at the low and middle elevations on banks and consists of shrub species and riparian tree species that are less than 20 feet tall. Species composition of the Riparian Scrub/Shrub community is similar to that described above for Riparian Forest.

(3) Riparian Herbaceous

This vegetation cover type includes Herbland Cover and the Gravel and Sand Bar community types (Nelson *et al.* 2000). Areas were only designated Herbland Cover if they were enclosed by riparian vegetation or the stream channel. The Gravel and Sand Bar community type is included in this grouping because these areas support annual and short-lived perennial species, including herbs, grasses, and subshrubs that cover less than 50 percent of a given area (Nelson *et al.* 2000).

The Riparian Herbaceous vegetation cover type occurs on the waterside of the levees, within gaps in the riparian forest canopy and Riparian Scrub/Shrub communities, at the middle and high elevations of banks, and on sand and gravel bars. The Riparian Herbaceous type of vegetation cover exists primarily in areas with frequent natural or human-induced disturbance; consequently, the species composition is a mix of native and nonnative plants. Species commonly found in the herbaceous riparian communities include European annual and native perennial grasses; other native perennials such as Douglas' sagewort (*Artemisia douglasiana*), whiteroot (*Carex barbarae*), smooth horsetail (*Equisetum laevigatum*), California pea (*Lathyrus jepsonii* var. *californicus*), and cudweed (*Gnaphalium* sp.); nonnative forbs and grasses such as garden asparagus and Bermuda grass (*Cynodon dactylon*); and invasive plants such as yellow star-thistle (*Centaurea solstitialis*). Monospecific stands of the invasive exotic giant reed (*Arundo donax*) are also included in this vegetation type category.

(4) Emergent Marsh

This vegetation cover type includes Valley Freshwater Marsh and Common Reed plant community types (Nelson *et al.* 2000). Emergent Marsh includes valley freshwater marsh that is dominated by cattails (*Typha* spp.) and tule (*Scirpus* spp.) with some sedge or associated broad-leaved aquatic species (such as *Verbena hastata*). Common reed (*Phragmites australis*) can grow in inundated areas and forms monocultures along the channel edge. Emergent aquatic vegetation provides refuge for several special-status fish species from predatory fish as well as a base for food production.

(5) Bare Ground

Areas within the levee boundaries are classified as Bare Ground if they appear to be disturbed and devoid of vegetation. Areas undergoing "major disturbance" and that are "completely devoid of vegetation" or have very little vegetation is included in this category (Nelson *et al.* 2000).

(6) Agricultural

Areas within the levee lines that are in active agricultural production, such as alfalfa and rice fields and orchards, are classified as Agricultural. Agricultural lands include laneways and hedgerows that provide habitat for various edge species such as hawks, rabbits, mice, ground squirrels, and red foxes.

(7) Ruderal Vegetation
Ruderal vegetation includes areas with sparse to moderate herbaceous plant cover that is likely dominated by weedy upland species such as star thistle, ox tongue (*Picris echioides*), dandelion (*Taraxacum officinale)*, and various European grasses.

V. Physical Conditions Baseline

This section describes baseline physical conditions of riverbanks within different regions of the Phase 1 SERP action area. This section also describes the extent and distribution of riparian vegetation types that occur within the bounds of existing levees or in areas where no levees exist and within 100 feet of the high-water channel edge.

<u>Region 1: Delta–Sacramento River and Major Tributaries, River Mile (RM) 0 to RM 60</u>
The Sacramento River flows into the Delta downstream of Isleton (RM 20), forming a distribution network of sloughs and channels. Flow is also received via the Yolo Bypass, which is a leveed, wide floodplain that flows parallel to the west of the mainstem Sacramento River during high flows. Additional flow comes from several water courses that feed into the bypass, including Knights Landing Ridge Cut, Cache Creek, Willow Slough Bypass, Sacramento Bypass, and Putah Creek. Seasonal high flows enter the Yolo Bypass from the Sacramento River via the Fremont Weir (RM 83) and the Sacramento Weir (RM 63). Flow velocities are low because flow is distributed throughout the Delta channels and sloughs. The Delta channels and sloughs are bordered by relatively low levees consisting of both natural bank materials and revetment (Jones and Stokes Associates 1987). These levees and structures to protect the banks prevent the river's access to historical tidal wetlands and islands.

Sloughs and channels in this region are generally confined on both sides by natural levees enhanced by decades of human-made improvements. The individual channels and sloughs are moderately sinuous, of uniform width, and do not migrate. Compared with the upper regions, seasonal flood events have less of an impact on the area because of both tidal action and the diversion of flow through the upstream flood bypasses and outtakes (USFWS 2001a). Historically, channel and slough morphology actively adjusted throughout the Delta in response to seasonal variations in flow and sediment load. The decrease in flow velocities caused the deposition of a gradient of coarser to finer material from upstream to downstream (fine sand to clayey silt). The intertidal deposits that border the Delta channels and sloughs are typically characterized by shallow, alternating layers of fine sandy silt and clayey silt, with occasional peaty muds. Artificial fill from hydraulic dredge soils was placed after 1900 throughout the Delta along channel margins and on various island surfaces (Atwater 1982).

The riparian forests in this region are primarily classified as Great Valley Mixed Riparian forest, but a small amount is classified as Great Valley Cottonwood Forest. Nearly all of the Riparian Scrub/Shrub is classified as Great Valley Riparian Scrub/Shrub. A small fraction of this area supports the invasive giant reed. Ruderal vegetation covers the remaining area of mapped land in this area. The riparian and forest vegetation that exists in Region 1 is primarily the narrow band of vegetation along the lower Sacramento River (RM 1–20).

The natural community in the Delta has been significantly altered since pre-European settlement times. Broad floodplains near the Delta that were once occupied by tule marshes have become isolated from the channels by levees. Patches of tule habitat are still present at the mouths of sloughs and in several areas. However, riparian vegetation along the major sloughs is restricted to scattered narrow bands typically less than 30 feet wide on banks, berms, and levee faces (Corps 2004). Bank revetments are common throughout this region.

Channels within Region 1 of the Phase 1 SERP coverage area include a segment of the Sacramento River downstream of the Sacramento Bypass, the Sacramento Bypass, the uppermost segment of the Yolo Bypass, the lowermost segment of Cache Creek, the Willow Slough Bypass, and the lowermost segment of Putah Creek.

Adult CCV steelhead could be present in Region 1 year-round; however, peak abundance is during the period between August and October. During the period of August-October, adult CCV steelhead enter freshwater to spawn, with a peak migration period of September-October (Moyle 2002). The peak of juvenile CCV steelhead emigration in Region 1 occurs during the period between March and June. Adult CV spring-run Chinook salmon are present in Region 1 from February to September with peak abundance between May and June. The peak of juvenile CV spring-run Chinook salmon emigration in Region 1 occurs during the period between December and April, though presence is possible from November to May. Adult Sacramento River winter-run Chinook salmon are present in Region 1 from December to July with peak abundance in March. The peak of juvenile Sacramento River winter-run Chinook salmon emigration in Region 1 occurs during the period between December and February, though presence is possible from September to April. Adult North American green sturgeon could be present in portions of Region 1 year-round. Year-round presence is expected in the Sacramento River. Larval and juveniles could be present from May to August, older juveniles and adults could be present year-round. Spawning will not occur in Region 1, with the exception of the potential for CCV steelhead spawning in Putah Creek.

Region 2: Mainstem Sacramento River and Major Tributaries, RM 60 to RM 143

From Colusa (RM 143) downstream of the Colusa Bypass to the confluences with the Feather River and Sutter Bypass at Verona (RM 80), the channel is generally confined by levees along the riverbanks, except in a few locations where they are set back to provide overflow across point bars of major meander bends (Jones and Stokes Associates 1987). Butte Creek, the Sutter Bypass, and the Feather River contribute flows into this reach (RM 80). To provide flood capacity, overflows at the Tisdale Weir (RM 119) are conveyed into the Tisdale Bypass, which routes the water into the Sutter Bypass. Upstream of this region, floodwaters may overflow the left bank into Butte Basin via three locations near Chico Landing and through the Moulton (RM 158) and Colusa (RM 146) Weirs. At extremely high river stages, floodwaters may also overflow the right bank of the river and drain into the Colusa Basin, which eventually connects to the Sacramento River and Yolo Bypass via the Colusa Main Drain. The Feather River has a relatively large drainage basin along the Sierra foothills. The basin receives input from several key tributaries, including Honcut Creek, the Yuba River, and the Bear River. Floodwaters may alternatively exit this reach of the Sacramento River via the Fremont Weir (RM 83) into the upper Yolo Bypass.

Within this region, the mainstem Sacramento River is primarily a sinuous single-thread channel with uniform width. Adjacent levees and revetment are present on both sides of the channel. A narrow berm of natural substrate is present inside the levees in some reaches, providing some erodible material; however, erosion and deposition are probably greatly diminished from pre-European settlement conditions (USFWS 2001a).

IWM input is only a small fraction of the historical rates that occurred prior to constructing levees and clearing floodplain forests (USFWS 2001a). Riparian vegetation is limited to relict stands and individual trees that have taken root in sands deposited over bank revetment. The elimination of channel migration, chute cutoffs, and overbank deposition has reduced the availability of suitable riparian recruitment areas that are essential for developing and maintaining the riparian ecosystem and maintaining IWM to the Sacramento River over the long term. However, several areas north of the Feather River confluence include setback levees where some channel meander and associated habitat complexity have been restored.

Channels in Region 2 of the Phase 1 SERP coverage area include the uppermost segment of the Colusa Main Drain, the Wadsworth and Cherokee canals, the left bank of the Sutter Bypass, Butte Creek, and a segment of the right bank of the Feather River.

Adult CCV steelhead could be present in Region 2 year-round; however, peak abundance is during the period between August and October. During the period of August-October, adult CCV steelhead enter freshwater to spawn, with a peak migration period of September-October (Moyle 2002). The peak of juvenile CCV steelhead emigration in Region 2 occurs during the period between March and June. Adult CV spring-run Chinook salmon are present in Region 2 from February to September with peak abundance between April and June. The peak of juvenile CV spring-run Chinook salmon emigration in Region 2 occurs during the period between December and April, though presence is possible from November to May. Adult Sacramento River winter-run Chinook salmon are present in Region 2 from December to July with peak abundance in March. The peak of juvenile Sacramento River winter-run Chinook salmon emigration in Region 2 occurs during the period between December and February, though presence is possible from September to April. Adult North American green sturgeon could be present in portions of Region 2 year-round. Year-round presence is expected in the Sacramento River, and possible in the Feather River. Larval and juveniles could be present from May to August, older juveniles and adults could be present year-round.

Listed species spawn in Region 2. CCV steelhead, and spring-run Chinook salmon spawn in Butte Creek. CCV steelhead, spring-run Chinook salmon, and North American green sturgeon spawn in the Feather River.

<u>Region 3: Upper Sacramento and Major Tributaries, RM 143 to RM 194</u>
Upstream of Colusa (RM 143), the Sacramento River meanders between widely spaced setback levees, which allow the river to continue its lateral migration processes within a floodplain. Levees of the SRFCP begin downstream from Ord Ferry (RM 184) on the right bank and downstream from Butte City (RM 176) on the left bank. Just upstream of Colusa, floodwaters are diverted over Colusa Weir (RM 146) into the lower Butte Basin.

Within this region, the Sacramento River is a meandering single-thread channel bordered by levees that are set back from the channel banks. Geomorphologic features that can be found along this reach include natural overflow areas, point bars, cut banks, islands, and oxbows. The channel is bounded by natural and levee alluvium consisting of unconsolidated silt- to cobble-sized particles (Saucedo and Wagner 1992). Channel migration is limited by revetment and other structures, even within the uppermost portion of this region. Channels in the Phase 1 SERP coverage area within this region include a segment of the Sacramento River upstream of Colusa and the Colusa Weir.

Adult CCV steelhead could be present in Region 3 year-round; however, peak abundance is during the period between August and October. During the period of August-October, adult CCV steelhead enter freshwater to spawn, with a peak migration period of September-October (Moyle 2002). The peak of juvenile CCV steelhead emigration in Region 3 occurs during the period between March and June. Adult CV spring-run Chinook salmon are present in Region 3 from February to September with peak abundance between May and June. The peak of juvenile CV spring-run Chinook salmon emigration in Region 3 occurs during the period between December and April, though presence is possible from November to May. Adult Sacramento River winter-run Chinook salmon are present in Region 3 from December to July with peak abundance in March. The peak of juvenile Sacramento River winter-run Chinook salmon emigration in Region 3 occurs during the period between December and February, though presence is possible from September to April. Adult North American green sturgeon could be present in Region 3 year-round. Larval and juveniles could be present from May to August, older juveniles and adults could be present year-round. Spawning will not occur in Region 3.

Region 4: Non-anadromous SERP Waterways
Region 4 is composed of a group of waterways throughout each of the regions described above that has fish passage restrictions and is thus isolated from anadromous fish populations. These waterways include but are not limited to the Willow Slough Bypass and Cache Creek from the Yolo Bypass to the upstream limit of the SRFCP levees. Timing restrictions for project construction have been reduced in these waterways because of the absence of potential anadromous fish habitat.

VI. EFFECTS OF THE ACTION

A. Approach to the Assessment

Pursuant to section 7(a)(2) of the ESA, Federal agencies are directed to insure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. To evaluate whether an action is likely to result in jeopardy to a listed species or result in the destruction or adverse modification of designated critical habitat, this BO considers the combination of the status of the species and critical habitat, the environmental baseline, the physical conditions baseline, the effects of the action, the cumulative effects of non-Federal actions that are reasonably certain to occur within the action area, and the interrelated or interdependent action. Regulations that implement section 7 of the ESA provide that the "effects of the action" refers to 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). An action that is not likely to jeopardize the continued existence of the listed species is one that is not reasonably expected to appreciably reduce the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution (50 CFR 402.02). This BO does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we rely upon the statutory provisions of the ESA and determine the effects of the action on the conservation value of critical habitat designated for listed species.

This BO assesses the effects of the SERP Phase I proposed actions on the listed Sacramento River winter-run Chinook salmon ESU, CV spring-run Chinook salmon ESU, CCV steelhead DPS, and sDPS of North American green sturgeon, and their designated critical habitats.

In the section II, "Description of the Proposed Action," of this BO, NMFS provided an overview of the action. In the sections III, IV, and IV, "Environmental Baseline", "Physical Conditions Baseline", and "Status of the Species and Critical Habitat", respectively, NMFS provided an overview of the threatened and endangered species in the action area of this consultation.

NMFS generally approaches "jeopardy" analyses in a series of steps. First, we evaluate the available evidence to identify the direct and indirect physical, chemical, and biotic effects of proposed actions on individual members of listed species or aspects of the species' environment (these effects include direct, physical harm or injury to individual members of a species; modifications to something in the species' environment - such as reducing a species' prey base, enhancing populations of predators, altering its spawning substrate, altering its ambient temperature regimes; or adding something novel to a species' environment - such as introducing exotic competitors or a sound). Once we have identified the effects of an action, we evaluate the available evidence to identify a species' probable response (including behavioral responses) to those effects to determine if those effects could reasonably be expected to degrade the Viable Salmonid Population parameters of listed species, including abundance, productivity, diversity, or spatial structure. We then use available evidence to determine if proposed activities would be likely to diminish the quantity, quantity, or diversity of critical habitats. Lastly, we determine if the effects of the proposed actions, if there are any, to VSP parameters or critical habitats could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild or result in destruction or adverse modification to critical habitat.

To evaluate the effects of the SERP Phase I, NMFS examined the potential proposed actions in the designated action areas, expected short- and long-term habitat modifications, and conservation measures, to identify likely impacts to listed anadromous salmonids within the action area based on the best available information. NMFS examined an extensive amount of evidence from a variety of sources. Detailed background information on the status of these species and critical habitat has been published in a number of documents including ESU and DPS status reviews, the scientific literature, life history descriptions, Federal Register notices, *etc.* This assessment also used information from the BA developed for the proposed action, and available monitoring data from other CV fish studies.

B. Assessment

The SERP Phase I footprint is described in Section II, C (Action Area). In general, the footprint consists of the levee repair areas and adjacent staging areas. The continued existence of the levees and its operational aspects may adversely affect several life stages of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and the sDPS of North American green sturgeon in the SERP Phase I action area.
The assessment will consider the nature, duration, and extent of the potential SERP Phase I actions relative to the migration timing, behavior, and habitat requirements of federally listed Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS of North American green sturgeon. Specifically, this assessment will consider the potential impacts resulting from the construction activities. Effects of the proposed project 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.

Levee 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. Some of these effects may occur downstream of the repair site 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. Adverse effects to these species and their habitat may result from the addition of armoring rock and bank revetment to the river channel.

It is important to note that SERP Phase I contains built-in conservation measures that will mitigate for the above potential impacts. Refer to section II, E of this BO for a detailed list of required conservation and mitigation measures. As part of the assessment, it is also important to note that not all waterways that are a part of SERP Phase I contain all the listed species described in Section V, A. Some of the waterways do not contain any NMFS listed species, as such, any SERP Phase I projects in these waterways will have no effect.

Regardless if the waterway contains winter-run Chinook salmon, spring-run Chinook salmon, or steelhead, or any combination of the listed salmonids, the effects analysis will be the same and the conservation and mitigation measures will be same. This conservative approach will ensure proper protection for the listed salmonids and sDPS green sturgeon. This approach is favorable due to the uncertainty in certain waterways as to the presence of various listed fish species. As an example, fish rescue efforts in May and June of 2013 in the Colusa Basin Drain watershed have confirmed the presence of both spring-run and winter-run Chinook salmon (Hendrick, personal communication, 2013). This BO also assumes that any conservation and mitigation prescribed for salmonids will cover impacts to green sturgeon.

Action Area Waterways without any presence of listed salmonids or North American green sturgeon

The following waterways have no listed anadromous fish, thus SERP Phase I will have no effect:

(1) Willow Slough Bypass;

(2) Cherokee Canal;

(3) Cache Creek upstream of the Yolo Bypass;

(4) Wadsworth Canal; and

(5) East and West Interceptor Canals.

1. Exposure of Salmonid and North American Green Sturgeon in the Action Area

Presence of CCV Steelhead in the Action Area

Adult CCV steelhead could be present in the Sacramento River year-round; however, peak abundance is during the period between August and October, particularly when increased flows are being released from Sacramento River reservoirs or when early winter rains cause increased flows in the system. During the period of August-October, adult CCV steelhead enter freshwater to spawn, with a peak migration period of September-October (Moyle 2002). The steelhead migration period overlaps the proposed in-water work window (July 1 to October 15). Similar time-frames would be assumed for waterways around the Delta, or those designated as Region 1. The same would hold true for Butte Creek, Feather River, and adjacent waterways. Due to temperature thresholds or lack of water, it is reasonable to assume that areas in the Colusa Basin Drain, Colusa Bypass, Sacramento Bypass, Tisdale Bypass, Sutter Bypass, and the Yolo Bypass would not have adult CCV steelhead during the August through October time-frame.

The peak of juvenile CCV steelhead emigration in the Sacramento River occurs during the period between March and June. There are larger steelhead smolts that migrate at other times of the year and thus may be exposed to SERP Phase I proposed actions. Similar to the adults, when they are present, there is potential for juvenile CCV steelhead to be found in all accessible waterways. The timing restrictions described in Section I, E SERP Conservation and Mitigation Measures, should limit any direct significant impacts to CCV steelhead, particularly adults. With the exception of Butte Creek and Feather River, SERP Phase I is not within the spawning habitat of CCV steelhead.

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

Adult CV spring-run Chinook salmon are present in the Sacramento River from March to September with peak abundance between May and June. The peak of juvenile CV spring-run Chinook salmon emigration in the Sacramento River occurs during the period between December and April, though presence is possible from November to May. Similar time-frames would be assumed for waterways around the Delta, or those designated as Region 1. Due to temperature thresholds or lack of water, it is reasonable to assume that areas in the Colusa Basin Drain, Colusa Bypass, Sacramento Bypass, Tisdale Bypass, Sutter Bypass, and the Yolo Bypass would not have adult CV spring-run Chinook salmon during the July through September time-frame. The timing restrictions described in Section I, E SERP Conservation and Mitigation Measures, should limit any direct significant impacts to adult and juvenile CV spring-run Chinook salmon. With the exception of Butte Creek and Feather River, SERP Phase I is not within the spawning habitat of CV spring-run Chinook salmon.

Presence of Sacramento River winter-run Chinook salmon in the Action Area
Adult Sacramento River winter-run Chinook salmon are present in the Sacramento River from December to July with peak abundance in March. The peak of juvenile Sacramento River winter-run Chinook salmon emigration in the Sacramento River occurs during the period between December and February, though presence is possible from September to April. Similar time-frames would be assumed for waterways around the Delta, or those designated as Region 1. Due to temperature thresholds, lack of water, and adult and juvenile absence, it is reasonable to assume that areas in the Colusa Basin Drain, Colusa Bypass, Sacramento Bypass, Tisdale Bypass, Sutter Bypass, and the Yolo Bypass would not have adult or juvenile Sacramento River winter-run Chinook salmon during the July through December time-frame.

The timing restrictions described in Section I, E SERP Conservation and Mitigation Measures, should limit any direct significant impacts to adult and juvenile CV winter-run Chinook salmon. SERP Phase I is not within the spawning habitat of Sacramento River winter-run Chinook salmon.

Presence of North American green sturgeon in the Action Area
Adult North American green sturgeon could be present in portions of the action area year-round. This would include Region 1, with the exception of Putah Creek. Year-round presence is expected in the Sacramento River and possible in the Feather River and portions of the Colusa Basin Drain. Adults are not expected to be found in smaller channels such as Wadsworth Canal and Cherokee Canal, and are not recorded in Butte Creek. Larval and juveniles could be present from May to August, older juveniles and adults could be present year-round. Green sturgeon (especially adults) are primarily benthic, and their presence along the shoreline is not common. Therefore, adverse effects including injury or death from construction activities are not expected. Thus, the timing restrictions described in Section I, E SERP Conservation and Mitigation Measures, would have little impact to the North American green sturgeon. With the exception of Feather River, SERP Phase I is not within the spawning habitat of North American green sturgeon.

2. Status of Critical Habitat within the Action Area

The SERP Phase I proposed action area includes critical habitat designated for CCV steelhead, CV spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, and sDPS of North American green sturgeon.

Designated critical habitat is indicated for each of the following species which occurs in these specific waterways:

(1) Butte Creek: CCV steelhead, and CV spring-run Chinook;
(2) Cache Creek: No critical habitat;

(3) Cherokee Canal: No critical habitat;
(4) Colusa Bypass: CCV steelhead, CV spring-run Chinook;
(5) Northern portion of Colusa Main Drain (area identified in Exhibit 2-1of SERP EIR): Not specified as critical habitat, but Colusa Bypass is critical habitat for CCV steelhead and CV spring-run Chinook;
(6) Portions of Feather River (area identified in Exhibit 2-1of SERP EIR): sDPS green sturgeon, CCV steelhead, and CV spring-run Chinook salmon;
(7) Putah Creek: CCV steelhead, and CV spring-run Chinook salmon;
(8) Sacramento Bypass: CCV steelhead, and CV spring-run Chinook salmon;
(9) Portions of Sacramento River (area identified in Exhibit 2-1of SERP EIR): sDPS green sturgeon, CCV steelhead, CV spring-run Chinook, and Sacramento River winter-run Chinook salmon;
(10) Sutter Bypass: sDPS green sturgeon, CCV steelhead, and CV spring-run Chinook salmon;
(11) Tisdale Bypass: CCV steelhead, and CV spring-run Chinook salmon;
(12) Wadsworth Canal: No critical habitat;
(13) Willow Slough Bypass: No critical habitat;
(14) Portions of Yolo Bypass (area identified in Exhibit 2-1of SERP EIR): sDPS green sturgeon, CCV steelhead, and CV spring-run Chinook salmon; and
(15) East and West Interceptor Canals: No critical habitat.

a. *Sacramento River Winter-Run Chinook Salmon, California Central Valley Steelhead, and Central Valley Spring-Run Chinook Salmon*

The proposed project action area is within designated critical habitat for Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead. Habitat requirements for these species are similar. The PCEs of CV spring-run Chinook and CCV steelhead habitat within the action area include: freshwater rearing habitat, freshwater migration, and freshwater spawning sites. The essential features of CV spring-run Chinook and CCV steelhead habitat PCEs include adequate substrate, water quality, water quantity, water temperature, water velocity, cover and shelter, food; riparian vegetation, space, and safe passage conditions. These habitats important for species conversation and recovery because they provide appropriate freshwater rearing and migration conditions for juveniles and unimpeded freshwater migration conditions for adults. Essential features of designated critical habitat for Sacramento River winter-run Chinook salmon include the river and estuarine water column, river bottom, adjacent riparian zone used by fry and juveniles for rearing and essential foraging habitat and food resources used by Sacramento River winter-run Chinook salmon as part of their juvenile emigration or adult spawning migration. The conservation condition and function of this habitat has been impaired through factors discussed in the *Status of the Species and Habitat* section of this BO. The result has been the reduction in quantity and quality of several essential features of migration and rearing habitat required by juveniles to grow and survive.

The diversion and storage of natural flows by dams and other structures on CV waterways have depleted streamflows and altered the natural cycles by which juvenile and adult salmonids have evolved. Changes in streamflows and diversions of water affect freshwater rearing habitat and freshwater migration corridor PCEs in the action area. Various land-use activities in the action area such as urbanization have resulted in habitat simplification. Runoff from residential and industrial areas also contributes to water quality degradation (CRWQCB 1998). Urban stormwater runoff contains pesticides, oil, grease, heavy metals, polynuclear aromatic hydrocarbons, other organics and nutrients (CRWQCB 1998) that contaminate drainage waters and destroy aquatic life necessary for salmonid survival (NMFS 1996a). In addition, juvenile salmonids are exposed to increased water temperatures as a result of thermal inputs from municipal, industrial, and agricultural discharges in the action area. Accelerated predation as a result of habitat changes in the action area, such as the alteration of natural flow regimes and the installation of bank revetment and other instream structures such as dams, bridges, water diversions, and piers are likely a factor in the decline of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead.

Within the proposed project action area, the essential features of freshwater rearing, migration, and spawning habitats have been transformed from a meandering waterway lined with dense riparian vegetation to a highly leveed system under varying degrees of constraint of riverine erosional processes and flooding. For example, overall, more than half of the Sacramento Rivers banks in the lower 194 miles have been riprapped (USFWS 2000).

In spite of the degraded condition of this habitat, the intrinsic conservation value of the proposed project action area is high because its entire length is used by federally listed anadromous fish species in the CV. All reproducing Sacramento River winter-run Chinook salmon and CV spring-run Chinook salmon, and a majority of the CCV steelhead must pass through the proposed project action area to reach their upstream spawning and freshwater rearing areas, and will pass through the region again during the downstream migrations of adult kelts, and juvenile/smolts. Therefore, it is of critical importance to the long-term viability of these species to maintain a functional migratory corridor and freshwater rearing habitat through the proposed project action area.

b. Southern Distinct Population Segment of North American Green Sturgeon

The action area is utilized by the sDPS of North American green sturgeon adults for holding and migration purposes. There is a possibility the green sturgeon spawns in the Feather River and the portion of the Sacramento River described in Region 2 and 3 of SERP Phase I, respectively. North American green sturgeon holding habitat consists of the bottoms of deep pools where velocities are lowest often in off-channel coves or low-gradient reaches of the main channel (Erickson *et al.* 2002). The proposed project may impact PCEs concerned with: adequate food resources for all life stages, water quality sufficient to allow normal physiological and behavioral responses, and sediment with sufficiently low contaminant burdens to allow for normal physiological and behavioral responses to the environment.

The high number of diversions on the Sacramento River and in the north Delta is a potential threat to the sDPS of North American green sturgeon. It is assumed larval green sturgeon are susceptable to entrainment primarily from benthic water diversion facilities during the first five days of development and suseptable to diversion entrainment from facilities drawing water from the bottom and top of the water column when they are exhibiting noctornal swim-up behavior.

Various land-use activities in the proposed action area such as urbanization have resulted in habitat simplification. Runoff from residential and industrial areas also contributes to water quality degradation (CRWQCB 1998). Urban stormwater runoff contains pesticides, oil, grease, heavy metals, polynuclear aromatic hydrocarbons, other organics and nutrients (CRWQCB 1998) that contaminate drainage waters and destroy aquatic life necessary for green sturgeon survival (NMFS 1996a).

The transformation of the Sacramento River from a meandering waterway lined with 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 (USFWS 2000). In addition, the change in the ecosystem as a result of the removal of riparian vegetation and IWM impacted ecological processes and potential prey items utilized by green sturgeon while rearing and holding.

In spite of the degraded condition of this habitat, the intrinsic conservation value of the proposed project action area, particularly the Sacramento River (to a lesser extent the Feather River) is high because its entire length is used by the sDPS of North American green sturgeon. All reproducing sDPS of North American green sturgeon pass through the proposed project action area in the lower Sacramento River to reach their upstream spawning and freshwater rearing areas, and will pass through this same region during the downstream migrations of both adult runbacks and juvenile smolts. A functional migratory corridor in the Sacramento River is crucial to the survival of the sDPS of North American green sturgeon. Therefore, it is of critical importance to the long-term viability of these species to maintain a functional migratory corridor and freshwater rearing habitat through the Sacramento River portion of the proposed project action area.

3. Effects of the Action on Listed Species

As described in the Presence of Salmonid and sDPS green sturgeon discussion, portions of the proposed project action area encompasses areas utilized by Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS of North American green sturgeon. Many of the range-wide factors affecting these species are discussed in the *Status of the Species and Critical Habitat* section of this BO. This section will focus on the specific factors in the proposed action area that are most relevant to the execution of SERP Phase I.

NMFS expects that relatively low number of anadromous salmonids will be present during construction activities at any of the potential repair sites because the construction periods do not occur during peak migration periods. Those fish that are exposed to these activities will encounter short-term (*i.e.*, minutes to hours) construction-related noise, physical disturbance, and water quality changes that may cause injury or death by increasing the susceptibility of some individuals to predation by temporarily disrupting normal behaviors, and affecting sheltering abilities. Some juvenile fish may sustain injury or incur harassment during construction activities, especially fry-sized Chinook salmonids that may be present in the Sacramento River or Butte Creek. Others may be displaced from natural shelter and preyed upon by piscivorous fish. Construction will not occur during peak migration periods; therefore relatively few juvenile fish are expected to sustain physical damage or harassment due to construction activities because most fish are expected to avoid daytime construction activities due to their predominately crepuscular migration behaviors. The implementation of best management practices (BMPs) and conservation measures described as part of the Project Description also will minimize impacts to the aquatic environment and reduce project-related effects to fish. In addition, and with the exception of the occurrence of winter-run Chinook salmon, peak migration events correspond with periods of high river flows, when construction activities will not occur. NMFS expects that actual physical damage or harassment levels will be low relative to the overall population abundance, and not likely to result in any long-term, negative population trends. Adults should not be injured because their size, preference for deep water, and their crepuscular migratory behavior will enable them to avoid most temporary, nearshore disturbance.

NMFS expects that a large, but unknown, number of green sturgeon will be present in the proposed action area during construction because peak migration and spawning periods occur during this time. Green sturgeon are primarily benthic, and their presence along the shoreline is not common. Therefore, adverse effects including injury or death from construction activities are not expected.

The project is expected to result in long-term habitat modifications, including modifications to the designated critical habitat of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS of North American green sturgeon. The modifications will affect fish behavior, growth and survival, and the PCEs of critical habitat including freshwater rearing sites, spawning sites, and migration corridors. However, it is important to emphasize that these long-term modifications are expected to result in a new positive benefit to listed fish species. At certain locations there could potentially be some short-term habitat deficits; however, the built in habitat features required for all repair sites will at minimum maintain existing habitat values, and in many cases, enhance baseline values at the levee repair locations. The extent of any short-term habitat deficits will be based upon the specifics of the sites chosen as part of SERP Phase I. Short-term habitat deficits could be variable on an annual basis, but will be limited by built in conservation measures.

With the habitat features described as part of the SERP Manual (attachment A) there is an expectation of long-term habitat gains through the SERP Phase I time-period. The project, as a whole (*i.e.*, all sites and all regions combined) will cause short-term (*i.e.*, 2 to 5 years) adverse effects to juvenile rearing, migration, and spawning PCEs, and long-term (*i.e.*, 5 to 50 years) improvements to these PCEs. Most deficits result from short-term reductions in vegetation and shade caused by construction and extension of the shoreline away from existing vegetation and shade. Revegetated areas must grow for several years before shade extends over the shoreline. Fall and summer deficits also result from the conversion of shallow-water habitat with fine-textured substrate to large angular rock. Despite the expected short-term impacts, the overall conservation condition of the PCEs will improve to a level above that of the current baseline conditions. Refer to the SERP Manual for design template details.

Construction activities will not exceed 15 levee repair sites annually for a maximum of 5 years. Any short-term or long-term impacts as a result of SERP Phase I activities will be limited to these repair sites and areas adjacent.

A. Short-Term Construction-Related Effects

NMFS expects that a relatively small but unknown number of anadromous salmonids will be present in the action area during construction activities due to overlapping migration timing. Only those fish that are holding adjacent to or migrating past a project site will be exposed or affected. 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. In particular, juvenile CCV steelhead, juvenile winter-run Chinook salmon, and sDPS of North American green sturgeon will potentially be impacted by short-term construction activities. Potential for impacts to these species will depend on the region.

Juvenile fish may be injured or harmed during rock placement. Others may be displaced from natural shelter and preyed upon by piscivorous fish. For those juvenile fish that are present, relatively few are expected to sustain physical damage or harassment from construction activities because most fish are expected to avoid construction activities due to their predominately crepuscular migration behaviors. The implementation of BMPs and conservation measures as part of the project description will minimize impacts to the aquatic environment and reduce project-related effects to fish. Other than the occurrence of winter-run Chinook salmon, construction will not impact salmon as migration corresponds with periods of high river flows, when construction activities will not occur. NMFS expects that actual injury levels will be low relative to the overall population abundance, and not likely to result in any long-term, negative population trends. Adults should not be sustain physical damage or harassment because their size, preference for deep water, and their crepuscular migratory behavior will enable them to avoid most temporary, nearshore disturbance.

Green sturgeon may be present holding and spawning in portions of the proposed action area. However, the construction activities are unlikely to impact any deepwater areas where the species spawn. The number of sturgeon likely to be affected by SERP Phase I is low and limited to the areas directly adjacent to the construction sites in those area where green sturgeon may be present, Sacramento and Feather rivers.

Depending on the region, there are timing restrictions in place that will reduce the likelihood of any impacts to salmonids. The timing restrictions were all developed by SERP agency coordination.

(1) Region 1: All in-water construction will occur from August 1 to November 30. The time period for completing work outside the active stream channel is April 15 to October 15.
(2) Region 2: All in-water construction will occur from July 1 to October 15. The time period for completing work outside the active stream channel is April 15 to October 15.

(3) Region 3: All in-water construction will occur from July 1 to August 31. The time period for completing work outside the active stream channel is April 15 to October 15.
(4) Region 4: All in-water construction will occur from April 15 to October 1. The time period for completing work outside the active stream channel is April 15 to October 15.

The best available outmigration data throughout the Sacramento River indicate that listed juvenile spring-run Chinook salmon will not be present during construction activities. Refer to Table 3 and the timing restrictions listed in Section II, E of this BO.

Numerous studies show that suspended sediment and turbidity levels moderately elevated above natural background values can result in non-lethal detrimental effects to salmonids. Suspended sediment affects salmonids by decreasing reproductive success, reducing feeding success and growth, causing avoidance of rearing habitats, and disrupting migration cues (Bash *et al.* 2001). Sigler *et al.* (1984) in Bjornn and Reiser (1991) found that prolonged turbidity between 25 and 50 Nephelometric Turbidity Unit (NTUs) reduced growth of juvenile coho salmon (*O. kisutch)* and steelhead.

MacDonald *et al.* (1991) found that the ability of salmon to find and capture food is impaired at turbidities from 25 to 70 NTUs. Increased sediment delivery can also fill interstitial substrate spaces and reduce cover for juvenile fish (Platts *et. al.* 1979) and abundance and availability of aquatic invertebrates for food (Bjornn and Reiser 1991). We expect turbidity to affect steelhead in much the same way that it affects other salmonids, because of similar physiological and life history requirements between species.

Suspended sediment from construction activities would increase turbidity at the proposed project site and could continue downstream. Although steelhead and Chinook salmon are highly migratory and capable of moving freely throughout the proposed action area, an increase in turbidity may injure fish by temporarily disrupting normal behaviors that are essential to growth and survival such as feeding, sheltering, and migrating. Injury is caused when disrupting these behaviors increases the likelihood that individual fish will face increased competition for food and space, and experience reduced growth rates or possibly weight loss. Project-related turbidity increases may also affect the sheltering abilities of some fish and may decrease their likelihood of survival by increasing their susceptibility to predation.

Larger fish, including adults and smolts probably will respond to construction activities by quickly swimming away from the proposed project site, and would 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 salmon, steelhead, 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 and conservation measures as part of the project description that dictate the use, containment, and cleanup of contaminants will minimize the risk of introducing such products to the waterway because the prevention and contingency measures will require frequent equipment checks to prevent leaks, will keep stockpiled materials away from the water, and will require that absorbent booms are kept on-site to prevent petroleum products from entering the river in the event of a spill or leak. NMFS does not expect the project to result in water contamination that will injure individual fish.

Green Sturgeon

Green sturgeon may be present in the action area during construction, and therefore may be exposed and affected by short-term increases in turbidity and suspended sediments. These increases could disrupt feeding and migratory behavior activities of post-larvae, juvenile, and adult fish. Rock placement will occur while green sturgeon may be present in the action area. 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). In-water activities could cause injury or mortality to individual green sturgeon that do not readily move away from the areas directly affected by rock placement. However, NMFS expects that since juvenile and adult green sturgeon show a preference for benthic habitat types, few fish should be exposed to rock placement along the shoreline, and proposed project construction activities are not likely to injure or kill juveniles or adults.

B. Long-Term Effects

The proposed project levee repairs will restore habitat features (riparian vegetation, shaded riverine aquatic habitat) beyond that which was found in the environmental baseline conditions. As it will take the ecosystem dynamics time to stabilize, there will be short-term negative impacts. However, it is expected that the conservation measures implemented to compensate for the impacts from the proposed project construction activities will be a net benefit for CCV steelhead, Chinook salmon, and green sturgeon. A NMFS approved monitoring plan will be in place to ensure that long-term impacts remain positive for the listed species and their associated critical habitats.

NMFS expects that actual physical damage or harassment to listed fish species will be low relative to the overall population abundance, and not likely to result in any long-term, negative population trends. Adults should not sustain any physical damage because their size, preference for deep water, and their crepuscular migratory behavior will enable them to avoid most temporary, nearshore disturbance.

Cumulatively, the projects as part of SERP Phase I are expected to result in long-term positive habitat modifications, including modifications to the designated critical habitat of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS of North American green sturgeon. The modifications will affect fish behavior, growth and survival, and the PCEs of critical habitat. In the long-term, these modifications are expected to be positive as compared to the environmental baseline.

Salmon and Steelhead

Adult CCV steelhead migrate upstream from September through May. Any losses of riparian shade or IWM may reduce habitat value for adult salmonids due to reduced cover available for resting and holding during upstream migration. Adult CCV spring-run Chinook salmon are present in the Sacramento River and Feather River from March to September with peak abundance between May and June. Adult Sacramento River winter-run Chinook salmon are present in the Sacramento River from December to July with peak abundance in March.

The value of shaded riverine aquatic habitat and IWM to salmonids has been directly demonstrated by various studies. Shaded riverine aquatic habitat provides high quality resting areas for adults and cover from predation (USFWS 2000, Lassettre and Harris 2001, Piegay 2002). Phase I SERP will result in net shaded riverine aquatic habitat and IWM gains. NMFS expects that adult fish will experience a long-term benefit.

Green Sturgeon

Adult green sturgeon may be moving upstream at the proposed project action area during construction. Changes in nearshore habitat are expected to have negligible effects on adults because adult sturgeon generally use deep, mid-channel habitat during migration and holding. The effects of the proposed project on green sturgeon adults would primarily be related to the alteration of the Sacramento River (and to a lesser extent, Feather River) below the waterline as migrating and holding adults utilize benthic habitat. The ecosystem changes resulting from the addition of riparian vegetation and IWM could affect potential prey species and species-interactions that could in turn affect adult green sturgeon while holding and migrating through the area. These changes are anticipated to be positive for the sturgeon.

NMFS expects the action to adversely affect the sDPS of the North American green sturgeon. Adverse effects to these species are expected to be limited to migrating and rearing larvae, post-larvae, and juveniles. Juveniles are expected to be affected because of their small size, reliance on aquatic food supply (allochthonous food production), and vulnerability to factors that affect their feeding success and survival. Construction activities will cause disruptions from increased noise, turbidity, and in-water disturbance that may injure or kill larvae, post-larvae, and juvenile green sturgeon by causing reduced growth and survival as well as increased susceptibility to predation. NMFS expects responses to long-term, project-related habitat conditions to be similar to those experiences by salmonids, as described above. However, because green sturgeon are not as near-shore oriented as juvenile Chinook salmon, the relative proportion of the green sturgeon population that will be affected by these conditions should be low. Therefore, in the long-term NMFS expects that larvae, post-larvae, and juvenile fish are not likely to be injured or killed as a result of the proposed project since most fish are expected to migrate through deeper mid-channel pathways and will avoid direct exposure to project sites.

Food resources, substrate type, size, water quality, depth, and sediment quality are the freshwater riverine PCEs for green sturgeon that are expected to be impacted by the proposed project. However, any of these impacts would be temporary during the construction period and NMFS expects no long-term negative effects.

C. Effects of Project Monitoring

The monitoring plans for the project repair sites include physical habitat monitoring. This monitoring will evaluate how sites meet habitat requirements as described in the SERP Manual and in the project description. This monitoring will be passive and is not expected to adversely affect listed fish or critical habitat.

D. Effects of Project Operations and Maintenance

Operations and Maintenance (O&M) activities are expected to occur for the life of the project to maintain the flood control and environmental values of the site. Anticipated O&M actions include vegetation management. DWR will continue its program of routine annual levee maintenance in accordance with the applicable Corps standard O&M manuals. Levee maintenance activities described in the O&M manuals include:

(1) Removing debris, spraying herbicides, mowing and burning vegetation on slopes, dragging levee slopes, controlling rodents with rodenticides, grouting rodent holes or other voids in levees, and repairing minor erosion; and,
(2) Managing vegetation with selective cutting, pruning, and spraying of young trees and selective cutting and pruning of the lower branches of mature trees to allow visual inspection of the levee and to maintain channel capacity.

DWR acknowledges that some of the levee maintenance activities described above (e.g., grouting rodent holes below the OHWM, repairing minor erosion that requires placing fill material below the OWHM, dragging levee slopes) may require separate authorization by the resource agencies.

Levee maintenance inspections are conducted by DWR in accordance with the standard O&M manual requirements. The inspections are conducted by DWR staff and generally involve driving along levee roads and observing levee conditions. Written inspection logs summarizing the inspection observations are maintained by DWR flood management staff and kept as permanent records.

In addition to routine levee inspections, DWR environmental staff will conduct a qualitative evaluation of levee conditions at the repair sites as part of the annual monitoring protocol. Environmental staff will provide monitoring data, including photographs, to the DWR project engineer of each repair site for their evaluation and assessment of the engineering component of SERP projects. The environmental staff assessment of the levee condition will be reported on the qualitative evaluation sheet provided at the end of this section.

O&M actions are only expected to repair damaged elements of the project, they are expected to be infrequent (*i.e.*, occurring only once every several years), small (*i.e.*, only affecting small sections of the project area), and will not occur at all sites. Therefore relatively few fish should be affected by O&M actions, and any actual injury levels will be negligible relative to overall population abundance and not likely to cause any long-term, negative population responses. Any O&M actions that affect habitat conditions will incorporate conservation measures that are a part of the proposed project, BMPs, and other minimization and avoidance measures to reduce the potential for effects to anadromous salmonids, green sturgeon, and their designated critical habitat.

5. Interrelated or Interdependent Actions

Regulations that implement section 7(b)(2) of the ESA require BOs to evaluate the direct and indirect effects of Federal actions and actions that are interrelated with or interdependent to the Federal action to determine if it would be reasonable to expect them to appreciably reduce listed species' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (16 U.S.C. §1536; 50 CFR 402.02). Within the BO, NMFS considered concurrent, ongoing repairs of levees along the same waterways as described in the action area of SERP Phase I currently being proposed by the Corps as potentially interrelated or interdependent actions to the proposed action. These projects are expected to result in effects to listed salmon, steelhead, and sturgeon. Some of these effects are expected to be similar while others may be more severe as compared to those described in this BO, including short-term adverse effects to these species and their designated and proposed critical habitat. NMFS does not consider these actions to be interrelated because there is no single authority or program that binds them together, nor are they interdependent because they would occur regardless of the proposed action.

VII. CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BO. 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.

A. Water Diversions

Water diversions for irrigated agriculture, municipal and industrial use, hydropower generation, and managed wetlands are found throughout the CV. Thousands of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, their tributaries, and the Delta, and many of them remain unscreened. 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). Most of the 370 water diversions operating in Suisun Marsh are unscreened (Herren and Kawasaki 2001).

B. Agricultural Practices

Agricultural practices in the SERP Phase I proposed 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. Agricultural practices in the Delta may adversely affect riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow in stream channels flowing into the Delta. Grazing activities from dairy and 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 SERP Phase I waterways. 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).

C. 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 (HSRG 2004). 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).

D. Increased Urbanization

The Delta, East Bay, and Sacramento regions, which include portions of Contra Costa, Alameda, Sacramento, San Joaquin, Solano, Stanislaus, and Yolo counties, are expected to increase in population by nearly 3 million people by the year 2020. Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. For example, the General Plans for the cities of Stockton, Brentwood, Lathrop, Tracy and Manteca and their surrounding communities anticipate rapid growth for several decades to come. City of Manteca (2012) observed a 32.4 percent population increase between 2001 and 2011. The projected population for 2013 is 74,915 (http://www.ci.manteca.ca.us/biz/). According to City of Lathrop website (updated in 2011), the current population was listed at 17,469 and estimated to reach a population level of 20,000 by 2012, with an expected "build out" population of 70,000 (http://www.ci.lathrop.ca.us/about/). The anticipated growth will occur along both the I-5 and US-99 transit corridors in the east and Highway 205/120 in the south and west. 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 processes with NMFS.

Increased urbanization also is expected to result in increased recreational activities in the region. Among the activities expected to increase in volume and frequency is recreational boating. Boating activities typically result in increased wave action and propeller wash in waterways. This potentially will degrade riparian and wetland habitat by eroding channel banks and mid-channel islands, thereby causing an increase in siltation and turbidity. Wakes and propeller wash also churn up benthic sediments thereby potentially re-suspending contaminated sediments and degrading areas of submerged vegetation. This in turn would 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 on the San Joaquin River and south Delta is anticipated to result in more contamination from the operation of gasoline and diesel powered engines on watercraft entering the water bodies of the San Joaquin River and south Delta. In addition to recreational boating, commercial vessel traffic is expected to increase with the redevelopment plans of the Port of Stockton. Portions of this redevelopment plan have already been analyzed by NMFS for the West Complex (formerly Rough and Ready Island) but the redevelopment of the East Complex, which currently does not have a Federal action associated with it, will also increase vessel traffic as the Port becomes more modernized. Commercial vessel traffic is expected to create substantial entrainment of aquatic organisms through ship propellers as the vessels transit the shipping channel from Suisun Bay to the Port and back again. In addition, the hydrodynamics of the vessel traffic in the confines of the channel will create sediment re-suspension, and localized zones of high turbulence and shear forces. These physical effects are expected to adversely affect aquatic organisms, including both listed salmonids and sDPS green sturgeon resulting in death or injury.

E. 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 sDPS 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 Central Valley 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 Central Valley 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 should 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 downstream of the dam over the summer and fall periods.

Within the context of the brief period over which the proposed project 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.

F. 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. Highway 160 is a state maintained road and part of the levee slopes are considered within the right of way of the California Department of Transportation (Caltrans). Caltrans has full access and rights to maintain and repair the roads without Federal permits when the project action is beyond the Corps jurisdiction. 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 proposed action.

G. Activities within the Nearshore Pacific Ocean

Future tribal, state and local government actions will likely be in the form of legislation, administrative rules, or policy initiatives and fishing permits. These actions may include changes in ocean policy and increases and decreases in the types of activities that currently occur, including changes in the types of fishing activities, resource extraction, or designation of marine protected areas, any of which could impact listed species or their habitat. Government actions are subject to political, legislative and fiscal uncertainties. Private activities are primarily associated with commercial and sport fisheries, construction, and marine pollution. These potential factors are ongoing and expected to continue in the future, and the level of their impact is uncertain. For these reasons, it is not possible to predict beyond what is included in the subsections pertaining to cumulative effects, above, whether future non-Federal actions will lead to an increase in effects to the survival and recovery of listed species. These realities, added to the geographic scope, which encompasses several government entities exercising various authorities, and the changing economies of the region, make analysis of cumulative effects speculative.

VIII. INTEGRATION AND SYNTHESIS

This section integrates the current conditions described in the environmental baseline with the effects of SERP Phase I proposed actions. The purpose of this synthesis is to develop an understanding of the likely short-term and long-term responses of listed salmonid and green sturgeon and critical habitat to SERP Phase I proposed actions. The *Status of Species, Physical Conditions Baseline,* and *Environmental Baseline* sections show that past and present impacts to the SERP Phase I action area have caused significant habitat loss, fragmentation, and degradation.

In the *Status of the Species and Critical Habitat, Environmental Baseline,* and *Physical Conditions Baseline* sections (Sections III through V); 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 human activities and climate 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.

A. Impacts of the Proposed Action on Sacramento River Winter-run Chinook Salmon, Central Valley Spring-run Chinook Salmon, CCV Steelhead, and the sDPS of North American green sturgeon

The SERP Phase I proposed project includes mandatory conservation measures that will limit the potential of adverse effects that would injure federally listed fish species as a result of construction activities. These conservation measures can be found in Section II, E "SERP

Conservation and Mitigation Measures" of this BO. By incorporating additional conservation measures into the proposed project, listed fish species are not expected to be adversely affected.

The SERP Phase I proposed actions, as described in this BO has specifically been designed to minimize and avoid continued near shore aquatic and riparian habitat loss. The proposed implementation of the integrated conservation measures and the commitment to implement additional compensation measures will ensure that short- and long-term impacts will be compensated in a way that prevents incremental habitat fragmentation, and loss throughout the proposed action area.

Although some injury to individual fish is possible from construction, successful implementation of all conservation measures is expected to improve migration and rearing conditions, and the growth and survival of juvenile salmon and steelhead during peak rearing and migration periods by protecting and increasing the amount of shaded riverine aquatic habitat throughout the action area. Because of this, the proposed action is not expected to reduce the likelihood of survival and recovery of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, or CCV steelhead.

Cumulatively, the projects as part of SERP Phase I are expected to result in long-term positive habitat modifications, including modifications to the designated critical habitat of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS of North American green sturgeon. The modifications will affect fish behavior, growth and survival, and the PCEs of critical habitat. In the long-term, these modifications are expected to be positive when compared to the environmental baseline.

The adverse effects to sDPS of North American green sturgeon within the action area are not expected to affect the overall survival and recovery of the sDPS. This is largely due to the fact that the project will compensate for temporary and permanent habitat losses through implementation of on-site conservation measures. Construction-related impacts will be temporary and will not impede adult fish from reaching upstream spawning and holding habitat, or larvae, post-larvae, and juvenile fish from rearing or migrating to downstream rearing areas. The number of individuals actually injured is expected to be undetectable and negligible and, population-level impacts are not anticipated. Implementation of the conservation measures will ensure that long-term impacts associated with bank protection projects will be compensated in a way that prevents incremental habitat fragmentation and reductions of the conservation value of aquatic habitat to anadromous fish within the action area. Because of this, the proposed action is not expected to reduce the likelihood of survival and recovery of the sDPS of North American green sturgeon.

B. Impacts of the Proposed Action on Critical Habitat

Impacts to the designated critical habitat of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead include the short- and long-term modifications to the migratory corridor and spawning habitat included as part of SERP Phase I. Impacts to fish will generally be short-term and result from loss or modification of riparian vegetation, shallow-water habitat, and the increase in bank substrate size. These losses and modifications affect juvenile rearing and migration by reducing in-stream cover and food production. The intended conservation roll of the critical habitat in the action area is primarily as a migration corridor. Freshwater migration corridors must function sufficiently to provide adequate passage; project effects are not expected to reduce passage conditions based on the length of time individual juvenile salmonids will be exposed to the reduced quality and availability of refuge areas as they transit through the action area. Thus, NMFS does not expect reduction in the quality and availability of refuge areas to impact the current function of the action area or affect its ability to reestablish essential features that have been impacted by past and current actions. In the long-term habitat conditions should improve as vegetation matures and extends over the shoreline. The improved habitat conditions are expected to improve the growth and survival of juvenile fish. Therefore, we do not expect project-related impacts to reduce the conservation value of designated critical habitat of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead.

Impacts to critical habitat of sDPS of North American green sturgeon include the short- and long-term modification to the freshwater riverine system. This could include impacts to food resources, substrate type and size, water quality, migratory corridor depth, and sediment quality for juvenile rearing and migration and adult spawning and migration. The building of levee slope benches could fill-in existing deep water habitat and the use of large riprap could change the substrate type and reduce water depths, thus decreasing available habitat for rearing and potential spawning habitat. The rearing habitat for benthic invertebrates would be disrupted from the construction activities, limiting the availability of food supply. However, typical recolonization of new substrate occurs when these drifting invertebrate larvae and plants encounter open substrate as they are dispersed into the barren fill area by river flows sweeping through the channel. Although initially the community composition of the newly colonized substrate is likely to be different than the surrounding channel, a mature benthic community resembling the surrounding area is expected to form with the passage of time if the substrate does not encounter any further disturbances. Due to built-in conservation measure, impacts to water quality would be temporary during the construction period and NMFS expects no long-term effects to water quality.

C. Summary

Potential effects of SERP Phase I are expected to result in take of listed Sacramento River winter-run Chinook salmon, CCV steelhead, and sDPS of North American green sturgeon in the proposed action area. This take will occur in the short-term due to construction activities. There is no anticipated long-term take as part of the SERP Phase I proposed project.

Any negative effects that are anticipated to result from the implementation are not the type or magnitude that would be expected to appreciably reduce the likelihood of survival and recovery of the listed fish species within the proposed action area. This is primarily based on the inclusion of conservation measures as part of the project description.

IX. CONCLUSION

After reviewing the best available scientific and commercial information, the current status of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and the sDPS of North American green sturgeon, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' BO that the SERP Phase I proposed actions and associated operations, maintenance, and monitoring, is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, or the sDPS of North American green sturgeon, and is not likely to destroy or adversely modify their designated critical habitat.

X. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA 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. Harm is further defined by NMFS as an act which kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that results from, but is not the purpose of, the carrying out of an otherwise lawful activity conducted by the Federal agency or applicant. 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 ESA 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 and DWR 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)).

A. Amount and Extent of Take

NMFS anticipates incidental take of juvenile Sacramento River winter-run Chinook salmon, juvenile CCV steelhead, and juvenile sDPS of North American green sturgeon through the implementation of SERP Phase I construction, operation, and maintenance activities. CV spring-run Chinook juveniles will not be present in the action area during construction and are not likely to incur take. Adult salmonids will either not be present or will avoid construction impacts and are not likely to incur take. More specifically, adult CV spring-run Chinook salmon will not be present.

Similarly, while adult sturgeon may be present during construction activities, any impacts will be negligible. Operations and maintenance activities are not likely to cause take of any listed fish species.

Specifically, NMFS anticipates that juvenile Sacramento River winter-run Chinook salmon, juvenile CCV steelhead, and juvenile sDPS of North American green sturgeon may be captured, killed, injured, or harassed during the implementation of the project. Most of the take will be in the form of harm due to habitat modifications. NMFS anticipates take will be limited to:

1. Take in the form of harm to rearing juvenile CCV steelhead and Sacramento River winter-run Chinook salmon resulting from construction activities of up to 15 levee repair sites annually, for 5 years. This could result in the short-term loss of shaded riverine aquatic habitat and will result in an increase in riprap revetment. Take will be limited to up to 15 annual levee repair sites that fit the criteria described in the project description. Based on SERP criteria, any one levee repair site cannot exceed 1,000 linear feet or 0.5 acres. Thus take would be limited to a maximum of 15,000 linear feet and 7.5 acres in any one year. Realistically, take in any one year will be less than the maximum values presented.

This take is expected to harm the species by modifying important elements of rearing habitat. Juvenile CCV steelhead, Sacramento River winter-run Chinook salmon, and sDPS of North American green sturgeon will be affected because they will have short-term loss of rearing habitat. Loss of rearing habitat will decrease feeding opportunities and could increase the chance of behavioral modifications that could cause the fish harm. These changes will temporarily reduce structural diversity of the existing habitat and cause reductions in food productivity for rearing and feeding fish by altering habitat benthic aquatic macro invertebrate communities, diversity and abundance. Resulting behavioral modifications that result from the habitat modification are the ecological surrogates for take. There is not a stronger ecological surrogate based on the information available. Due to the unknowns as to the precise locations and numbers of levee repair project, the exact number of juvenile fish that will be affected is not known. Therefore take is measured in the form of harm related to the short-term and temporary loss of rearing habitat. This form of take is both quantifiable and trackable.

2. Take in the form of injury to migrating juvenile CCV steelhead, Sacramento River winter-run Chinook salmon, and sDPS of North American green sturgeon, will result from the introduction of rock revetment along SERP Phase I waterways. Injury could occur from direct impacts of the rock revetment coming into contact with fish during the construction period. Injury could occur during the construction period and from indirect effects created by alteration of habitat conditions. Specifically, the alternation of a more natural substrate to rock may decrease foraging opportunities and increase predation. These impacts are expected to occur only in the short-term. Based on SERP criteria, any one levee repair site cannot exceed 1,000 linear feet or 0.5 acres. Thus take would be limited to a maximum of 15,000 linear feet and 7.5 acres in any one year. Realistically, take in any one year will be less than the maximum values presented.

This take is expected in the form of injury to the species by direct impact from the introduction of rock revetment into the system. Take is also expected in the form of harm from modifying important elements of rearing habitat including riparian shrub cover, naturally textured stream bank, and streambed. These changes will reduce structural diversity of the existing habitat and cause reductions in food productivity for rearing and feeding fish by altering habitat benthic aquatic macro invertebrate communities, diversity and abundance. These are the ecological surrogates for take. There is not a stronger ecological surrogate based on the information available at this time. Due to a lack of site-specific fish data, the exact number of juvenile fish that will be affected is not known. Therefore harm and injury are measured in the form of harm and injury related to the amount of rock revetment introduced and the amount of habitat altered as part of SERP Phase I construction activities. This form of take is both quantifiable and trackable.

It is important to note that the SERP Phase I activities that occur in waterways that do not contain listed species, as described in Section VI, B, will not have take of listed fish species.

Anticipated incidental take will be exceeded if the criteria described above are not met, the proposed project is not implemented as described in the BA prepared for this project, all conservation measure are not implemented as described in the BA (including successful completion of monitoring and reporting criteria), or the project is not implemented in compliance with the terms and conditions of this incidental take statement. If take is exceeded formal consultation must be reinitiated (50 C.F.R. § 402.16(a)).

B. Effect of the Take

In the accompanying BO, NMFS determined that this level of anticipated take is not likely to result in jeopardy to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, or the sDPS of North American green sturgeon. In addition, NMFS determined that this level of anticipated take is not likely to result in the destruction or adverse modification of designated critical habitat for Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, or the sDPS of North American green sturgeon.

C. Reasonable and Prudent Measures

Pursuant to section 7(b)(4) of the ESA, NMFS concludes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of juvenile Sacramento River winter-run Chinook salmon, CCV steelhead, and the southern DPS of North American green sturgeon resulting from implementation of the action.

(1) Measures shall be taken to maintain, monitor, and adaptively manage the onsite conservation and revegetation activities to minimize the negative effects to listed fish species resulting from the temporary loss of aquatic habitat.
(2) Measures shall be taken to ensure that in the event that any site does not adequately demonstrate the required vegetation and habitat re-establishment, that the Corps ensures DWR purchases offsite mitigation credits to compensate for the longer than anticipated temporary loss of habitat.
(3) Measures shall be taken to minimize the impacts of the placement of rock revetment.
(4) Measures shall be taken to minimize the amount and duration of placement of rock revetment below the OHWL.

(5) Measures shall be taken to ensure that the Corps requires DWR to adhere to all the conservation, minimization, and avoidance measures that are described in the SERP BA (DWR 2012).

(6) Measures shall be taken to ensure that the Corps requires DWR to provide an annual project summary and compliance report. This report should include the success of vegetation plantings at all repair sites. The annual project summary should be continued for at least three years after the final construction year to ensure that all sites get at least three years of post-construction monitoring.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Corps, and DWR must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above, and outline reporting and monitoring requirements. These terms and conditions are non-discretionary and must be incorporated as binding conditions of any contracts or permits between the Corps, DWR, and its contractors:

(1) Measures shall be taken to maintain, monitor, and adaptively manage the onsite conservation and revegetation activities to minimize the negative effects to listed fish species resulting from the temporary loss of aquatic habitat

Conditions: Implement integrated onsite conservation measures that provide beneficial growth and survival conditions for juvenile salmonids, and the sDPS of North American green sturgeon. These onsite conservation measures are described in the BO, section II, E, and in the SERP BA (DWR 2012).

(2) Measures shall be taken to ensure that in the event that any site does not adequately demonstrate the required vegetation and habitat re-establishment, that the Corps ensures DWR purchases offsite mitigation credits to compensate for the longer than anticipated temporary loss of habitat.

Conditions: If onsite revegetation does not perform as required based on the SERP Manual and the conservation measures included in section II, E of this BO and in the SERP BA (DWR 2012), the Corps shall require DWR to mitigate offsite at a NMFS approved mitigation bank to compensate for the loss of aquatic habitat. This will occur only if after the monitoring period dictated in the BO, the onsite conservation measures are determined to be ineffective. Specifically, the Corps will require DWR to purchase aquatic fish rearing habitat credits at a 3:1 ratio for any net loss at a NMFS approved mitigation bank. The exact credit type is not known at this time, but the purchase would not be expected to be in-kind mitigation although benefits to juvenile rearing and growth are expected. This increase in habitat for listed salmonid species and has the potential to contribute to their abundance, thus providing an overall benefit.

(3) Measures shall be taken to minimize the impacts of the placement of rock revetment.

Conditions: Implement integrated onsite conservation measures that will limit the impact to listed fish species due to the placement of rock revetment. These onsite conservation measures are described in the BO, section II, E, and in the SERP BA (DWR 2012).

(4) Measures shall be taken to minimize the amount and duration of placement of rock revetment below the OHWL.

Conditions: Implement integrated onsite conservation measures that will limit the amount and duration of placement of rock revetment below the OHWL. These onsite conservation measures are described in the BO, section II, E, and in the SERP Program BA (DWR 2012).

(5) Measures shall be taken to ensure that the Corps requires DWR to adhere to all the conservation, minimization, and avoidance measures that are described in the SERP BA (DWR 2012).

Conditions: The Corps will ensure that DWR submits annual reports, including each year for at least three years after the final year of SERP Phase I project construction. These reports will include thorough documentation of the vegetation and habitat enhancement activities. Photopoint shots at each repair site should be established and used as a tool to determine vegetation success and survival rates. The photos shall be taken annually on the same date, as much as practicable. The reports will also include information on how the SERP Phase I construction, operations, and maintenance activities are in compliance with the onsite conservation measures as described in the BO, section II, E, and in the SERP BA (DWR 2012).

(6) Measures shall be taken to ensure that the Corps requires DWR to provide an annual project summary and compliance report. This report should include the success of vegetation plantings at all repair sites. The annual project summary should be continued for at least three years after the final construction year to ensure that all sites get at least three years of post-construction monitoring.

Conditions: The annual reports shall describe construction dates, and implementation of proposed project conservation measures; observed or other known effects on listed species, if any; and any occurrences of incidental take of the Sacramento River winter-run Chinook salmon, CCV steelhead, or sDPS of North American green sturgeon. All reports will be submitted to the Corps and NMFS by December 31 of the year in which monitoring is conducted.

Updates and reports required by these terms and conditions shall be submitted to:

Maria Rea
Central Valley Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento CA 95814
FAX: (916) 930-3629
Phone: (916) 930-3600

XI. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. "Conservation" is defined in the ESA as those measures necessary to delist a species. These conservation recommendations include discretionary measures that the Corps can take to minimize or avoid adverse effects of a proposed action on a listed species or designated critical habitat or regarding the development of information. In addition to the terms and conditions of the Incidental Take Statement, NMFS provides the following conservation recommendations that will reduce or avoid adverse impacts on the listed species. NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be implemented by the Corps, DWR, and its contractors:

(1) The Corps should encourage DWR to minimize any potential take whenever possible.

(2) The Corps and DWR should support and promote aquatic and riparian habitat restoration within SERP Phase I watersheds, especially those with listed aquatic species. Practices that that avoid or minimize negative impacts to listed species should be encouraged.

(3) The Corps and DWR 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 within the SRFCP.

(4) The Corps and DWR, especially in large-scale levee erosion repairs, should consider and encourage setback levee designs. If engineered appropriately, setback levees can increase flood capacity and decrease flood maintenance needs while at the same time restoring habitat for listed aquatic species.

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.

XII. REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed action. Reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the action, including the avoidance, minimization, and compensation measures is subsequently modified in a manner that causes an effect to the listed species that was not considered in the BO; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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Attachment A

California Department of Water Resources. 2012. Small Erosion Repair Manual. July 2012.

Enclosure 2

Magnuson-Stevens Fishery Conservation and Management Act

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS
Small Erosion Repair Program, Phase I

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

As authorized in the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended (16 U.S.C. § 1801 et seq.), the Councils identify essential fish habitat (EFH) and describe EFH in Federal fishery management plans (FMPs). Federal action agencies must consult with NOAA's National Marine Fisheries Service (NMFS) on any activity which they fund, authorize, or undertake or propose to fund, authorize, or undertake that may adversely affect EFH. NMFS provides EFH conservation and enhancement recommendations to the Federal action agencies.

EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of EFH, "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; and "spawning, breeding, feeding, or growth to maturity" covers all habitat types used by a species throughout its life cycle. The action area for the Oasis Center Development Project, Redding, California has been identified as EFH for Pacific Coast Salmon species identified in Amendment 14 of the Pacific Salmon FMP [Pacific Fishery Management Council (PFMC) 1999].

PFMC (1999) has identified and described EFH, and has identified adverse impacts and recommended conservation measures for salmon in amendment 14 to the Pacific Coast Salmon FMP. Freshwater EFH for Pacific salmon in the California Central Valley (CV) includes waters currently or historically accessible to salmon within the CV ecosystem as described in Myers *et al.* (1998). 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 FMP that occur in the CV. Since this project is located on smaller intermittent creeks within the Sacramento River watershed, EFH will be discussed for CV fall-/late fall-run Chinook salmon.

The biological opinion (BO) for the Small Erosion Repair Program (SERP), Phase I, addresses Chinook salmon and California Central Valley steelhead listed under the both the Endangered Species Act (ESA) and the MSA that potentially will be affected by the proposed project. These include the Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), CV spring-run Chinook salmon (*O. tshawytscha)*, and California CV steelhead (*O. mykiss)*. 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 the subject BO.

Historically, CV fall-run Chinook salmon generally spawned in the CV and lower foothill reaches up to an elevation of approximately 1,000 feet. Much of the historical fall-run Chinook salmon spawning habitat was located downstream of existing dam sites and the run therefore was not as severely affected by water projects as other runs in the CV.

Although fall-run Chinook salmon abundance is relatively high, several factors continue to affect their habitat conditions in the SERP Phase I action area, including loss of fish to unscreened agricultural diversions, predation by non-native fish species, lack of rearing habitat, regulated river flows, high water temperatures, and reversed flows in the Delta that draw juveniles into state and Federal water project pumps.

A. Life History and Habitat Requirements

General life history information for CV fall-/late fall-run Chinook salmon is summarized below. Further detailed information on Chinook salmon evolutionarily significant units (ESU) are available in the NMFS status review of Chinook salmon from Washington, Idaho, Oregon, and California (Myers *et al.* 1998), and the NMFS proposed rule for listing several ESUs of Chinook salmon (March 9, 1998, 63 FR 11482). The life history and habitat requirements of the listed species addressed in the BO are described in the BO.

Central Valley fall-/late fall-run

Adult CV fall-run Chinook salmon enter the Sacramento and San Joaquin Rivers from July through December and spawn from October through December, while adult CV late fall-run Chinook salmon enter the Sacramento and San Joaquin Rivers from October to April and spawn from January to April [U.S. Fish and Wildlife Service (USFWS) 1998].

Chinook salmon would spawn in water that ranges from a few centimeters to several meters deep provided that there is suitable sub-gravel flow (Healey 1991). Spawning typically occurs in gravel beds that are located in marginally swift riffles, runs and pool tails with water depths exceeding one foot and velocities ranging from one to 3.5 feet per second. Preferred spawning substrate is clean loose gravel ranging from one to four inches in diameter with less that 5 percent fines (Reiser and Bjornn 1979).

Egg incubation occurs from October through March (Reynolds *et al.* 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and into the San Francisco Bay and its estuarine waters (Kjelson *et al.* 1982). The remaining fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, submerged and overhead cover in the form of rocks, aquatic and riparian vegetation, logs, and undercut banks provide habitat for food organisms, shade, and protect juveniles and smolts from predation.

II. PROPOSED ACTION

The U.S Army Corps of Engineers (Corps) and the California Department of Water Resources (DWR) propose to initiate and complete levee repairs as part of SERP Phase I. The repairs will occur in the action area described in the SERP Phase I Biological Assessment. SERP is a collaborative interagency (including NMFS) effort to develop a streamlined regulatory review and authorization process that will facilitate implementation of annual repairs of small erosion sites on Sacramento River Flood Control Project area levees. SERP plans to use programmatic authorizations to streamline the process for implementation of small erosion repairs in accordance with conservation-based design and monitoring standards. SERP proposed projects would be designed to minimize effects on listed fish species, and to protect and enhance the existing aquatic and riparian habitats comprising the riverine corridor. The proposed action is described in detail in the *Description of the Proposed Action* section of the preceding BO (Enclosure 1).

III. EFFECTS OF THE PROPOSED ACTION

The effects of the proposed action on Pacific Coast salmon EFH would be similar to those discussed in the *Effects of the Proposed Action* section of the preceding BO (Enclosure 1) for endangered Sacramento River winter-run Chinook salmon, threatened CV spring-run Chinook salmon, and threatened CV steelhead. Based on the information provided, NMFS concludes that the proposed action would 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 Pacific salmon EFH resulting from proposed project construction activities may contribute sediment and increase turbidity in waterways associated with SERP Phase I, including areas downstream of the construction site. These impacts will occur only during the time when construction is occurring in the water column. There is potential for toxic compounds to be introduced into EFH during proposed project construction. This could occur at any time during the construction, both during in-water and out-of-water phases. The introduction of bank revetment and the construction activities as part of the levee repairs will have adverse impacts on EFH. However, EFH adverse impacts will only continue to occur until the vegetation related conservation measures bring the action area to an improved state compared to the proposed project environmental baseline. With the incorporation of conservation measures, any negative impacts on habitat would be insignificant in the long-term. It is anticipated that SERP Phase I would not result in any permanent net loss in anadromous salmonid spawning habitat. All these impacts are discussed in more detail in the preceding BO (Enclosure 1).

Conservation measures proposed as part of the project description consist of several components designed to avoid or to minimize potentially adverse effects to habitat. Details on these conservation measures can be found in Enclosure 1, Section I, E.

IV. CONCLUSION

Upon review of the effects of SERP Phase I NMFS believes that it would adversely affect EFH for federally managed Pacific salmon. However, considering that the habitat requirements of the Chinook salmon ESU within the SERP Phase I action area are similar to the federally listed CV steelhead DPS, Sacramento River winter-run Chinook salmon, and CV spring-run Chinook salmon, addressed in the preceding BO (Enclosure 1), the Terms and Conditions and Conservation Recommendation in the preceding BO contain adequate measures to avoid, minimize, or otherwise offset the adverse effects to EFH. Therefore, NMFS has no additional EFH Conservation Recommendations to provide.

V. ACTION AGENCY STATUTORY REQUIREMENTS

Section 305(b)(4)(B) of the MSA and Federal regulations (50 CFR § 600.920) to implement the EFH provisions of the MSA require Federal action agencies to provide a detailed written response to NMFS, within 30 days of its receipt, responding to the EFH conservation recommendations. The response must include a description of measures adopted by the Agency for avoiding, mitigating, or offsetting the impact of the Project on Pacific salmon EFH. In the case of a response that is inconsistent with NMFS' recommendations, the Agency must explain their reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)).

VI. SUPPLEMENTAL CONSULTATION

Pursuant to 50 CFR 600.920(l), 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.

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