UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

SEP 13 2012

In Response Refer To:
2011/01137

Jacqueline M. Wait, Chief
Environmental MPS and Local Assistance Branch
California Department of Transportation
1976 E. Charter Way/ 1976 E. Dr. Martin Luther King Jr. Blvd.
Stockton, California 95205

Dear Ms. Wait:

Enclosed is NOAA's National Marine Fisheries Service's (NMFS) biological and conference opinion (BO) (Enclosure 1) for the proposed McHenry Avenue Corridor Improvement project (Project) located in San Joaquin County, California, and its effects on California Central Valley (CV) steelhead (*Oncorhynchus mykiss*) and its designated critical habitat, in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your initial request for formal section 7 consultation and conferencing on this project was received on February 1, 2011. On May 9, 2011, formal consultation and conferencing was initiated by NMFS' Central Valley Office.

This biological and conference opinion is based primarily on the biological assessment (BA) provided on February 1, 2011. The BA incorporated recommendations and addressed NMFS comments as discussed in meetings, correspondence, and emails.

Based on the best available scientific and commercial information, the biological and conference opinion concludes that the Project, as presented by the California Department of Transportation, is not likely to jeopardize the continued existence of the listed species or destroy or adversely modify designated or proposed critical habitat. NMFS anticipates that the proposed project will result in the incidental take of CV steelhead. An incidental take statement that includes reasonable and prudent measures and non-discretionary terms and conditions that are intended to minimize the impact of the anticipated incidental take of CV steelhead is included with the BO.

It is important to note than an experimental population of Chinook salmon will be present in the upper reaches of the San Joaquin River as part of the San Joaquin River Restoration Program. This is scheduled to occur no later than December 31, 2012. Pursuant to ESA section 10(j), with limited exceptions, each member of an experimental population shall be treated as a threatened species. The re-introduction of spring-run Chinook salmon and the specific processes therein are currently under development. It is reasonable to assume that reintroduced spring-run Chinook salmon juveniles will be present in the San Joaquin River and within the proposed project action

area. As the proposed project is scheduled for completion in the fall of 2012, this should not be an issue. However, if the project is delayed, impacts of the proposed project on spring-run Chinook salmon may need to be assessed.

Also enclosed are NMFS' Essential Fish Habitat (EFH) conservation recommendations for Pacific salmon (*O. tshawytscha*) as required by the Magnuson-Stevens Fishery Conservation and Management Act 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 certain terms and conditions of the incidental take statement and the ESA conservation recommendations of the biological opinion as the EFH conservation recommendations.

Please contact Dylan Van Dyne at our Central Valley Office at (916) 930-3725, or via e-mail at Dylan.VanDyne@noaa.gov, if you have any questions regarding this response or require additional information.

Sincerely,

For Rodney R. McInnis
Regional Administrator

Enclosures (2)

cc: Copy to file – ARN 151422SWR2011SA00165
NMFS-PRD, Long Beach, CA
Bryan Chesney, Long Beach, CA

Enclosure 1

BIOLOGICAL OPINION

ACTION AGENCY: California Department of Transportation

ACTION: McHenry Avenue Corridor Improvement Project

CONSULTATION
CONDUCTED BY: Southwest Region, National Marine Fisheries Service

FILE TRACKING NUMBER: 151422SWR2011SA00165 (TN2011/001137)

DATE ISSUED: SEPTEMBER 13, 2012

I. CONSULTATION HISTORY

The California Department of Transportation (Caltrans) is proposing to construct the McHenry Avenue Corridor Improvement Project (Project) in Stanislaus County, California. The Project is an aggregate of three component projects: (1) McHenry Avenue Widening; (2) replacement of the Stanislaus River Bridge; and (3) replacement of the South San Joaquin Irrigation District (SSJID) Bridge on McHenry Avenue.

On October 7, 2010, National Marine Fisheries Service (NMFS) and other resource agencies attended a pre-application meeting regarding the Project.

On February 1, 2011, NMFS received a letter from Caltrans requesting initiation of section 7 consultation under the Endangered Species Act (ESA).

On April 14, 2011, NMFS attended a site meeting with other resource agencies to discuss construction effects to listed anadromous fish and address other concerns associated with the Project Biological Assessment (BA) submittal.

On May 6, 2011, NMFS received a Technical Memorandum from Caltrans addressing the concerns outlined from the April 14, 2011, site visit.

On May 9, 2011, formal consultation was initiated by NMFS' Central Valley Office.

On September 19, 2011, NMFS received another Technical Memorandum that addressed NMFS' concerns regarding the pile driving analysis.

On June 28, 2012, Caltrans and their consultants met with NMFS to discuss the Project Description in a sufficient level of detail required to complete the Effects Analysis of the biological opinion (BO).

On July 24, 2012, Caltrans sent a Technical Memorandum containing an amended Project Description via email at NMFS' request. Staff and the Section 7 Coordinator deemed the submittal sufficient enough to conduct a proper Effects Analysis on August 1, 2012.

II. DESCRIPTION OF THE PROPOSED ACTION

McHenry Avenue is a two-lane, undivided, north-south road that runs through San Joaquin and Stanislaus counties. It serves as a principal arterial for local traffic and as a connector between State Route 120 in Escalon and State Route 108 in unincorporated Stanislaus County. San Joaquin County, in cooperation with Stanislaus County, proposes to widen and improve McHenry Avenue from 200 feet south of Jones Road in San Joaquin County to 1,700 feet south of East River Road in Stanislaus County. There are two bridges and one major intersection within this 1.1-mile-long segment of McHenry Avenue. The McHenry Avenue Corridor Improvement Project is an aggregate of three component projects with three distinct federal aid numbers:

(1) RPSTPLE-5929(196): Widening of McHenry Avenue to accommodate a two-way center left turn lane from just south of Jones Road to south of Stanislaus River, and improvement of the McHenry Avenue and East River Road intersection.
(2) BRLS-5929(166): Replacement of the Stanislaus River Bridge (No. 38C-0032) on McHenry Avenue over the Stanislaus River to accommodate the proposed roadway improvements.
(3) BRLS-5929(167): Replacement of the South San Joaquin Irrigation District Bridge (No. 29C-0166) on McHenry Avenue over the South San Joaquin Irrigation District/Oakdale Irrigation District (SSJID/OID)Main Canal to accommodate proposed roadway improvements.

A. Project Location

The proposed project is located along McHenry Avenue in the southeast portion of San Joaquin County, south of the city of Escalon, and crosses the Stanislaus River directly south of the intersection at East River Road, at the border of San Joaquin and Stanislaus counties, California (Figure 1). The proposed action is located within the Escalon, California, U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle (USGS 1976) within portions of 4, 5, 8, 9, 16, 17, 20, 21, 28 and 29 of Township 2 South, Range 9 East, Mount Diablo Baseline and Meridian (Figure 2). The project limits are approximately 1,700 feet south of East River Road to 4,000 feet north of East River Road and extend east 1,300 feet along East River Road and west 700 feet along East River Road.

B. Construction Activities

The proposed project is estimated to take three years to complete; construction is scheduled to commence in year 2013 and end in year 2015. The type of equipment to be used includes excavators, backhoes, large haul trucks, concrete trucks, truck and flatbed trailers, large cranes, and pile-driving equipment.

The sequence of construction activities will be dictated by the date on which the contractor is given notice to proceed; however, the overall timeline will be driven by the various restrictions imposed on the construction of the bridge replacements. Construction within the Stanislaus River will be limited to the period between June 15 and October 15. Work within the river channel may include the construction of falsework, bridge piers, and footings. Work within the designated floodway that is governed by Central Valley Flood Protection Board (Board) will be restricted to the period from April 15 to October 31 unless otherwise authorized by the Board. Staging areas on both sides of the river will be used by the contractor to store construction equipment and materials and to access the construction site. The edge of the staging areas will be at least 50 feet from the channel in order to minimize impacts to the riparian corridor.

Project construction activities outside of the river channel, the designated floodway boundary, or the SSJID canal, such as roadway embankments, paving, etc., may occur throughout the year.

Diversion of the Stanislaus River at the construction site would be required to remove the existing bridge superstructure and piers, place temporary falsework, and construct the new bridge. Some form of cofferdam must be constructed to facilitate dewatering for construction of temporary embankments/work platforms; temporary falsework/trestles; and to protect the waterway during demolition and removal of the existing Stanislaus River Bridge. Temporary embankment/work pad(s) will be constructed of clean, local cobble and gravel substrate material approved by the U.S. Army Corps of Engineers and NMFS. Temporary embankment/work pad(s) are proposed for use to divert the flow and maintain dry conditions around the work area. Culvert pipes would not be sufficient to handle the flow of the Stanislaus River if flows during the allowable in-water work window are higher than anticipated; therefore, no culverts will be used for diversion. Instead, a channel opening will be utilized. The temporary work pad will be used to support drilling equipment for the construction of cast-in-drilled-hole (CIDH) piles. Either temporary or permanent steel casing will be placed to support the walls of each hole during drilling. Below the bottom of the casing for the CIDH-type foundation, a slurry displacement method will be used to control groundwater intrusion into the pile excavation, with the drilling fluids controlled using special equipment and typical Best Management Practices (BMPs) for these activities.

The proposed project includes permanent or temporary steel pipe casing that will be used for the installation of the CIDH concrete piling. A total of eight piles will be driven via the vibratory hammer method (located at Bent 23 & 24) method and are 72-inch diameter steel pipe casing (in-water or placed through temporary embankment) in size. Eight additional piles will be driven with a vibratory hammer (located at Bent 22 & 25) and are 48-inch diameter steel pipe casing (land-based) in size. A total of 180 land-driven piles will be driven with a diesel impact hammer and are 24-inch precast/prestressed (PC/PS) hexagonal concrete piles (land-based) in size.

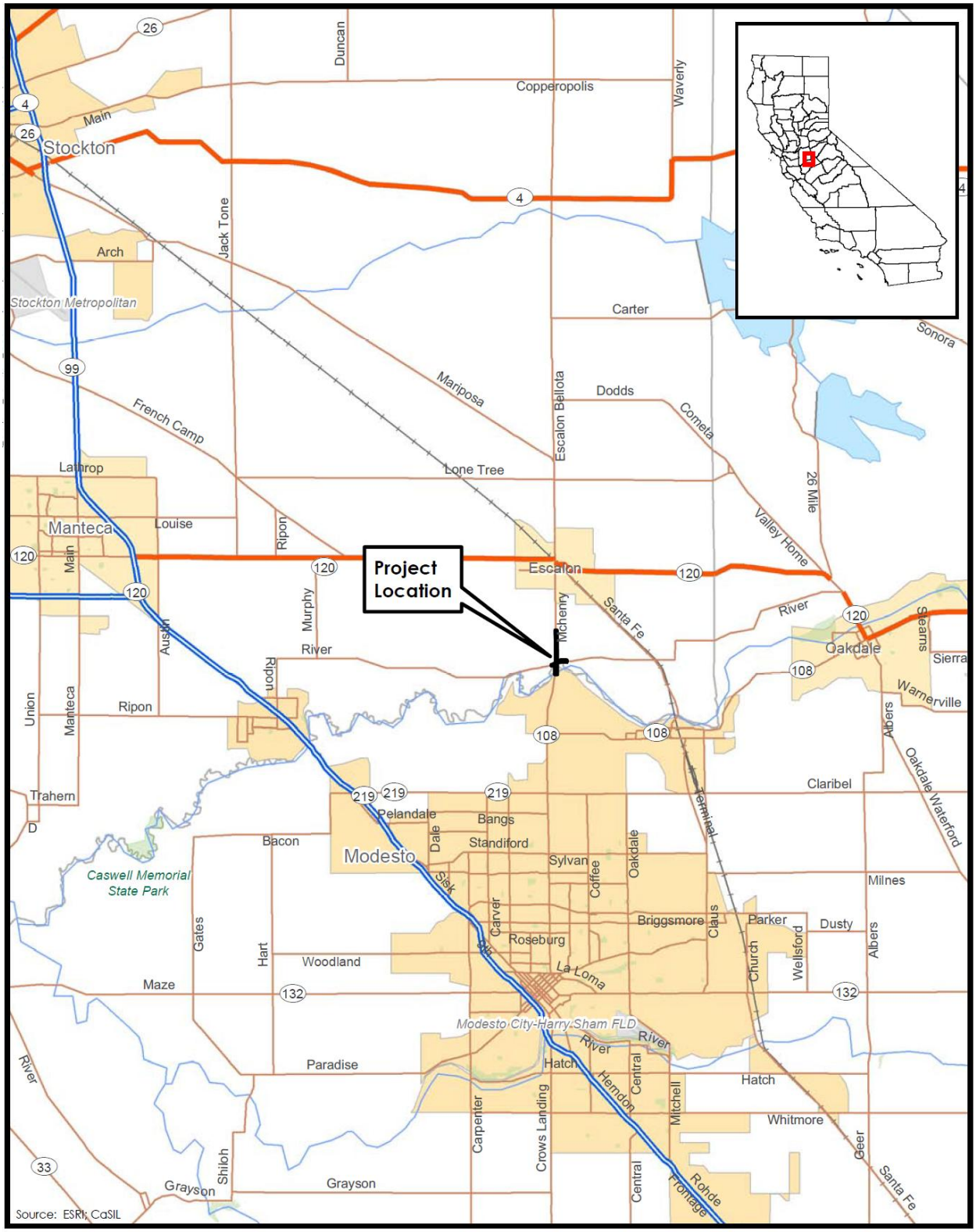

Figure 1. Regional Vicinity Map

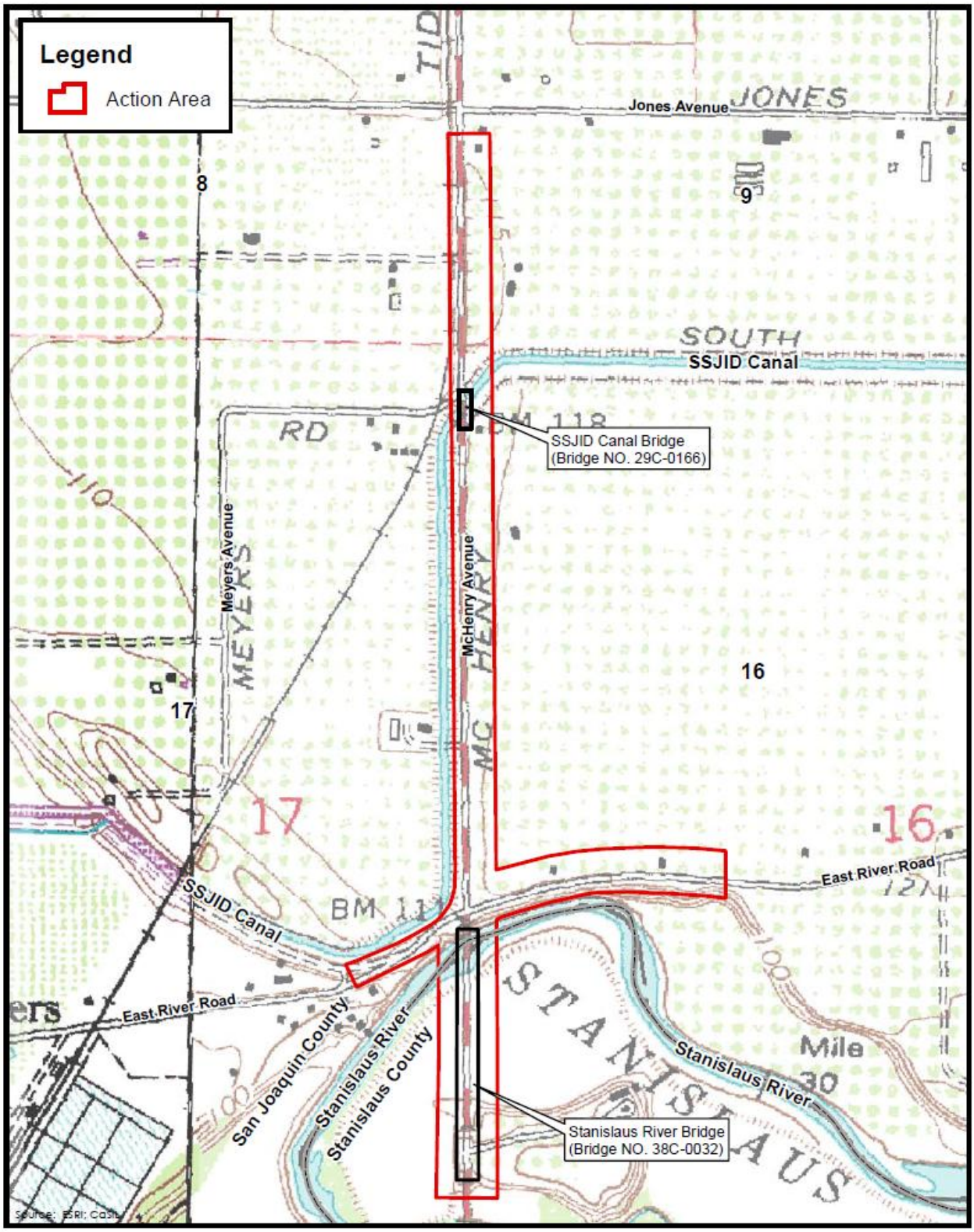

Figure 2. Project Location Map

Approximately two steel pipe casings, either 72-inch or 48-inch and five to ten 24-inch PC/PS concrete piles are anticipated to be installed per day (clock resets only after a 12 hour break or more occurs). Actual installation rates for the PC/PS piling will vary depending on a number of factors, including staging, associated construction activities, and substrate conditions. Strikes required per pile vary depending on pile size and type, and underlying substrate conditions. Geotechnical analyses indicate that 24-inch concrete piles installed with a diesel impact hammer will rapidly seat into the soil upon placement with minimal resistance. The need for impact hammering is expected to be needed only during the final few feet of seating the pile. As a result, a conservative estimate of approximately 250 strikes per pile is anticipated for the 24-inch concrete piles. The 48- and 72-inch diameter steel pipe casings will be driven the majority of the distance with a vibratory hammer. It is anticipated that each pile will require approximately 10 minutes of vibratory driving time.

For in-water casing installation, depth of water is anticipated to range from approximately 0 to 10 feet deep (depending on use of temporary embankment, location of casing installation, and water stage elevation). Distance to water for 24-inch concrete piles driven on land varies (closest piles are located 31.5 feet from water).

C. Construction Summary of Events

The south portion of the Stanislaus River replacement structure is anticipated to be supported on 24-inch hexagonal PC/PS concrete piling that would be driven into the ground by use of a diesel powered pile hammer. A total of 180 piles (not in addition to the 180 piles discussed above) will be driven with a diesel impact hammer over two years (construction seasons). All 180 concrete piles will be installed on dry land adjacent to the river with varying distance to the river's edge.

The northern portion of the river bridge will consist of CIDH piling (48- and 72-inch steel pipes) with cast-in-place (CIP) concrete column extensions and a CIP pre-stressed concrete box girder superstructure. A total of eight 72-inch steel pipe casings (in-water) and eight 48-inch steel pipe casings (adjacent to or in-water) will be driven with vibratory hammer over two years (construction seasons).

The proposed project will temporarily affect 0.443 acre and permanently affect (or fill) 0.002 acre of riverine habitat. Activities related to the construction of the proposed project will result in localized loss of vegetation (permanent loss of 0.45 acre of riparian vegetation) general disturbance to the soil, and an increase in impervious surfaces.

D. Construction Sequencing and Schedule

The sequence of construction activities will be dependent on when the contractor is given a notice to proceed with the work and on the various permit requirements. It is anticipated that the schedule will be driven by both bridge sites. That is, the period of time the SSJID canal will not be delivering water to customers and the proposed work windows for construction within the limits of the Stanislaus River channel and adjacent floodway. The general sequence work is anticipated to be:

(1) Relocate the existing Modesto Irrigation District (MID) transmission line on the east side of McHenry Avenue.
(2) Install construction area signage.
(3) Create temporary local detours to control traffic at McHenry Avenue/East River Road.
(4) Maintain two-way traffic on existing McHenry Avenue pavement and construct an embankment and structural section for new northbound lane.
(5) Construct the new east halves of both the Stanislaus River Bridge and the SSJID Bridge.
(6) Shift traffic to the new portions of the bridges and demolish and remove the existing bridges.
(7) Construct the west halves of the new bridges and close bridge decks as required.
(8) Install traffic signal equipment and facilities at the McHenry Avenue/East River Road intersection.
(9) Complete approach work and stripe new structures for three-lane configuration.
(10) Shift traffic to permanent lane configuration and remove temporary local detours.
(11) Complete miscellaneous site work; conform work at field entrances and property access; clean up.

Year One

During this construction season, one-half of the proposed new Stanislaus River Bridge would be built upstream of and immediately adjacent to the existing bridge. This portion of the bridge would eventually carry northbound traffic on McHenry Avenue. Traffic on McHenry Avenue would continue to use the existing Stanislaus River Bridge during this first stage of construction. In-water work would be limited to the period between June 15 and October 15. Details of work would include (see Figure 3):

- Construction of coffer dams to allow partial dewatering of the Stanislaus River in the immediate project area. Coffer dams would extend from the south bank of the river within the shallow areas of the riverbed (areas with water depths less than 6 feet during periods of low flow). The deepest part of the river channel; or low flow channel shown in Figure 3., with typical water depths of 6 to 10 feet (during periods of low flow) would be left open during construction to allow upstream and downstream fish passage. The open channel would be approximately 20 feet wide, and would be wide enough to accommodate low flows in the Stanislaus River without the use of culverts. Two possible types of coffer dams might be used:

  (1) Ones that can be installed on the surface of the riverbed, such as those constructed of steel frames covered by a membrane (i.e. "PORTADAM™") or those made of a series of water-filled bladders; or
  (2) Ones that must penetrate the riverbed, such as sheet pile coffer dams. If this type of coffer dam is utilized, sheet piles would be vibrated, not impact driven, into position after which the area enclosed by the coffer dam would be dewatered.

- The total area to be dewatered would range between 4,000 to 8,500 square feet depending on the amount of activity in a given stage. Water would be pumped out and handled in a way to

prevent silt from entering the river. A fish recovery plan would be implemented to salvage and relocate any fish trapped within the boundaries of the coffer dams.

- Construction of a temporary work platform within the dewatered area for use by construction equipment. Two of the possible types of platforms might be used:

  (1) An earthen embankment built of gravel and other clean local fill material. Such a platform would be approximately 175 feet long and 50 feet wide, depending on the size of equipment to be supported; or
  (2) A temporary work trestle consisting of steel supports with timber decking. Steel pipe or H-pile supports be installed using vibratory pile hammers if the pile would be in direct contact with the water.

* Construction of elements of the first half of the new bridge structure that must be built within the limits of the river channel. This includes eight CIDH concrete piles and columns within the active waterway limits, CIDH piles for the bents outside the waterway and all the PC/PS piles needed for the portion of the new bridge in the overflow area to the south of the river.

- Construction of falsework to be used for bridge construction activities. Vibratory pile hammers would be utilized to install falsework support piles where the piles would be in direct contact with water in the active waterway. Falsework piles to be installed on the dry overbank or in dewatered areas of the river channel could be driven in using an impact hammer.

- Removal of all work pads and dewatering materials from the river channel by October 15. Falsework piles would remain in place through the remainder of the year to allow construction of the above-water portions of the northbound half of the new bridge to continue outside the in-water work window.

Year Two

During this construction season, all traffic on McHenry Avenue would be diverted to the new half of the Stanislaus River Bridge, and the existing Stanislaus River Bridge would be demolished. The second half of the proposed new Stanislaus River Bridge would then be built adjacent to the half of bridge built in Year One, on the same alignment as the existing bridge. This portion of the bridge would eventually carry traffic southbound on McHenry Avenue. Similar to Year 1, in-water work would be limited to the period between June 15 and October 15. Details of work would include (see Figure 4):

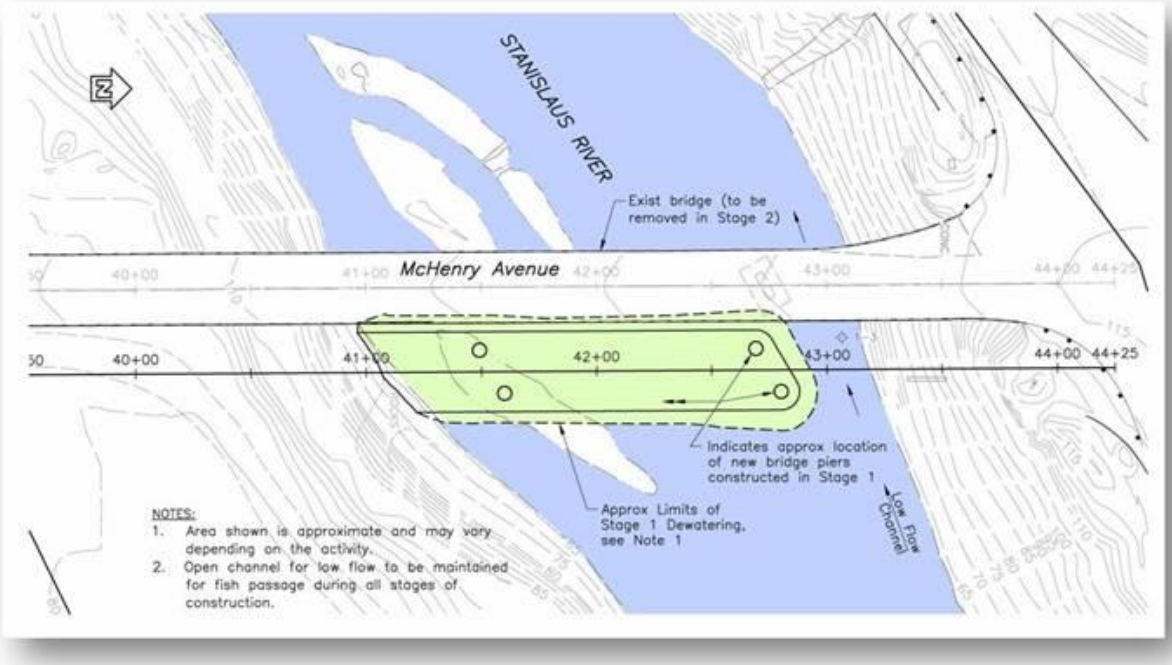

Figure 3. Approximate limits of in-water work area during the first year of construction

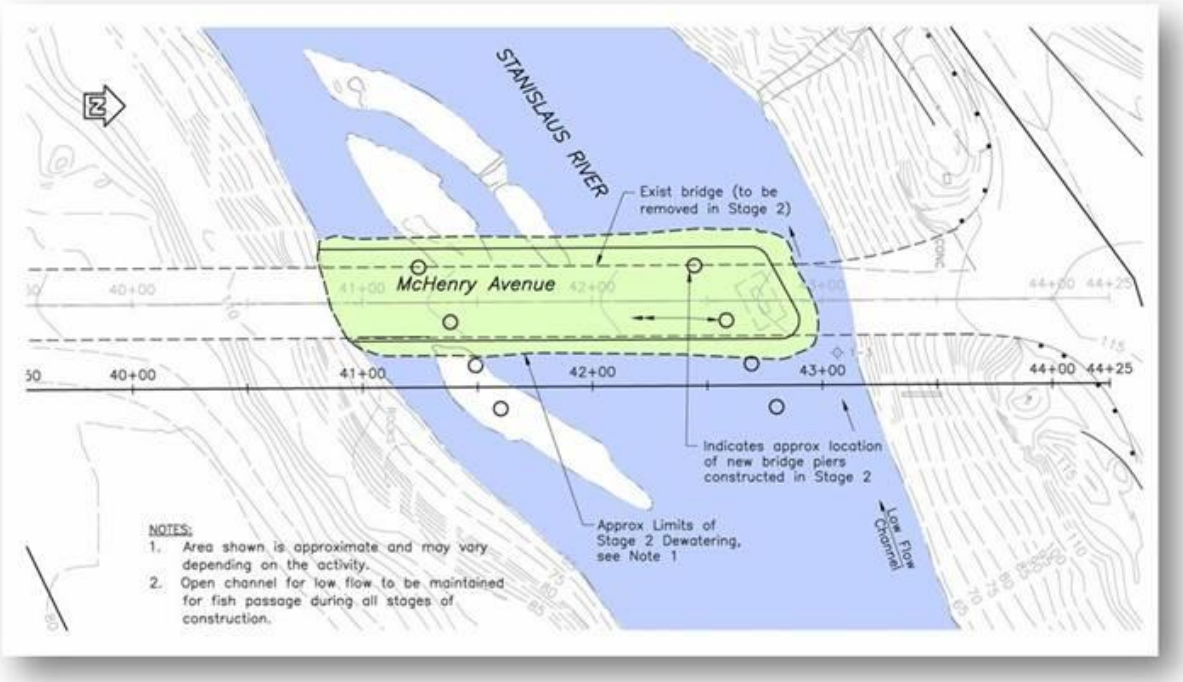

Figure 4. Approximate limits of in-water work area during the second year of construction

- Construction of coffer dams necessary to isolate construction activity from the active waterway will consist of the same types and configurations described for use in Year 1.

- Figure 4 describes the approximate area to be protected during the in-water work windows.

- As in the first year, the total area to be dewatered would range between approximately 4,000 to 8,500 square feet, depending on the activity. Similarly water would be pumped out and handled in a way to prevent silt from entering the river.

- During demolition of the existing Stanislaus River Bridge, appropriate containment measures will be used to prevent debris from entering the water.

- Construction of falsework for bridge demolition and other construction activities will follow the same guidelines established for the construction of the Stage 1 half of the new structure.

- Removal of all work pads and dewatering materials from the river channel by October 15. Falsework piles required to support the on-going above-water construction activity would remain in place through the remainder of the year

Year Three

During this construction season, bridge construction and roadway work would be completed. This would include the following activities in/near the Stanislaus River:

- Construction activities needed to join the two halves of the new Stanislaus River Bridge

- Removal of falsework and in-river piles supporting falsework

- Site restoration work in/near the river channel.

E. Proposed Conservation Measures

The following measures will be implemented to ensure impacts to California Central Valley (CV) steelhead (*Oncorhynchus mykiss*) Distinct Population Segment (DPS) are minimized to the greatest extent possible.

1. In-water activities proposed on the Stanislaus River will be limited to between June 15 and October 15.

2. The anticipated work schedule, including start and end dates, will be provided to the USFWS and NMFS one week in advance of construction start. NMFS may inspect the work site to evaluate and assist with the implementation of proposed avoidance and minimization measures.

3. The permanent loss of 0.002 acre of CV steelhead habitat, will be offset through the purchase of credits, at a 3:1 ratio, from a USFWS approved CV steelhead mitigation

bank. Proof of purchase will be provided to the USFWS and NMFS prior to initiation of construction activities.

4. Prior to the initiation of construction activities, a Worker Environmental Awareness Program (WEAP) will be developed and implemented. All onsite project personnel will be required to complete the WEAP training prior to start of work. At a minimum, the training will include a description of all special-status species that have the potential to occur within the action area, their habitat requirements, the avoidance and minimization measures that are to be implemented and maintained for the conservation of the species, and the limits of construction/disturbance for the project.

5. The following components will be implemented, by qualified biologists, to reduce the potential for direct take of CV steelhead:

    a. An approximately 20-foot wide section of the river, representing the low-flow channel, will be left open during all in-water activities to facilitate upstream/downstream dispersal of fish populations within the Stanislaus River.
    b. Block nets will be installed around the limits of the in-water work areas, prior to the initiation of construction activities in all years. Netting mesh size will be chosen to provide exclusionary benefits to young-of-the year CV steelhead.
    c. Seine nets and/or electrofishers will then be utilized to relocate as many fish as possible within the containment area.
    d. Collected fish will be relocated to a suitable location within the Stanislaus River either upstream or downstream of the project site.
    e. Block nets will remain in place until such time as a turbidity/silt curtain (if required) is installed, or cofferdam construction has been completed.
    f. A qualified biologist, designated by San Joaquin County, will be present to monitor onsite compliance with all minimization measures.

6. All pumped water shall be routed to either: (1) a sedimentation pond located on a flat stable area above the Ordinary High Water Mark (OHWM), to prevent silt-laden runoff from entering the river; or (2) a sedimentation tank/holding facility that allows only clear water to return to the river, and includes disposal of settled solids at an appropriate offsite location.

7. The contractor shall prepare and implement a demolition containment plan to keep debris from entering the main channel of the river. Debris includes raw cement, concrete, concrete washes, asphalt, paint or other coating materials (including lead-based paint from the existing structure), oil and petroleum products, and any other substance that could be hazardous to aquatic life.

8. Downstream sedimentation and turbidity is harmful to aquatic life; therefore, a Stormwater Pollution Prevention Plan (SWPPP) shall be developed and implemented to ensure the proper installation and maintenance of sediment control measures.

Implementation of the SWPPP shall be phased for the installation of dry-weather protective measures and rainy season protective measures.

9. To control sedimentation during and after project implementation, the permit holder will be responsible for implementation of Best Management Practices (BMP's) as outlined in any authorizations or permits issued for the project under the authority of the Clean Water Act. If BMP's are ineffective, the permit holder will attempt to remedy the situation immediately.

10. All refueling, maintenance, and staging of equipment and vehicles will occur at least 60 feet from riparian habitat or other water bodies and not in a location from where a spill would drain directly toward aquatic habitat. Refueling of construction equipment and vehicles will occur only within designated areas where possible spills shall be readily contained. The monitor will ensure contamination of habitat does not occur during such operations. Prior to the onsite of the work, the project proponent will ensure that the contractor's SWPPP includes provisions for prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and the appropriate measures to take should a spill occur. Any spills will be cleaned up immediately.

11. The number of access routes, size of staging areas, and total area of the activity will be limited to the minimum necessary to achieve the project goal. Environmentally sensitive areas will be established to confine access routes and construction areas to the minimum area necessary to complete construction and to minimize the impact to sensitive habitat; this goal includes locating access routes and construction areas outside of wetlands and/or riverine areas to the maximum extent practicable. Stockpiling construction materials, including portable equipment, vehicles, supplies, and chemicals, shall only be permitted in designated construction staging areas.

12. Litter and construction debris from below the OHWM will be removed and placed at an appropriate site not subject to flooding during the period from October 15 to May 15. Any spills of hazardous materials in riverine habitat will be immediately cleaned up and disposed of properly.

13. Pile driving and post-drilling will only occur from 8am to 5pm on weekdays. Restricted working hours will allow for relaxation periods and movement windows for special status fish present in the action area.

F. Action Area

The proposed project action area consists of two components:

(1) The terrestrial component of the action area is defined by:
    (a) The project footprint, including all cleared areas, and staging areas; and
    (b) The area where construction noise levels are in excess of ambient conditions.
(2) The aquatic component of the action area is defined by:

(a) The segment of the Stanislaus River upstream and downstream of bridge construction sites where pile driving sound noise levels are expected to exceed ambient conditions;
(b) Construction-related water quality impacts in excess of ambient conditions; and
(c) Operational stormwater quality impacts in excess of ambient conditions.

The proposed project action area consists of the Stanislaus river miles (RM) 29 and 30, extending 1,500 feet upstream and 1,500 feet downstream of the bridge site, but does not include the railroad tracks (Tidewater Southern Railroad) or the SSJID/OID Main Canal to the west of McHenry Avenue in the northern portion of the action area. The proposed project action area encompasses approximately 43.7 acres. represents the area within and adjacent to the Stanislaus River that is used by California (CV) steelhead and where these fish could potentially be exposed to construction related effects including changes in water turbidity, near shore impacts to riparian habitat, the acoustic sounds of pile driving within the water column and the area of potential fish rescue actions.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

The following listed species and it's designated critical habitat occur in the action area and may be affected by the proposed action:

California Central Valley distinct population segment (DPS) (*Oncorhynchus mykiss*) (referred to as Central Valley steelhead or CV steelhead throughout this BO) threatened (January 5, 2006, 71 FR 834)

Central Valley steelhead designated critical habitat (September 2, 2005, 70 FR 52488)

A. Species and Critical Habitat Listing Status

1. <u>CV steelhead</u>

The California Central Valley (CV) steelhead (*Oncorhynchus mykiss*) Distinct Population Segment (DPS) was originally listed as threatened on March 19, 1998, (63 FR 13347). This DPS consists of steelhead populations in the Sacramento and San Joaquin river basins in California's Central Valley. In June 2004, after a complete status review of 27 west coast salmonid evolutionarily significant units (ESUs) and DPSs, NMFS proposed that CV steelhead remain listed as threatened (69 FR 33102; June 14, 2004). On January 5, 2006, after reviewing the best available scientific and commercial information, NMFS issued its final decision to retain the status of CV steelhead as threatened (71 FR 834). This decision also included the Coleman National Fish Hatchery and Feather River Hatchery (FRH) steelhead populations. These populations were previously included in the DPS but were not deemed essential for conservation and thus not part of the listed steelhead population. Critical habitat was designated for CV 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. Designated critical habitat for CV steelhead occurs within the proposed project's action area.

B. Species Life History, Population Dynamics, and Likelihood of Survival and Recovery

CV steelhead

a. General Life History

Steelhead can be divided into two life history types, summer-run steelhead and winter-run steelhead, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration, stream-maturing and ocean-maturing. Only winter-run steelhead currently are found in California Central Valley rivers and streams (McEwan and Jackson 1996), although there are indications that summer-run steelhead were present in the Sacramento River system prior to the commencement of large-scale dam construction in the 1940s (Interagency Ecological Program [IEP] Steelhead Project Work Team 1999). At present, summer-run steelhead are found only in North Coast drainages, mostly in tributaries of the Eel, Klamath, and Trinity river systems (McEwan and Jackson 1996).

CV steelhead generally leave the ocean from August through April (Busby *et al.* 1996) and enter freshwater from August to November and spawn from December to April in small streams and tributaries where cool, well oxygenated water is available year-round (Table 1; Williams 2006; Hallock *et al.* 1961; McEwan and Jackson 1996). Timing of upstream migration is correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. Unlike Pacific salmon, steelhead are iteroparous, which are capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are 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, Shapovalov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams.

Spawning occurs during winter and spring months. The length of time it takes for eggs to hatch depends mostly on water temperature. Hatching of steelhead eggs in hatcheries takes about 30 days at 51 degrees Fahrenheit (F). 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). Newly emerged fry move to the shallow, protected areas associated with the stream margin (McEwan and Jackson 1996) and they soon move to other areas of the stream and establish feeding locations, which they defend (Shapovalov and Taft 1954).

Steelhead rearing during the summer takes place primarily in higher velocity areas in pools, although young-of-the-year also are abundant in glides and riffles. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small woody debris. Cover is an important habitat component for juvenile steelhead both as velocity refugia and as a means of

Table 1. The temporal occurrence of adult (a) and juvenile (b) CV steelhead in the Central Valley. Darker shades indicate months of greatest relative abundance.

(a) Adult

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

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[1,2]Sacramento River												
[2,8]Sac. R at Knights Land												
[9]Sac. River @ KL												
[10]Chipps Island (wild)												
[8]Mossdale												
[11]Woodbridge Dam												
[12]Stan R. at Caswell												
[13]Sac R. at Hood												

Source: [1]Hallock et al. 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; [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.

Relative Abundance: = High = Medium = Low

avoiding predation (Meehan and Bjornn 1991).

Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows. Emigrating CV steelhead use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean. Juvenile CV steelhead feed mostly on drifting aquatic organisms and terrestrial insects and will also take active bottom invertebrates (Moyle 2002). Some may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods prior to their final emigration to the sea. Hallock *et al.* (1961) found that juvenile steelhead in the Sacramento River basin migrate downstream during most months of the year, but the peak period of emigration occurred in the

spring with a much smaller peak in the fall. Nobriga and Cadrett (2003) also have verified these temporal findings based on analysis of captures at Chipps Island.

(1) Population Dynamics. Historic CV 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). Over the past 30 years, the naturally-spawned steelhead populations in the upper Sacramento River have declined substantially. 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 Red Bluff Diversion Dam (RBDD) declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the early 1990s, 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.

Recent estimates from trawling data in the Delta indicate that approximately 100,000 to 300,000 (mean 200,000) smolts emigrate to the ocean per year, representing approximately 3,600 female steelhead spawners in the Central Valley basin (Good *et al*. 2005). This can be compared with McEwan's (2001) estimate of one million to two million spawners before 1850, and 40,000 spawners in the 1960s.

Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River (below Red Bluff Diversion Dam) 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). Snorkel surveys (1999 to 2002) indicated that steelhead are present in Clear Creek (Good *et al*. 2005). Because of the large resident *O. mykiss* population in Clear Creek, steelhead spawner abundance has not been estimated.

Until recently, CV steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected small self-sustaining populations 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 (S.P. Cramer and Associates Inc. 2000, 2001).

It is possible that naturally-spawning populations exist in many other streams but are undetected due to a lack of monitoring programs (IEP Steelhead Project Work Team 1999). Incidental catches and observations of steelhead juveniles also have occurred on the Tuolumne and Merced rivers during fall-run Chinook salmon monitoring activities, indicating that steelhead are widespread throughout accessible streams and rivers in the Central Valley (Good *et al*. 2005). CDFG staff has prepared juvenile migrant CV steelhead catch summaries on the San Joaquin River near Mossdale representing migrants from the Stanislaus, Tuolumne, and Merced rivers. Based on trawl recoveries at Mossdale between 1988 and 2002, as well as rotary screw trap efforts in all three tributaries, CDFG staff stated that it is “clear from this data that rainbow trout do occur in all the tributaries as migrants and that the vast majority of them occur on the

Stanislaus River" (CDFG 2003). The documented returns on the order of single fish in these tributaries suggest that existing populations of CV steelhead on the Tuolumne, Merced, and lower San Joaquin rivers are severely depressed.

Lindley *et al*. (2006) indicated that prior population census estimates completed in the 1990s found the CV steelhead spawning population above RBDD had a fairly strong negative population growth rate and small population size. Good *et al.* (2005) indicated the decline was continuing as evidenced by new information (Chipps Island trawl data). CV steelhead populations generally show a continuing decline, an overall low abundance, and fluctuating return rates.

(2) Viable Population Summary for CV Steelhead. In order to determine the current likelihood of viability of the CV steelhead DPS, we used the historical population structure of CV steelhead presented in Lindley *et al*. (2006) and the viable salmonid population (VSP) concept for evaluating populations described by McElhany *et al.* (2000). While McElhany *et al.* (2000) introduced and described the concept of VSP, Lindley *et al*. (2007) applied the concept to the CV steelhead DPS. The following provides the evaluation of the likelihood of viability for the threatened CV steelhead DPS based on the VSP parameters of abundance, productivity, spatial structure, and diversity.

Abundance. All indications are that natural CV steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good *et al.* 2005); the long-term trend remains negative. There has been little steelhead population monitoring despite 100 percent marking of hatchery steelhead since 1998. Hatchery production and returns are far greater than those of natural fish and include significant numbers of non-DPS-origin Eel River steelhead stock.

Productivity. An estimated 100,000 to 300,000 natural juvenile steelhead are estimated to leave the Central Valley annually, based on rough calculations from sporadic catches in trawl gear (Good *et al.* 2005). Concurrently, one million in-DPS hatchery steelhead smolts and another half million out-of-DPS hatchery steelhead smolts are released annually in the Central Valley. The estimated ratio of non-clipped to clipped steelhead has decreased from 0.3 percent to less than 0.1 percent, with a net decrease to one-third of wild female spawners from 1998 to 2000 (Good *et al.* 2005).

Spatial Structure. Steelhead appear to be well-distributed throughout the Central Valley (Good *et al.* 2005). Until recently, there was very little documented evidence of steelhead due to the lack of monitoring efforts. Since 2000, steelhead have been confirmed in the Stanislaus and Calaveras rivers.

Diversity. Analysis of natural and hatchery steelhead stocks in the Central Valley reveal genetic structure remaining in the DPS (Nielsen *et al.* 2003). There appears to be a great amount of gene flow among upper Sacramento River basin stocks, due to the post-dam, lower basin distribution of steelhead and management of stocks. Recent reductions in natural population sizes have created genetic bottlenecks in several CV steelhead stocks (Good *et al.* 2005; Nielsen *et al.* 2003). The out-of-basin steelhead stocks of the Nimbus and Mokelumne River hatcheries are

not included in the CV steelhead DPS.

Lindley *et al*. (2007) indicated that prior population census estimates completed in the 1990s found the CV steelhead spawning population above RBDD had a fairly strong negative population growth rate and small population size. Good *et al.* (2005) indicated the decline was continuing as evidenced by new information (Chipps Island trawl data). CV steelhead populations generally show a continuing decline, an overall low abundance, and fluctuating return rates. The future of CV steelhead is uncertain due to limited data concerning their status. However, Lindley *et al.* (2007) concluded that there is sufficient evidence to suggest that the DPS is at moderate to high risk of extinction.

C. CV steelhead Critical Habitat and Function for Species' Conservation

Critical habitat for CV 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 basin, 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 one to two years on the annual flood series) (Bain and Stevenson 1999; 70 FR 52488). Critical habitat for CV steelhead is defined as specific areas that contain the primary constituent elements (PCE) and physical habitat elements essential to the conservation of the species. Freshwater rearing habitat and migration corridors are the inland habitat types used as PCEs that are present in the action area for CV steelhead.

1. 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 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 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 dependant on the function of this habitat for successful survival and recruitment.

2. 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 spawning and rearing 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 outmigrant 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 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.

D. Factors Affecting CV steelhead

1. Habitat Blockage

Hydropower, flood control, and water supply dams of the Central Valley Pumps (CVP), State Water Pumps (SWP), and other municipal and private entities have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. Clark (1929) estimated that originally there were 6,000 linear miles of salmon habitat in the Central Valley system and that 80 percent of this habitat had been lost by 1928. Yoshiyama *et al.* (1996) calculated that roughly 2,000 linear miles of salmon habitat was actually available before dam construction and mining, and concluded that 82 percent is not accessible today.

As a result of migrational barriers, steelhead populations have been confined to lower elevation mainstems that historically only were used for migration. Population abundances have declined in these streams due to decreased quantity and quality of spawning and rearing habitat. Higher temperatures at these lower elevations during late-summer and fall are also a major stressor to adult and juvenile salmonids. CV steelhead historically had at least 81 independent populations based on Lindley *et al.*'s (2006) analysis of potential habitat in the Central Valley. However, due to dam construction, access to 38 percent of all spawning habitat has been lost as well as access to 80 percent of the historically available habitat.

2. Water Development

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted streamflows and altered the natural cycles by which juvenile and adult salmonids base their migrations. As much as 60 percent of the natural historical inflow to Central Valley watersheds and the Delta have been diverted for human uses. Depleted flows have contributed to higher temperatures, lower dissolved oxygen (DO) levels, and decreased recruitment of gravel and large woody debris (LWD). More uniform flows year round have

resulted in diminished natural channel formation, altered food web processes, and slower regeneration of riparian vegetation. These stable flow patterns have reduced bed load movement (Mount 1995; Ayers 2001), caused spawning gravels to become embedded, and decreased channel widths due to channel incision, all of which has decreased the available spawning and rearing habitat below dams. The storage of unimpeded runoff in these large reservoirs also has altered the normal hydrograph for the Sacramento and San Joaquin river watersheds. Rather than seeing peak flows in these river systems following winter rain events (Sacramento River) or spring snow melt (San Joaquin River), the current hydrology has truncated peaks with a prolonged period of elevated flows (compared to historical levels) continuing into the summer dry season.

Water withdrawals, for agricultural and municipal purposes have reduced river flows and increased temperatures during the critical summer months, and in some cases, have been of a sufficient magnitude to result in reverse flows in the lower San Joaquin River (Reynolds *et al*. 1993). Direct relationships exist between water temperature, water flow, and juvenile salmonid survival (Brandes and McLain 2001). Elevated water temperatures in the Sacramento River have limited the survival of salmonids in those waters.

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the Central Valley. Thousands of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, and their tributaries. Although efforts have been made in recent years to screen some of these diversions, many 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 salmonids. For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley 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).

Outmigrant juvenile salmonids in the Delta have been subjected to adverse environmental conditions created by water export operations at the CVP and SWP facilities. Specifically, juvenile salmonid survival has been reduced by the following: (1) water diversion from the mainstem Sacramento River into the Central Delta via the Delta Cross Channel; (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; (3) entrainment at the CVP/SWP export facilities and associated problems at Clifton Court Forebay; and (4) increased exposure to introduced, non-native predators such as striped bass (*Morone saxatilis*), largemouth bass (*Micropterus salmoides*), and sunfishes (Centrarchidae).

3. <u>Water Conveyance and Flood Control</u>

The development of the water conveyance system in the Delta has resulted in the construction of more than 1,100 miles of channels and diversions to increase channel elevations and flow capacity of the channels (Mount 1995). Levee development in the Central Valley affects spawning habitat, freshwater rearing habitat, freshwater migration corridors, and estuarine habitat PCEs. As Mount (1995) indicates, there is an "underlying, fundamental conflict inherent in this channelization." Natural rivers strive to achieve dynamic equilibrium to handle a

watershed's supply of discharge and sediment (Mount 1995). The construction of levees disrupts the natural processes of the river, resulting in a multitude of habitat-related effects.

Many of these levees use angular rock (riprap) to armor the bank from erosive forces. The effects of channelization, and riprapping, include the alteration of river hydraulics and cover along the bank as a result of changes in bank configuration and structural features (Stillwater Sciences 2006). These changes affect the quantity and quality of nearshore habitat for juvenile salmonids and have been thoroughly studied (USFWS 2000; Schmetterling *et al.* 2001; Garland *et al*. 2002). Simple slopes protected with rock revetment generally create nearshore hydraulic conditions characterized by greater depths and faster, more homogeneous water velocities than occur along natural banks. Higher water velocities typically inhibit deposition and retention of sediment and woody debris. These changes generally reduce the range of habitat conditions typically found along natural shorelines, especially by eliminating the shallow, slow-velocity river margins used by juvenile fish as refuge and escape from fast currents, deep water, and predators (Stillwater Sciences 2006).

Prior to the 1970s, there was so much debris resulting from poor logging practices that many streams were completely clogged and were thought to have been total barriers to fish migration. As a result, in the 1960s and early 1970s it was common practice among fishery management agencies to remove woody debris thought to be a barrier to fish migration (NMFS 1996b). However, it is now recognized that too much LWD was removed from the streams resulting in a loss of salmonid habitat and it is thought that the large scale removal of woody debris prior to 1980 had major, long-term negative effects on rearing habitats for salmonids in northern California (NMFS 1996b). Areas that were subjected to this removal of LWD are still limited in the recovery of salmonid stocks; this limitation could be expected to persist for 50 to 100 years following removal of debris.

Large quantities of downed trees are a functionally important component of many streams (NMFS 1996b). LWD influences stream morphology by affecting channel pattern, position, and geometry, as well as pool formation (Keller and Swanson 1979; Bilby 1984; Robison and Beschta 1990). Reduction of wood in the stream channel, either from past or present activities, generally reduces pool quantity and quality, alters stream shading which can affect water temperature regimes and nutrient input, and can eliminate critical stream habitat needed for both vertebrate and invertebrate populations. Removal of vegetation also can destabilize marginally stable slopes by increasing the subsurface water load, lowering root strength, and altering water flow patterns in the slope.

In addition, the armoring and revetment of stream banks tends to narrow rivers, reducing the amount of habitat per unit channel length (Sweeney *et al*. 2004). As a result of river narrowing, benthic habitat decreases and the number of macroinvertebrates, such as stoneflies and mayflies, per unit channel length decreases affecting salmonid food supply.

4. Land Use Activities

Land use activities continue to have large impacts on salmonid habitat in the Central Valley watershed. Until about 150 years ago, the Sacramento River was bordered by up to 500,000

acres of riparian forest, with bands of vegetation extending outward for 4 or 5 miles (California Resources Agency 1989). Starting with the gold rush, these vast riparian forests were cleared for building materials, fuel, and to clear land for farms on the raised natural levee banks. The degradation and fragmentation of riparian habitat continued with extensive flood control and bank protection projects, together with the conversion of the fertile riparian lands to agriculture outside of the natural levee belt. By 1979, riparian habitat along the Sacramento River diminished to 11,000 to 12,000 acres, or about 2 percent of historic levels (McGill 1987). The clearing of the riparian forests removed a vital source of snags and driftwood in the Sacramento and San Joaquin River basins. This has reduced the volume of LWD input needed to form and maintain stream habitat that salmon depend on in their various life stages. In addition to this loss of LWD sources, removal of snags and obstructions from the active river channel for navigational safety has further reduced the presence of LWD in the Sacramento and San Joaquin rivers, as well as the Delta.

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is one of the primary causes of salmonid habitat degradation (NMFS 1996a). Sedimentation can adversely affect salmonids during all freshwater life stages by: clogging or abrading gill surfaces, adhering to eggs, hampering fry emergence (Phillips and Campbell 1961), burying eggs or alevins, scouring and filling in pools and riffles, reducing primary productivity and photosynthesis activity (Cordone and Kelley 1961), and affecting intergravel permeability and DO levels. Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning and egg and fry survival (Waters 1995).

Land use activities associated with road construction, urban development, logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality through the 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 LWD; and removal of riparian vegetation, resulting in increased streambank erosion (Meehan 1991). Urban stormwater and agricultural runoff may be contaminated with herbicides and pesticides, petroleum products, sediment, *etc*. Agricultural practices in the Central Valley have eliminated large trees and logs and other woody debris that would otherwise be recruited into the stream channel (NMFS 1998).

Since the 1850s, wetlands reclamation for urban and agricultural development has caused the cumulative loss of 79 and 94 percent of the tidal marsh habitat in the Delta downstream and upstream of Chipps Island, respectively (Conomos *et al.* 1985; Nichols *et al.* 1986; Wright and Phillips 1988; Monroe *et al.* 1992; Goals Project 1999). Prior to 1850, approximately 1400 km^2 of freshwater marsh surrounded the confluence of the Sacramento and San Joaquin rivers, and another 800 km^2 of saltwater marsh fringed San Francisco Bay's margins. Of the original 2,200 km^2 of tidally influenced marsh, only about 125 km^2 of undiked marsh remains today. In Suisun Marsh, saltwater intrusion and land subsidence gradually has led to the decline of agricultural production. Presently, Suisun Marsh consists largely of tidal sloughs and managed wetlands for duck clubs, which first were established in the 1870s in western Suisun Marsh (Goals Project 1999). Even more extensive losses of wetland marshes occurred in the Sacramento and San Joaquin river basins. Little of the extensive tracts of wetland marshes that existed prior to 1850 along the valley's river systems and within the natural flood basins exist today. Most has been "reclaimed" for agricultural purposes, leaving only small remnant patches.

Dredging of river channels to enhance inland maritime trade and to provide raw material for levee construction has significantly and detrimentally altered the natural hydrology and function of the river systems in the Central Valley. Starting in the mid-1800s, the U.S Army Corps of Engineers (Corps) and private consortiums began straightening river channels and artificially deepening them to enhance shipping commerce. This has led to declines in the natural meandering of river channels and the formation of pool and riffle segments. The deepening of channels beyond their natural depth also has led to a significant alteration in the transport of bedload in the riverine system as well as the local flow velocity in the channel (Mount 1995). The Sacramento Flood Control Project at the turn of the nineteenth century ushered in the start of large scale Corps actions in the Delta and along the rivers of California for reclamation and flood control. The creation of levees and the deep shipping channels reduced the natural tendency of the San Joaquin and Sacramento rivers to create floodplains along their banks with seasonal inundations during the wet winter season and the spring snow melt periods. These annual inundations provided necessary habitat for rearing and foraging of juvenile native fish that evolved with this flooding process. The armored riprapped levee banks and active maintenance actions of Reclamation districts precluded the establishment of ecologically important riparian vegetation, introduction of valuable LWD from these riparian corridors, and the productive intertidal mudflats characteristic of the undisturbed Delta habitat.

Urban stormwater and agricultural runoff may be contaminated with pesticides, oil, grease, heavy metals, polycyclic aromatic hydrocarbons (PAHs), and other organics and nutrients (California Regional Water Quality Control Board-Central Valley Region [Regional Board] 1998) they can potentially destroy aquatic life necessary for salmonid survival (NMFS 1996a, b). Point source (PS) and non-point source (NPS) pollution occurs at almost every point that urbanization activity influences the watershed. Impervious surfaces (*i.e.*, concrete, asphalt, and buildings) reduce water infiltration and increase runoff, thus creating greater flood hazard (NMFS 1996a, b). Flood control and land drainage schemes may increase the flood risk downstream by concentrating runoff. A flashy discharge pattern results in increased bank erosion with subsequent loss of riparian vegetation, undercut banks and stream channel widening. In addition to the PS and NPS inputs from urban runoff, juvenile salmonids are exposed to increased water temperatures as a result of thermal inputs from municipal, industrial, and agricultural discharges.

Past mining activities routinely resulted in the removal of spawning gravels from streams, the straightening and channelization of the stream corridor from dredging activities, and the leaching of toxic effluents into streams from mining operations. Many of the effects of past mining operations continue to impact salmonid habitat today. Current mining practices include suction dredging (sand and gravel mining), placer mining, lode mining and gravel mining. Present day mining practices are typically less intrusive than historic operations (hydraulic mining); however, adverse impacts to salmonid habitat still occur as a result of present-day mining activities. Sand and gravel are used for a large variety of construction activities including base material and asphalt, road bedding, drain rock for leach fields, and aggregate mix for concrete to construct buildings and highways.

Most aggregate is derived principally from pits in active floodplains, pits in inactive river terrace deposits, or directly from the active channel. Other sources include hard rock quarries and

mining from deposits within reservoirs. Extraction sites located along or in active floodplains present particular problems for anadromous salmonids. Physical alteration of the stream channel may result in the destruction of existing riparian vegetation and the reduction of available area for seedling establishment (Stillwater Sciences 2002). Loss of vegetation impacts riparian and aquatic habitat by causing a loss of the temperature moderating effects of shade and cover, and habitat diversity. Extensive degradation may induce a decline in the alluvial water table, as the banks are effectively drained to a lowered level, affecting riparian vegetation and water supply (NMFS 1996b). Altering the natural channel configuration will reduce salmonid habitat diversity by creating a wide, shallow channel lacking in the pools and cover necessary for all life stages of anadromous salmonids. In addition, waste products resulting from past and present mining activities, include cyanide (an agent used to extract gold from ore), copper, zinc, cadmium, mercury, asbestos, nickel, chromium, and lead.

Juvenile salmonids are exposed to increased water temperatures in the Delta during the late spring and summer due to the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges. Studies by the California Department of Water Resources (DWR) on water quality in the Delta over the last 30 years show a steady decline in the food sources available for juvenile salmonids and sturgeon and an increase in the clarity of the water due to a reduction in phytoplankton and zooplankton. These conditions have contributed to increased mortality of juvenile Chinook salmon, steelhead, and sturgeon as they move through the Delta.

5. Water Quality

The water quality of the Delta has been negatively impacted over the last 150 years. Increased water temperatures, decreased DO levels, and increased turbidity and contaminant loads (as described in *Land Use Activities*) have degraded the quality of the aquatic habitat for the rearing and migration of salmonids. The Regional Board, in its 1998 Clean Water Act §303(d) list characterized the Delta as an impaired waterbody having elevated levels of chlorpyrifos, dichlorodiphenyltrichlor (*i.e.* DDT), diazinon, electrical conductivity, Group A pesticides (aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexanes [including lindane], endosulfan and toxaphene), mercury, low DO, organic enrichment, and unknown toxicities (Regional Board 1998, 2001).

In general, water degradation or contamination can lead to either acute toxicity, resulting in death when concentrations are sufficiently elevated, or more typically, when concentrations are lower, to chronic or sublethal effects that reduce the physical health of the organism, and lessens its survival over an extended period of time. Mortality may become a secondary effect due to compromised physiology or behavioral changes that lessen the organism's ability to carry out its normal activities. For example, increased levels of heavy metals are detrimental to the health of an organism because they interfere with metabolic functions by inhibiting key enzyme activity in metabolic pathways, decrease neurological function, degrade cardiovascular output, and act as mutagens, teratogens or carcinogens in exposed organisms (Rand *et al*. 1995; Goyer 1996). For listed species, these effects may occur directly to the listed fish or to its prey base, which reduces the forage base available to the listed species.

In the aquatic environment, most anthropogenic chemicals and waste materials including toxic organic and inorganic chemicals eventually accumulate in sediment (Ingersoll 1995). Direct exposure to contaminated sediments may cause deleterious effects to listed salmonids or the threatened Southern green sturgeon DPS. This may occur if a fish swims through a plume of the resuspended sediments or rests on contaminated substrate and absorbs the toxic compounds through one of several routes: dermal contact, ingestion, or uptake across the gills. Elevated contaminant levels may be found in localized "hot spots" where discharge occurs or where river currents deposit sediment loads. Sediment contaminant levels can thus be significantly higher than the overlying water column concentrations (Environmental Protection Agency 1994). However, the more likely route of exposure to salmonids or sturgeon is through the food chain, when the fish feed on organisms that are contaminated with toxic compounds. Prey species become contaminated either by feeding on the detritus associated with the sediments or dwelling in the sediment itself. Therefore, the degree of exposure to the salmonids and green sturgeon depends on their trophic level and the amount of contaminated forage base they consume. Response of salmonids and green sturgeon to contaminated sediments is similar to water borne exposures.

Low DO levels frequently are observed in the portion of the Stockton deep water ship channel (DWSC) extending from Channel Point, downstream to Turner and Columbia cuts. Over a 5-year period, starting in August 2000, a DO meter has recorded channel DO levels at Rough and Ready Island (Dock 20 of the West Complex). Over the course of this time period, there have been 297 days in which violations of the 5 mg/L DO criteria for the protection of aquatic life in the San Joaquin River between Channel Point and Turner and Columbia cuts have occurred during the September through May migratory period for salmonids in the San Joaquin River. The data derived from the California Data Exchange Center files indicate that DO depressions occur during all migratory months, with significant events occurring from November through March when listed CV steelhead adults and smolts would be utilizing this portion of the San Joaquin River as a migratory corridor.

Potential factors that contribute to these DO depressions are reduced river flows through the ship channel, released ammonia from the City of Stockton Wastewater Treatment Plant, upstream contributions of organic materials (*e.g.*, algal loads, nutrients, agricultural discharges) and the increased volume of the dredged ship channel. During the winter and early spring emigration period, increased ammonia concentrations in the discharges from the City of Stockton Waste Water Treatment Facility lowers the DO in the adjacent DWSC near the West Complex. In addition to the adverse effects of the lowered DO on salmonid physiology, ammonia is in itself toxic to salmonids at low concentrations. Likewise, adult fish migrating upstream will encounter lowered DO in the DWSC as they move upstream in the fall and early winter due to low flows and excessive algal and nutrient loads coming downstream from the upper San Joaquin River watershed. Levels of DO below 5 mg/L have been reported as delaying or blocking fall-run Chinook salmon in studies conducted by Hallock *et al.* (1970).

6. <u>Hatchery Operations and Practices</u>

Five hatcheries currently produce Chinook salmon in the Central Valley and four of these also produce steelhead. Releasing large numbers of hatchery fish can pose a threat to wild Chinook

salmon and steelhead stocks through 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 (Waples 1991). The genetic impacts of artificial propagation programs in the Central Valley primarily are caused by straying of hatchery fish and the subsequent interbreeding of hatchery fish with wild fish. In the Central Valley, practices such as transferring eggs between hatcheries and trucking smolts to distant sites for release contribute to elevated straying levels (Department of the Interior [DOI] 1999). For example, Nimbus Hatchery on the American River rears Eel River steelhead stock and releases these fish in the Sacramento River basin. One of the recommendations in the Joint Hatchery Review Report (NMFS and CDFG 2001) was to identify and designate new sources of steelhead brood stock to replace the current Eel River origin brood stock.

Hatchery practices as well as spatial and temporal overlaps of habitat use and spawning activity between spring- and fall-run fish have led to the hybridization and homogenization of some subpopulations (CDFG 1998). As early as the 1960s, Slater (1963) observed that early fall- and spring-run Chinook salmon were competing for spawning sites in the Sacramento River below Keswick Dam, and speculated that the two runs may have hybridized. The FRH spring-run Chinook salmon have been documented as straying throughout the Central Valley for many years (CDFG 1998), and in many cases have been recovered from the spawning grounds of fall-run Chinook salmon, an indication that FRH spring-run Chinook salmon may exhibit fall-run life history characteristics. Although the degree of hybridization has not been comprehensively determined, it is clear that the populations of spring-run Chinook salmon spawning in the Feather River and counted at RBDD contain hybridized fish.

The management of hatcheries, such as Nimbus Hatchery and FRH, can directly impact spring-run Chinook salmon and steelhead populations by oversaturating the natural carrying capacity of the limited habitat available below dams. In the case of the Feather River, significant redd superimposition occurs in-river due to hatchery overproduction and the inability to physically separate spring- and fall-run Chinook salmon adults. This concurrent spawning has led to hybridization between the spring- and fall-run Chinook salmon in the Feather River. At Nimbus Hatchery, operating Folsom Dam to meet temperature requirements for returning hatchery fall-run Chinook salmon often limits the amount of water available for steelhead spawning and rearing the rest of the year.

The increase in Central Valley hatchery production has reversed the composition of the steelhead population, from 88 percent naturally-produced fish in the 1950s (McEwan 2001) to an estimated 23 to 37 percent naturally-produced fish currently (Nobriga and Cadrett 2003). The increase in hatchery steelhead production proportionate to the wild population has reduced the viability of the wild steelhead populations, increased the use of out-of-basin stocks for hatchery production, and increased straying (NMFS and CDFG 2001). Thus, the ability of natural populations to successfully reproduce and continue their genetic integrity likely has been diminished.

The relatively low number of spawners needed to sustain a hatchery population can result in high harvest-to-escapements ratios in waters where fishing regulations are set according to hatchery population. This can lead to over-exploitation and reduction in the size of wild populations existing in the same system as hatchery populations due to incidental bycatch (McEwan 2001).

Hatcheries also can have some positive effects on salmonid populations. Artificial propagation has been shown to be effective in bolstering the numbers of naturally spawning fish in the short term under specific scenarios. Artificial propagation programs can also aid in conserving genetic resources and guarding against catastrophic loss of naturally spawned populations at critically low abundance levels, as was the case with the Sacramento River winter-run Chinook salmon population during the 1990s. However, relative abundance is only one component of a viable salmonid population.

7. Over Utilization

a. ***Ocean Commercial and Sport Harvest – Chinook salmon and steelhead***

Extensive ocean recreational and commercial troll fisheries for Chinook salmon exist along the Northern and Central California coast, and an inland recreational fishery exists in the Central Valley for Chinook salmon and steelhead. However, there is essentially no ocean harvest of steelhead.

b. ***Inland Sport Harvest –steelhead***

There is little information on steelhead harvest rates in California. Hallock *et al.* (1961) estimated that harvest rates for Sacramento River steelhead from the 1953-1954 through 1958-1959 seasons ranged from 25.1 percent to 45.6 percent assuming a 20 percent non-return rate of tags. The average annual harvest rate of adult steelhead above RBDD for the 3-year period from 1991-1992 through 1993-1994 was 16 percent (McEwan and Jackson 1996). Since 1998, all hatchery steelhead have been marked with an adipose fin clip allowing anglers to distinguish hatchery and wild steelhead. Current regulations restrict anglers from keeping unmarked steelhead in Central Valley streams. Overall, this regulation has greatly increased protection of naturally produced adult steelhead; however, the total number of CV steelhead contacted might be a significant fraction of basin-wide escapement, and even low catch-and-release mortality may pose a problem for wild populations (Good *et al*. 2005).

8. Disease and Predation

Infectious disease is one of many factors that influence adult and juvenile salmonid survival. Salmonids are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment (NMFS 1996a, 1996b, 1998). Specific diseases such as bacterial kidney disease, C*eratomyxosis shasta* (C-shasta), columnaris, furunculosis, infectious hematopoietic necrosis, redmouth and black spot disease, whirling disease, and erythrocytic inclusion body syndrome are known, among others, to affect steelhead (NMFS 1996a, 1996b, 1998). Very little current or historical information exists to quantify changes in infection levels and mortality rates attributable to these diseases; however, studies have shown that wild fish tend to be less susceptible to pathogens than are hatchery-reared fish. Nevertheless, wild salmonids may contract diseases that are spread through the water column (*i.e*., waterborne pathogens) as well as through interbreeding with infected hatchery fish. The stress of being released into the wild from a controlled hatchery environment

frequently causes latent infections to convert into a more pathological state, and increases the potential of transmission from hatchery reared fish to wild stocks within the same waters.

Human-induced habitat changes such as alteration of natural flow regimes and installation of bank revetment and structures such as dams, bridges, water diversions, piers, and wharves often provide conditions that both disorient juvenile salmonids and attract predators (Stevens 1961; Decato 1978; Vogel *et al.* 1988; Garcia 1989). On the mainstem Sacramento River, high rates of predation are known to occur at the RBDD, Anderson-Cottonwood Irrigation District's (ACID) diversion dam, Glenn Colusa Irrigation District's diversion facility, areas where rock revetment has replaced natural river bank vegetation, and at South Delta water diversion structures (*e*.g., Clifton Court Forebay; CDFG 1998). USFWS found that more predatory fish were found at rock revetment bank protection sites between Chico Landing and Red Bluff than at sites with naturally eroding banks (Michny and Hampton 1984). From October 1976 to November 1993, CDFG conducted 10 mark/recapture studies at the SWP's Clifton Court Forebay to estimate pre-screen losses using hatchery-reared juvenile salmonids. Pre-screen losses ranged from 69 percent to 99 percent. Predation by striped bass is thought to be the primary cause of the loss (Gingras 1997; DWR 2009).

Predation on juvenile salmonids has increased as a result of water development activities which have created ideal habitats for predators and non-native invasive species (NIS). Turbulent conditions near dam bypasses, turbine outfalls, water conveyances, and spillways disorient juvenile salmonid migrants and increase their predator avoidance response time, thus improving predator success. Increased exposure to predators has also resulted from reduced water flow through reservoirs; a condition which has increased juvenile travel time. Other locations in the Central Valley where predation is of concern include flood bypasses, post-release sites for salmonids salvaged at the CVP and SWP Fish Facilities, and the Suisun Marsh Salinity Control Gates (SMSCG). Predation on salmon by striped bass and Sacramento pikeminnow (*Ptychocheilus grandis*) at salvage release sites in the Delta and lower Sacramento River has been documented (Orsi 1967; Pickard *et al.* 1982); however, accurate predation rates at these sites are difficult to determine. CDFG conducted predation studies from 1987 to 1993 at the SMSCG to determine if the structure attracts and concentrates predators. The dominant predator species at the SMSCG was striped bass, and the remains of juvenile salmonids were identified in their stomach contents (Edwards *et al.* 1996; Tillman *et al.* 1996; NMFS 1997).

Avian predation on fish contributes to the loss of migrating juvenile salmonids by constraining natural and artificial production. Fish-eating birds that occur in the California Central Valley include great blue herons (*Ardea herodias*), gulls (*Larus* spp.), osprey (*Pandion haliaetus*), common mergansers (*Mergus merganser*), American white pelicans (*Pelecanus erythrorhynchos*), double-crested cormorants (*Phalacrocorax* spp.), Caspian terns (*Sterna caspia*), belted kingfishers (*Ceryle alcyon*), black-crowned night herons (*Nycticorax nycticorax*), Forster's terns (*Sterna forsteri*), hooded mergansers (*Lophodytes cucullatus*), and bald eagles (*Haliaeetus leucocephalus*) (Stephenson and Fast 2005). These birds have high metabolic rates and require large quantities of food relative to their body size.

Mammals can also be an important source of predation on salmonids within California's Central Valley. Predators such as river otters (*Lutra canadensis*), raccoons (*Procyon lotor*), striped

skunk (*Mephitis mephitis*), and western spotted skunk (*Spilogale gracilis*) are common. Other mammals that take salmonids include: badger (*Taxidea taxus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), long-tailed weasel (*Mustela frenata*), mink (*Mustela vison*), mountain lion (*Felis concolor*), red fox (*Vulpes vulpes*), and ringtail (*Bassariscus astutus*). These animals, especially river otters, are capable of removing large numbers of salmon and *O. mykiss* from the aquatic habitat (Dolloff 1993). Mammals have the potential to consume large numbers of salmonids, but generally scavenge post-spawned salmon. In the marine environment, pinnipeds, including harbor seals (*Phoca vitulina*), California sea lions (*Zalophus californianus*), and Steller's sea lions (*Eumetopia jubatus*) are the primary marine mammals preying on salmonids (Spence *et al*. 1996). Pacific striped dolphin (*Lagenorhynchus obliquidens*) and killer whale (*Orcinus orca*) can also prey on adult salmonids in the nearshore marine environment, and at times become locally important. Although harbor seal and sea lion predation primarily is confined to the marine and estuarine environments, they are known to travel well into freshwater after migrating fish and have frequently been encountered in the Delta and the lower portions of the Sacramento and San Joaquin rivers. All of these predators are opportunists, searching out locations where juveniles and adults are most vulnerable, such as the large water diversions in the South Delta.

9. Environmental Variation

Natural changes in the freshwater and marine environments play a major role in salmonid abundance. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20- to 30-year cycles of climatic conditions and ocean productivity (Hare *et al*. 1999; Mantua and Hare 2002). This phenomenon has been referred to as the Pacific Decadal Oscillation. In addition, large-scale climatic regime shifts, such as the El Niño condition, appear to change productivity levels over large expanses of the Pacific Ocean. A further confounding effect is the fluctuation between drought and wet conditions in the basins of the American west. During the first part of the 1990s, much of the Pacific Coast was subject to a series of very dry years, which reduced inflows to watersheds up and down the west coast.

"El Niño" is an environmental condition often cited as a cause for the decline of West Coast salmonids (NMFS 1996b). El Niño is an unusual warming of the Pacific Ocean off South America and is caused by atmospheric changes in the tropical Pacific Ocean (Southern Oscillation-ENSO) resulting in reductions or reversals of the normal trade wind circulation patterns. The El Niño ocean conditions are characterized by anomalous warm sea surface temperatures and changes to coastal currents and upwelling patterns. Principal ecosystem alterations include decreased primary and secondary productivity in affected regions and changes in prey and predator species distributions. Cold-water species are displaced towards higher latitudes or move into deeper, cooler water, and their habitat niches are occupied by species tolerant of warmer water that move upwards from the lower latitudes with the warm water tongue.

A key factor affecting many West Coast stocks has been a general 30-year decline in ocean productivity. The mechanism whereby stocks are affected is not well understood, partially because the pattern of response to these changing ocean conditions has differed among stocks, presumably due to differences in their ocean timing and distribution. It is presumed that survival

in the ocean is driven largely by events occurring between ocean entry and recruitment to a sub-adult life stage.

10. Ecosystem Restoration

a. *CALFED Bay-Delta Program and Delta Stewardship Council (CALFED)*

Two programs included under CALFED; the Ecosystem Restoration Program (ERP) and the Environmental Water Account (EWA), were created to improve conditions for fish, including listed salmonids, in the Central Valley (CALFED 2000). Restoration actions implemented by the ERPP include the installation of fish screens, modification of barriers to improve fish passage, habitat acquisition, and instream habitat restoration. The majority of these actions address key factors affecting listed salmonids and emphasis has been placed in tributary drainages with high potential for steelhead and spring-run Chinook salmon production. Additional ongoing actions include new efforts to enhance fisheries monitoring and directly support salmonid production through hatchery releases. Recent habitat restoration initiatives sponsored and funded primarily by the CALFED-ERP Program have resulted in plans to restore ecological function to 9,543 acres of shallow-water tidal and marsh habitats within the Delta. Restoration of these areas primarily involves flooding lands previously used for agriculture, thereby creating additional rearing habitat for juvenile salmonids. Similar habitat restoration is imminent adjacent to Suisun Marsh (*i.e.*, at the confluence of Montezuma Slough and the Sacramento River) as part of the Montezuma Wetlands project, which is intended to provide for commercial disposal of material dredged from San Francisco Bay in conjunction with tidal wetland restoration.

The EWA is designed to provide water at critical times to meet ESA requirements and incidental take limits without water supply impacts to other users, particularly south of Delta water users. In early 2001, the EWA released 290 thousand acre feet of water from San Luis Reservoir at key times to offset reductions in south Delta pumping implemented to protect winter-run Chinook salmon, delta smelt (*Hypomesus transpacificus*), and Sacramento splittail (*Pogonichthys macrolepidotus*). However, the benefit derived by this action to winter-run Chinook salmon in terms of number of fish saved was very small. The anticipated benefits to other Delta fisheries from the use of the EWA water are much higher than those benefits ascribed to listed salmonids by the EWA release. Under the long term operations of the CVP and SWP, EWA assets have declined to 48 thousand acre feet after carriage water costs. The RPA actions developed within NMFS' 2009 Biological Opinion on the long-term operations of the Central Valley Project and State Water Project (NMFS 2009) are designed to minimize or remove the adverse impacts associated with many of the OCAP project related stressors. Within the Delta, stressors such as the Delta Cross Channel (DCC) gates and export operations have been modified to reduce the hydraulic changes created by the project operations. Earlier closures of the DCC gates prevent early emigrating listed salmonids from entering the Delta interior through the open DCC gates. Management of the Old and Middle river flows prevents an excessive amount of negative flow towards the export facilities from occurring in the channels of the Old and Middle rivers. When flows are negative, water moves in the opposite direction than would occur naturally, drawing fish into the south Delta and towards the export facilities or delaying their migration through the system.

b. *Central Valley Project Improvement Act (CVPIA)*

The CVPIA, implemented in 1992, requires that fish and wildlife get equal consideration with other demands for water allocations derived from the CVP. From this act arose several programs that have benefited listed salmonids: the Anadromous Fish Restoration Program (AFRP), the Anadromous Fish Screen Program (AFSP), and the Water Acquisition Program (WAP). The AFRP is engaged in monitoring, education, and restoration projects geared toward recovery of all anadromous fish species residing in the Central Valley. Restoration projects funded through the AFRP include fish passage, fish screening, riparian easement and land acquisition, development of watershed planning groups, instream and riparian habitat improvement, and gravel replenishment. The AFSP combines Federal funding with State and private funds to prioritize and construct fish screens on major water diversions mainly in the upper Sacramento River. The goal of the WAP is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve the DOI's ability to meet regulatory water quality requirements. Water has been used successfully to improve fish habitat for spring-run Chinook salmon and steelhead by maintaining or increasing instream flows in Butte and Mill creeks and the San Joaquin River at critical times.

c. *State Water Project Delta Pumping Plant Fish Protection Agreement (Four-Pumps Agreement)*

The Four Pumps Agreement Program has approved about $49 million for projects that benefit salmon and steelhead production in the Sacramento-San Joaquin basins and Delta since the agreement inception in 1986. Four Pumps projects that benefit steelhead include water exchange programs on Mill and Deer creeks; enhanced law enforcement efforts from San Francisco Bay upstream to the Sacramento and San Joaquin rivers and their tributaries; design and construction of fish screens and ladders on Butte Creek; and screening of diversions in Suisun Marsh and San Joaquin tributaries. Predator habitat isolation and removal, and spawning habitat enhancement projects on the San Joaquin tributaries benefit steelhead.

d. *San Joaquin River Restoration Program (SJRRP)*

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the United States and the CVP Friant Division Contractors. After more than 18 years of litigation of this lawsuit, known as *NRDC, et al. v. Kirk Rodgers, et al.*, a settlement was reached. On September 13, 2006, the Settling Parties, including NRDC, Friant Water Users Authority, and the U.S. Departments of the Interior and Commerce, filed a stipulation of the terms and conditions of the settlement, which was subsequently approved by the U.S. District Court, Eastern District of California, on October 23, 2006. The settlement establishes restoration and management goals. The Restoration Goal is to restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence with the Merced River, including naturally reproducing and self-sustaining of salmon and other fish. The Water Management Goal is to reduce or avoid water supply impacts to all of the Friant Division long-term contractors that may result from the Interim and Restoration Flows provided for in the Settlement. President Obama signed the San Joaquin River Restoration Settlement Act

(Act) on March 30, 2009, which authorized implementation of the settlement, as part of the Omnibus Public Land Management Act of 2009. Pub. L. No. 111-11, 123 Stat. 991.

To achieve the Restoration Goal, the settlement calls for a combination of channel and structural modifications along the San Joaquin River below Friant Dam, releases of water from Friant Dam to the confluence of the Merced River, and the reintroduction of spring-run Chinook salmon prior to December 31, 2012. Title X, section 10011(b) of the Act states that spring-run Chinook salmon shall be reintroduced in the San Joaquin River below Friant Dam pursuant to section 10(j) of the ESA, provided that a permit for the reintroduction may be issued pursuant to section 10(a)(1)(A) of the ESA. In addition, Title X, section 10011(c)(2) of the Act states that the Secretary of Commerce shall issue a final rule pursuant to section 4(d) of the ESA governing the incidental take of reintroduced Central Valley spring-run Chinook salmon prior to the reintroduction. Furthermore, Title X, section 10011(c)(3) of the Act states that the rule issued under paragraph 2 shall provide that the reintroduction will not impose more than de minimus: water supply reductions, additional storage releases, or bypass flows on unwilling third parties due to such reintroduction.

11. Non-Native Invasive Species (NIS)

As currently seen in the San Francisco estuary, NIS can alter the natural food webs that existed prior to their introduction. Perhaps the most significant example is illustrated by the Asiatic freshwater clams *Corbicula fluminea* and *Potamocorbula amurensis*. The arrival of these clams in the estuary disrupted the normal benthic community structure and depressed phytoplankton levels in the estuary due to the highly efficient filter feeding of the introduced clams (Cohen and Moyle 2004). The decline in the levels of phytoplankton reduces the population levels of zooplankton that feed upon them, and hence reduces the forage base available to salmonids transiting the Delta and San Francisco estuary which feed either upon the zooplankton directly or their mature forms. This lack of forage base can adversely impact the health and physiological condition of these salmonids as they emigrate through the Delta region to the Pacific Ocean.

Attempts to control the NIS also can adversely impact the health and well-being of salmonids within the affected water systems. For example, the control programs for the invasive water hyacinth (*Eichhornia crassipes*) and Brazilian Elodea (*Egeria densa*) plants in the Delta must balance the toxicity of the herbicides applied to control the plants to the probability of exposure to listed salmonids during herbicide application. In addition, the control of the nuisance plants can have negative effects on certain physical parameters that must be accounted for in the treatment protocols, particularly the decrease in DO resulting from the decomposing vegetable matter left by plants that have died.

12. Summary

For CV steelhead, 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 has been linked with the extirpation of CV spring-run Chinook salmon in the San Joaquin River upstream

of the Merced River within just a few years. The reduced populations of steelhead that remain below Central Valley dams are forced to spawn in lower elevation tailwater 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. All salmonid species considered in this consultation have been adversely affected by the production of hatchery fish associated with the mitigation for the habitat lost to dam construction (*e.g.*, from genetic impacts, increased competition, exposure to novel diseases, *etc*.).

Land-use activities such as road construction, urban development, logging, mining, agriculture, and recreation are pervasive and have significantly altered fish habitat quantity and quality for 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 LWD; 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. In contrast, various ecosystem restoration activities have contributed to improved conditions for listed salmonids (*e.g.*, various fish screens).

IV. ENVIRONMENTAL BASELINE

The environmental baseline "includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" (50 CFR §402.02).

The New Melones Dam operates in conjunction with Tulloch Reservoir and Goodwin Dam on the Stanislaus River (figure 5-20). Goodwin Dam, completed in 1912, is an impassible barrier to upstream fish migration at RM 59. Water is released from New Melones to satisfy senior water right entitlements, instream and Delta water quality standards specified under D-1641, CDFG fish agreement flows, CVP water contracts and b(2) or CVPIA 3406(b)(3) [hereafter referred to b(3)] fishery flows.

The San Joaquin River is one of the two major rivers that flow into the Sacramento-San Joaquin Delta and ultimately San Francisco Bay. Its headwaters originate on the slopes of Mt. Goddard in Kings Canyon National Park and flow first northwest, and then southwest out of the Sierra Nevada. Behind Friant Dam (a project of Reclamation), the river forms Millerton Lake which is a popular recreation area. Below the Dam, the river flows northwesterly through the Central Valley and towards Stockton before joining the Sacramento River. The San Joaquin River is a

major component of the Delta. It offers a continuous flow of water, and a variety of natural aquatic environments including riverine and estuarine habitats.

Within the project/action area, several anadromous fish species use the Stanislaus River as a migration corridor including fall-run Chinook salmon and CV steelhead. During the summer, water temperatures can increase significantly due to lack of bank shading (from insufficient riparian habitat) and shallow water depths.

A. Status of the Species and Critical Habitat within the Action Area

1. Status of the Species within the Action Area

CV steelhead is the only anadromous ESA-listed species that occurs in the Stanislaus River. Spring-run and summer-run steelhead have been extirpated from this watershed (Yoshiyama *et al*. 1996). Steelhead populations in the Stanislaus, Tuolumne, Merced, and Calaveras rivers are the only remaining representatives of the San Joaquin River diversity group of the CV steelhead. None of these populations are considered to be viable at this time (Lindley *et al*. 2007). Anadromous *O. mykiss* populations may have been extirpated from their entire historical range in the San Joaquin Valley owing to dam construction, but current populations survive on these rivers in tailwater conditions controlled by the dams. Based on information from a variety of sources (rotary screw trap sampling, trawling at Mossdale, direct and angler observations) in all three tributaries of the San Joaquin River, CDFG (2003) stated that it is "clear from this data that rainbow trout do occur in all the tributaries as migrants and that the vast majority of them occur on the Stanislaus River." Documented returns of single digit numbers of fish into the tributaries suggest that existing populations of CV steelhead on the Stanislaus, Tuolumne, Merced, Calaveras, and lower San Joaquin rivers are severely depressed.

Information regarding steelhead numbers on the Stanislaus River is very limited and has typically been gathered incidental to existing monitoring activities for fall-run. A counting weir for fall-run also has recorded passage of steelhead. In the 2006-2007 counting season, 12 steelhead were observed passing through the counting weir, coincidental with the observation of 3,078 adult salmon (Anderson *et al*. 2007). An adipose fin-clipped steelhead was observed at the counting weir, indicating some opportunity for genetic introgression from hatchery operations on other Central Valley rivers. On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (S.P. Cramer and Associates Inc. 2000, 2001), but the numbers are very low, ranging from 10 to 30 annually, compared to annual catches of fall-run in the range of hundreds. The low juvenile steelhead numbers likely indicate a much smaller steelhead population than fall-run, but steelhead smolts are considerably larger than fall-run smolts, and can avoid capture by the traps (Stillwater Sciences 2000). Most of the steelhead smolts are captured from January to mid-April, and are 175 to 300 mm fork length. The raw data from rotary screw trapping show *O. mykiss* in a smolted stage being trapped in late May at both the Oakdale and Caswell trap locations. These fish are physiologically prepared to leave the river at a time well after the scheduled Vernalis Adaptive Management Plan (VAMP) pulse flows, but not later than when historical unimpaired rain-on-snow events would have provided out migration flows.

Zimmerman *et al.* (2008) have documented CV steelhead in the Stanislaus, Tuolumne and Merced rivers based on otolith microchemistry.

Juvenile steelhead reside in freshwater year round. Steelhead rearing in the Stanislaus River occurs upstream of Orange Blossom Bridge (RM 47) where gradients are highest. The highest rearing densities are upstream of Knights Ferry (RM 54.7, Kennedy and Cannon 2002).

Juvenile steelhead migrate during the winter and spring from the above-described rearing areas downstream through the rivers and the Delta to the ocean. The habitat conditions they encounter from the upstream reaches of the rivers downstream to the Delta become generally further from their preferred habitat requirements with respect to cover, temperature, water quality, and exposure to predatory fishes such as striped bass and non-native black bass. Emigration conditions for juvenile steelhead in the Stanislaus River down through the San Joaquin River and the south Delta tend to be less suitable than conditions for steelhead emigrating from the Sacramento River and its tributaries.

CDFG staff has prepared catch summaries for juvenile migrant steelhead on the San Joaquin River near Mossdale, which represents migrants from the Stanislaus, Tuolumne, and Merced rivers. These trawl recoveries at Mossdale between 1988 and 2002 ranged from a minimum of 1 fish per year to a maximum of 29 fish in 1 year (Figure 5).

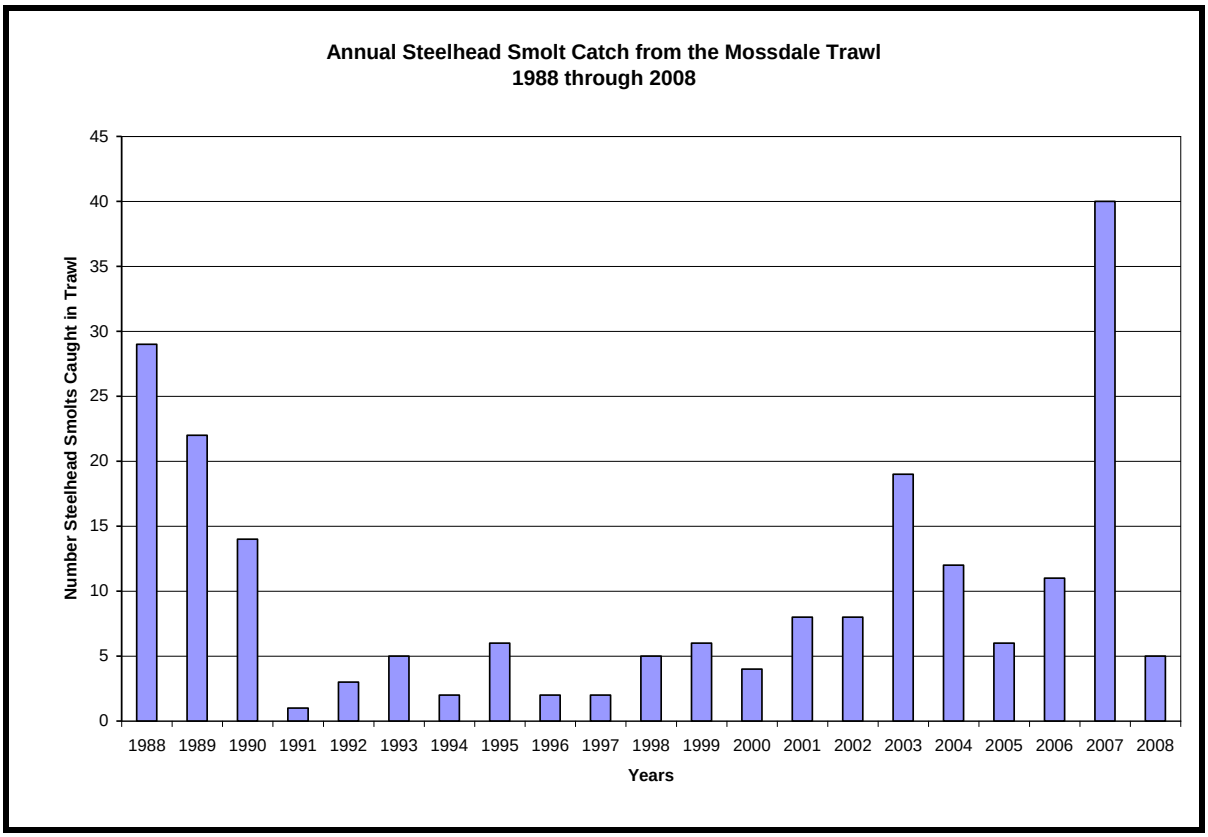

Figure 5. Annual number of Central Valley steelhead smolts caught while Kodiak trawling at the Mossdale monitoring location on the San Joaquin River (Marston 2004, SJRGA 2007, Speegle 2008).

Adult steelhead migrate upstream from the ocean to their spawning grounds near the terminal dams primarily during the fall and winter months. Flows are generally lower during the upstream migrations than during the outmigration period. Adult steelhead may occur in the Stanislaus River earlier than in other Central Valley rivers when fall attraction flows are released in October for the benefit of fall-run. The general temporal occurrence of steelhead and fall-run in the Stanislaus River at various life history stages is illustrated in Figure 6.

Construction of Goodwin Dam in 1912 has excluded steelhead from 100 percent of its historical spawning and rearing habitat on the Stanislaus River (Lindley *et al*. 2006). Critical habitat has been designated up to Goodwin Dam, to include currently occupied areas. Extension of critical habitat above the dams was deemed premature until recovery planning determines a need for these areas in the recovery of the DPS (September 2, 2005, 70 FR 52488).

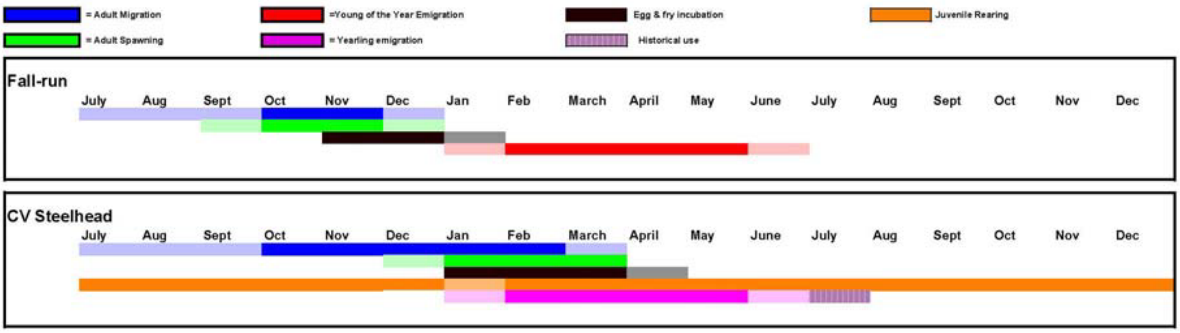

Figure 6. Temporal occurrence of fall-run Chinook salmon and steelhead in the Stanislaus River, California. Darker shading indicates peak use.

The construction of the East Side Division Dams (New Melones, Tulloch, and Goodwin) blocked the downstream transport of spawning gravel that would replenish gravel below the dams. Past East Side Division operations have mobilized gravel remaining below the dams, which has led to a degradation of the quality and quantity of available steelhead spawning gravels (Kondolf *et al*. 2001). Gravel replenishment projects funded by CVPIA have offset some of this habitat loss, but the rate of replenishment is not sufficient to offset ongoing loss rates, nor to offset losses from past years of operations.

Past operations of the East Side Division have eliminated channel forming flows and geomorphic processes that maintain and enhance steelhead spawning beds and juvenile spawning areas associated with floodplains and channel complexity. Since the construction and operation of New Melones Dam, operational criteria have resulted in channel incision, as much as 1-3 feet (Kondolf *et al*. 2001). This downcutting, combined with operational criteria, have effectively cut off overbank flows which would have inundated floodplain rearing habitat, as well as providing areas for fine sediment deposition, rather than within spawning gravels, as occurs now. Operational flow patterns in late spring and summer, combined with lack of overbank flows has severely constrained recolonization of large riparian trees that are needed for riparian shading and LWD contribution.

2. Status of Critical Habitat within the Action Area

Steelhead critical habitat on the Stanislaus River has been designated up to Goodwin Dam. The PCEs of critical habitat for Stanislaus River steelhead include freshwater rearing and freshwater migration. Although Stanislaus River water temperatures are generally suitable for rearing, during the smolt emigration life stage (January through June), steelhead may beexposed to water temperatures that would prohibit successfully completing transformation to the smolt stage. In addition, steelhead spawning and rearing habitat on the Stanislaus River is affected by the limited occurrence of flows that are sufficient to carry out natural geomorphic processes. As such, sediment deposition on spawning habitats has decreased the availability of suitable spawning areas. The relatively low and uniform releases in the Stanislaus River reduces the conservation value of rearing habitat by reducing habitat complexity and decreasing connectivity with floodplains, which are proven to be high quality rearing habitats (Sommer *et al*. 2005).

B. Factors affecting the species and critical habitat in the action area

The action area encompasses a small portion of the area utilized by the CV steelhead DPS. Many of the range-wide factors affecting CV steelhead are discussed in the *Status of the Species and Critical Habitat* section of this biological opinion, and are considered the same in the action area. This section will focus on the specific factors in the action area that are most relevant to the proposed Project.

The magnitude and duration of peak flows during the winter and spring, which affects listed salmonids in the action area, are reduced by water impoundment in upstream reservoirs. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round. Current flood control practices require peak flood discharges to be held back and released over a period of weeks to avoid overwhelming the flood control structures downstream of the reservoirs (*i.e.*, levees) and low lying terraces under cultivation (*i.e.*, orchards and row crops) in the natural floodplain along the basin tributaries. Consequently, managed flows in the mainstem of the river often truncate the peak of the flood hydrograph and extend the reservoir releases over a protracted period. These actions reduce or eliminate the scouring flows necessary to mobilize sediments and create natural riverine morphological features within the action area.

High water temperatures also limit habitat availability for listed salmonids in the San Joaquin River and the lower portions of the tributaries feeding into the mainstem of the river. High summer water temperatures in the lower San Joaquin River frequently exceed 72°F, and create a thermal barrier to the migration of adult and juvenile salmonids (California Data Exchange Center database).

Levee construction and bank protection have affected salmonid habitat availability and the processes that develop and maintain preferred habitat by reducing floodplain connectivity, changing riverbank substrate size, and decreasing riparian habitat and shaded riverine aquatic (SRA) cover. Such bank protection generally results in two levels of impacts to the environment: (1) site-level impacts which affect the basic physical habitat structure at individual

bank protection sites; and (2) reach-level impacts which are the cumulative impacts to ecosystem functions and processes that accrue from multiple bank protection sites within a given river reach (USFWS 2000). Revetted embankments result in loss of sinuosity and braiding and reduce the amount of aquatic habitat. Impacts at the reach level result primarily from halting erosion and controlling riparian vegetation. Reach-level impacts which cause significant impacts to fish are reductions in new habitats of various kinds, changes to sediment and organic material storage and transport, reductions of lower food-chain production, and reduction in LWD.
The use of rock armoring limits recruitment of LWD (*i.e.*, from non-riprapped areas), and greatly reduces, if not eliminates, the retention of LWD once it enters the river channel. Riprapping creates a relatively clean, smooth surface which diminishes the ability of LWD to become securely snagged and anchored by sediment. LWD tends to become only temporarily snagged along riprap, and generally moves downstream with subsequent high flows. Habitat value and ecological functioning aspects are thus greatly reduced, because wood needs to remain in place for extended periods to generate maximum values to fish and wildlife (USFWS 2000). Recruitment of LWD is limited to any eventual, long-term tree mortality and whatever abrasion and breakage may occur during high flows (USFWS 2000). Juvenile salmonids are likely being impacted by reductions, fragmentation, and general lack of connectedness of remaining near-shore refuge areas.

PS and NPS of pollution resulting from agricultural discharge and urban and industrial development occur upstream of, and within the action area. The effects of these impacts are discussed in detail in the *Status of the Species and Critical Habitat* section. Environmental stresses as a result of low water quality can lower reproductive success and may account for low productivity rates in fish (*e.g.* green sturgeon, Klimley 2008). Organic contaminants from agricultural drain water, urban and agricultural runoff from storm events, and high trace element (*i.e.*, heavy metals) concentrations may deleteriously affect early life-stage survival of fish in the Central Valley watersheds (USFWS 1995). Other impacts to adult migration present in the action area, such as migration barriers, water conveyance factors, water quality, NIS, *etc.*, are discussed in the *Status of Species and Critical Habitat* section.

V. EFFECTS OF THE ACTION

A. Approach to the Assessment

Pursuant to section 7(a)(2) of the ESA (16 U.S.C. §1536), Federal agencies are directed to ensure 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. This biological opinion assesses the effects of the proposed Project on threatened CV steelhead and their designated critical habitat (Caltrans 2011). The Project is likely to adversely affect threatened CV steelhead and their designated critical habitat through the removal of the temporary cofferdam, bypass pumping, and fish rescue in the event that the San Joaquin River naturally over-tops the cofferdam. In the *Description of the Proposed Action* section of this BO, NMFS provided an overview of the action. In the *Status of the Species* and *Environmental Baseline* sections of this BO, NMFS provided an overview of the threatened and endangered species and critical habitat that are likely to be adversely affected by the activity under consultation.

Regulations that implement section 7(b)(2) of the ESA require biological opinions 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). Section 7 of the ESA and its implementing regulations also require biological opinions to determine if Federal actions would destroy or adversely modify the conservation value of critical habitat (16 U.S.C. §1536). This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

NMFS generally approaches "jeopardy" analyses in a series of steps. First, NMFS evaluates the available evidence to identify direct and indirect physical, chemical, and biotic effects of the proposed actions (these effects include direct impacts to a species habitat; 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 disruptive noises). Once NMFS has identified the effects of the action, the available evidence is evaluated to identify a species' likelihood and extent of exposure to any adverse effects caused by the action (*i.e.* the extent of spatial and temporal overlap between the species and the effects of the action). Once NMFS has identified the level of exposure that a species will have to the effects of the action, the available evidence is evaluated to identify the species' probable response, including physical and behavioral reactions, to these effects. These responses then will be assessed to determine if they can reasonably be expected to reduce a species' reproduction, numbers, or distribution (for example, by changing birth, death, immigration, or emigration rates; increasing the age at which individuals reach sexual maturity; or decreasing the age at which individuals stop reproducing). The available evidence is then used to determine if these reductions, if there are any, could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

1. <u>Information Available for the Assessment</u>

To conduct the assessment, NMFS examined an extensive amount of evidence from a variety of sources. Detailed background information on the status of the species and critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, governmental and non-governmental reports, the biological assessment for this project, and project meeting notes. Additional information investigating the effects of the project's actions on the listed species in question, their anticipated response to these actions, and the environmental consequences of the actions as a whole was obtained from the aforementioned resources. For information that has been taken directly from published, citable documents, those citations have been referenced in the text and listed at the end of this document.

2. <u>Assumptions Underlying This Assessment</u>

In the absence of definitive data or conclusive evidence, NMFS must make a logical series of

assumptions to overcome the limits of the available information. These assumptions will be made using sound, scientific reasoning that can be logically derived from the available information. The progression of the reasoning will be stated for each assumption, and supporting evidence cited.

B. Assessment

The proposed Project includes actions that may adversely affect several life stages of CV steelhead. Adverse effects to these species and their habitat may result from changes in water quality from temporary water diversion construction, acoustic effects associated with pile driving, and handling of fish from fish rescue. The project includes integrated design features to avoid and minimize many of these potential impacts.

1. Presence of CV steelhead

Adult CV steelhead migrate upstream into the region's watersheds (San Joaquin, Stanislaus, Tuolumne, and Merced rivers) between September and February, particularly when increased flows are being released from upstream reservoirs to enhance fall-run Chinook salmon spawning habitat in the tributaries, or early winter rains cause increased flows in the system. Therefore, adult CV steelhead may be present if the temporary water diversion is removed between September and October. Juvenile CV steelhead migrate downstream through the San Joaquin River between February and early June as they make their way towards the Delta. Therefore, juvenile presence may occur during pile driving, temporary water diversion removal, and fish rescue if these activities occur between March and early June.

2. Water Quality Impacts Associated with Temporary Water Diversion Construction

During construction diversion of the Stanislaus River at the project site will be required to remove the existing bridge superstructure and piers, place temporary falsework, and construct the new bridge. A temporary embankment/work pad(s) will be constructed of water bladders, clean local fill material, and other methods that will not result in notably degraded water quality and are proposed for use to divert the flow and maintain dry conditions around the work area. The flows will be diverted into temporary culvert pipes that pass through the embankment/work pad. The fill will be temporary and will be removed after the completion of the project or need for falsework.

NMFS anticipates that some local increases in turbidity and suspended sediment above baseline levels will result from water diversion removal. NMFS expects these water quality impacts to be minor, short term increases in turbidity and sedimentation and only lasting the duration of the project. Water quality impacts are unlikely to affect migrating adults to the extent of injuring them, but may injure some juvenile fish, which are smaller and less mobile and actively feeding and growing, by temporarily disrupting normal behaviors that are essential to growth and survival.

NMFS expects turbidity to affect steelhead in much the same way that it affects salmon in the studies mentioned below, due to similar physiological and life history requirements between

these species. Therefore, NMFS will use these studies as a surrogate to CV steelhead. Responses of salmonids to elevated levels of suspended sediments often fall into three major categories: physiological effects, behavioral effects, and habitat effects (Bash *et al.* 2001). The severity of the effect is a function of concentration and duration (Newcombe and MacDonald 1991; Newcombe and Jensen 1996) so that low concentrations and long exposure periods are frequently as deleterious as short exposures to high concentrations of suspended sediments. A review by Lloyd (1987) indicated that several behavioral characteristics of salmonids can be altered by even relatively small changes in turbidity (10 to 50 Nephelometric Turbidity Units [NTUs]). Salmonids exposed to slight to moderate increases in turbidity exhibited avoidance, loss of station in the stream, reduced feeding rates and reduced use of overhead cover. Short-term increases in turbidity and suspended sediment may disrupt feeding activities of fish or result in temporary displacement from preferred habitats. 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 NTUs reduced growth of juvenile coho salmon 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. Reaction distances of *O. mykiss* to prey were reduced with increases of turbidity of only 15 NTUs over an ambient level of 4 to 6 NTUs in experimental stream channels (Barrett *et al.* 1992). Bisson and Bilby (1982) reported that juvenile coho salmon avoid turbidities exceeding 70 NTUs. Increased turbidity, used as an indicator of increased suspended sediments, also is correlated with a decline in primary productivity, a decline in the abundance of periphyton, and reductions in the abundance and diversity of invertebrate fauna in the affected area (Lloyd 1987; Newcombe and MacDonald 1991). 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).

3. Effects Associated with Fish Capture and Relocation

The proposed Project conservation measures will include preparation of a fish rescue plan and implementation of the plan in the event that the Stanislaus River water over-tops the temporary water diversion construction. This may occur as early as April to early June. Beach seines and dip nets will be used to rescue fish and transfer them to an oxygenated holding tank. Fish will be transported to an appropriate downstream release site for juveniles and upstream site for adults. The effects of a fish rescue are generally beneficial because it will minimize the mortality of juveniles entrapped around the water diversion site. Entrainment of juvenile CV steelhead in the water diversion zone and subsequent rescue operations using beach seining can affect their behavior by causing them to alter their migration routes, sheltering or feeding patterns, or may cause physical damage relating to the hauling, collecting, and handling of the fish and potential death caused by being crushed or left in the seine after sampling. However, mortality as a result of beach seining and dip netting is typically rare.

4. Pile Driving

Pile driving consists of driving steel pile columns and sheets into the riverbed with a mechanical hammer. The force of the hammer hitting a pile forms a sound wave that travels down the pile and causes the pile to resonate radially and longitudinally. Acoustic energy is formed as the walls0 of the steel pile expand and contract, forming a compression wave that moves through the pile. The outward movement of the pipe pile wall sends a pressure wave propagating outward from the pile and through the riverbed and water column in all directions.

The south portion of the Stanislaus River replacement structure is anticipated to be supported on 24-inch hexagonal PC/PS concrete piling that would be driven into the ground by use of a diesel powered pile hammer. A total of 180 piles would be driven with a diesel impact hammer over two years (construction seasons). All 180 concrete piles would be installed on dry land adjacent to the river with varying distance to the river's edge.

The northern portion of the river bridge will consist of CIDH piling (48- and 72-inch steel pipes) with cast-in-place (CIP) concrete column extensions and a CIP pre-stressed concrete box girder superstructure. A total of eight 72-inch steel pipe casings (in-water) and eight 48-inch steel pipe casings (adjacent to or in-water) would be driven with vibratory hammer over two years (construction seasons).

The effect pile driving has on fish depends upon the pressure, measured in dB, of a sound or compression wave. Rasmussen (1967) found that immediate mortality of juvenile salmonids may occur at sound pressure levels exceeding 208 dB. Sustained sound pressures (four hours) in excess of 187 dB damaged the hair cells in the inner ear of cichlids (Hastings *et al.* 1996).

Feist *et al.* (1992) found that abundance of juvenile salmon near pile driving rigs in Puget Sound was two-fold greater on non-pile driving days as on pile-driving days, indicating that juveniles were startled by the activity and that pile driving caused a temporary avoidance of habitat at the project site. Although the pile-driving created sound that could be detected at least 1848 m away from the source at a level within the range of salmonid hearing, salmon at this range did not always exhibit a reaction to the sound (Feist *et al.* 1992). McKinley and Patrick (1986) found that salmon smolts exposed to pulsed sound (similar to pile driving) demonstrated a startle or avoidance response, and Anderson (1990) observed a startle response in salmon smolts at the beginning of a pile driving episode but found that after a few poundings fish were no longer startled.

The effect of pile driving on free swimming fish depends on the duration, frequency (Hz), and pressure (dB) of the compression wave. Rassmusen (1967) found that immediate mortality of juvenile salmonids may occur at sound pressure levels exceeding 208 dB. Due to their size, adult salmon and steelhead can tolerate higher pressure levels and immediate mortality rates for adults are expected to be less than those experienced by juveniles (Hubbs and Rechnitzer 1952). As sound pressure levels are not expected to exceed 187 dB, no immediate mortality of juvenile or adult fish is expected.

The startling of juvenile salmonids causes injury 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. Disruption of these behaviors may also result in the death of some individuals to increased predation if fish are disoriented or concentrated in areas with high predator densities. Disruption of these behaviors will occur between June 15 and October 15 of each construction year, during weekday daylight operation hours (8 a.m. to 5 p.m.) of the hydraulic hammer. Because of their nocturnal migratory behavior, daily migration delays are expected only to impact the portion of each ESU that migrates during daylight hours. On similar bridge projects, such as the replacement of the I-5 bridge over the Sacramento River near Anderson, lapses in pile driving activity are common throughout the day because construction crews suspend hammer work for equipment maintenance, to shift from one pile to another, and to take breaks (D. Whitley, Caltrans, pers. comm., 2002). These construction lapses, including daily breaks and nighttime non-working periods will allow fish to migrate through the action area and minimize the extent of injury that occurs to populations.

Adult CV steelhead that are migrating upstream in May and June may be startled by pile driving and may experience daily migration delays of up to eight hours by holding downstream of the bridge until the pile driving stops. These migration delays are not expected to injure adults because adult fish commonly hold in deep pools while migrating upstream, and because they do not begin spawning until September, at least three months after any migration delay might occur.

NMFS anticipates that pile driving will be detectable to salmonids up to 215 meters from the source, and that the sounds generated will harass juvenile steelhead by causing injury from temporary disruption of normal behaviors such as feeding, sheltering, and migrating that may contribute to reduced or negative growth. Disruption of these behaviors may also lead to increased predation if fish become disoriented or concentrated in areas with high predator densities. These effects should be small because pile driving will occur during the day, enabling unhindered fish passage at night during peak migration times. The June 15 through October 15 work window will further minimize the extent of the impacts on listed anadromous fish by avoiding the peaks of adult and juvenile migration periods.

5. Effects on Designated Critical Habitat Primary Constituent Elements (PCEs)

As described earlier, the removal of temporary water diversion construction from the Stanislaus River will affect critical habitat for CV steelhead.

The basic premise to the conservation value of an overall critical habitat designation is the sum of the values of the components that comprise the habitat. For example, the conservation value of listed salmonid critical habitat is determined by the conservation value of the watersheds that make up the designated area. In turn, the conservation value of the specific watershed is comprised of the sum of the value of the PCEs that make up the area. PCEs are specific areas or functions, such as spawning or rearing habitat, that support different life history stages or requirements of the species. The conservation value of the PCE is the sum of the quantity, quality, and availability of the essential features of that PCE. Essential features are the specific

processes, variables or elements that comprise a PCE. Thus, an example of a PCE would be spawning habitat and the essential features of that PCE are conditions such as clean spawning gravels, appropriate timing and duration of certain water temperatures, and water quality free of pollutants.

Therefore, reductions in the quantity, quality, or availability of one or more essential feature reduce the value of the PCE, which in turn reduces the function of the sub-area (*e.g.*, watersheds), which in turn reduces the function of the overall designation. In the strictest interpretation, reductions to any one essential feature or PCE would equate to a reduction in the value of the whole. However, there are other considerations. We look to various factors to determine if the reduction in the value of an essential feature or PCE would affect higher levels of organization. For example:

- The timing, duration and magnitude of the reduction;
- The permanent or temporary nature of the reduction; and
- Whether the essential feature or PCE is limiting (in the action area or across the designation) to the recovery of the species or supports a critical life stage in the recovery needs of the species (for example, juvenile survival is a limiting factor in recovery of the species and the habitat element supports juvenile survival).

In our assessment, we combine information about the contribution of constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) to the conservation value of those areas of critical habitat that occur in the action area, given the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area. We use the conservation value of those areas of designated critical habitat that occur in the action area as our point of reference for this comparison. For example, if the critical habitat in the action area has limited current value or potential value for the conservation of listed species, that limited value is our point of reference for our assessment of the consequences of the added effects of the proposed action on that conservation value.

a. Freshwater Migratory Corridor

Safe and unobstructed migratory pathways are necessary for adult salmonids to migrate to and from spawning habitats, and for larval and juveniles to migrate downstream from spawning/rearing habitats within freshwater rivers to rearing habitats within the estuaries. The removal of the water diversion construction will not obstruct the migratory pathway for exposed fish. In addition, the water diversion channel will be temporary and will be designed to still allow fish passage during construction. Fish that use the action area as a migratory corridor will be able to continue using the channel during and after construction of the proposed action.

b. Freshwater rearing habitat

Freshwater rearing habitat provides water quantity, quality, and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility. Rearing habitat condition is strongly affected by habitat complexity, food supply, and presence of

predators of juvenile salmonids. Freshwater rearing habitats have a high intrinsic value to salmonids, as the juvenile life stages are dependent on the function of this habitat for successful survival and recruitment.

The removal of the temporary water diversion may result in elevated turbidity levels and increased suspended sediment, resulting in a temporary localized direct disturbance and potential indirect disturbance which may decrease water quality downstream of the project site. Increased sedimentation may reduce primary and secondary river productivity, interfere with feedings, cause behavioral avoidance, and cause a breakdown of social organization to native species downstream of the discharge area. A silt curtain will be in place during the removal of the temporary water diversion to minimize any water quality impacts.

The proposed project will temporarily affect 0.443 acre and permanently affect (or fill) 0.002 acre of riverine habitat, which is designated critical habitat for the CV steelhead. The temporary impacts include water diversion with the use of temporary fill for work within the OHWM of the Stanislaus River. The dewatering of the river and placement of the temporary fill may adversely affect CV steelhead, as salvaging fish during dewatering may induce stress on individual fish (take through harassment) or result in death of individual fish during salvage and transport. Permanent modification to 0.002 acre of CV steelhead critical habitat may affect, but is not likely to adversely affect, the CV steelhead due to the very insignificant loss of habitat quantity and quality. No adverse modification to CV steelhead or its habitat will result due to implementation of the proposed project.

In addition to impacts to the Stanislaus River, the proposed project will also impact riparian vegetation associated with the Stanislaus River, which could indirectly affect Central Valley steelhead in the river. Activities related to the construction of the proposed project will result in localized loss of vegetation (permanent loss of 0.45 acre of riparian vegetation), general disturbance to the soil, and an increase in impervious surfaces. Removal of vegetation and soil can accelerate erosion processes within the action area and increase the potential for sediment to enter into the river, which has the potential to contain special-status species. Aquatic organisms are generally not directly affected by suspended solids and turbidity unless they reach extremely high levels (i.e., levels of suspended solids reaching 25 milligrams/liter) (Bilotta and Brazier 2008). At these high levels, suspended solids can adversely affect the physiology of aquatic organisms and may suppress photosynthetic activity at the base of food webs, thereby impacting aquatic organisms either directly or indirectly. The soils on the north bank are particularly susceptible to erosion. It should be noted that the loss of riparian vegetation will be offset to a degree by the construction of the widened bridge over the Stanislaus River. The new bridge will provide approximately an additional 0.16 acres of shade along the vegetated bank of the river and an addition of approximately 0.22 acre of shade on the river.

5. Summary

NMFS does not anticipate that turbidity levels associated with water diversion removal will increase to deleterious levels due to the placement of silt curtains, and any increase in NTU levels would be short term and only lasting the duration of the project. Mitigation measures such as the implementation of a silt curtain around the action area will minimize the amount of

increased turbidity and sediment introduced to the waterway. If a fish rescue is necessary in the event that the San Joaquin River water over-tops the temporary water diversion, the effects will generally be beneficial, but it can affect juvenile steelhead behavior or may cause physical damage, or even potential death. However, mortality as a result of beach seining and dip netting is rare. Upon beach seining, dip netting, and holding tank placement, fish will be returned to the river. Therefore, these activities are not expected to result in appreciable reductions in the species' likelihood of surviving and recovering in the wild. NMFS expects that these activities will not result in appreciable reduction to the value of the designated critical habitat for the conservation of the species in the action area due to the placement of silt curtain and the short term nature of the project. In addition, NMFS anticipates that pile driving will be detectable to salmonids up to 215 meters from the source, and these effects should be small because pile driving will occur during the day. The June 15 through October 15 work window will further minimize the extent of the impacts on listed anadromous fish by avoiding the peaks of adult and juvenile migration periods.

VI. CUMULATIVE EFFECTS

For purposes of the ESA, cumulative effects are defined as the effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR §402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultations pursuant to section 7 of the ESA.

A. Agricultural Practices

Agricultural practices in and upstream of the Stanislaus River 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 San Joaquin River. 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. Unscreened agricultural diversions throughout the Delta entrain fish including juvenile salmonids. 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 the San Joaquin River and Delta. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may adversely affect salmonid reproductive success and survival rates (Dubrovsky *et al.* 1998, 2000; Daughton 2003).

B. 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 (2007) anticipated 21 percent annual growth through 2010 reaching a population of approximately 70,000 people. City of Lathrop (2007) expects to double its population by 2012, from 14,600 to approximately 30,000 residents. 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 process with NMFS.

Increased urbanization also is expected to result in increased wave action and propeller wash in the San Joaquin River due to increased recreational boating activity. This potentially will degrade riparian and wetland habitat by eroding channel banks, 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. Increased recreational boat operation on the San Joaquin River is anticipated to result in more contamination from the operation of engines on powered craft entering the river and its tributaries. 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 North American green sturgeon resulting in death or injury.

C. 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 (Intergovernmental Panel on Climate Change [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 salmonid 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 35.6^{o}F and 44.6^{o}F by 2100 (Dettinger *et al.* 2004; Hayhoe *et al.* 2004; Van Rheenen *et al.* 2004; Dettinger 2005), with a drier hydrology predominated by precipitation rather than snowfall. This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring/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 below 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 below 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 CV steelhead) that must hold below the dam over the summer and fall periods.

The near term effects of global climate change are unlikely to result in any perceptible declines to the overall health or distribution of the listed CV steelhead within the action area that are the subject of this consultation.

VII. INTEGRATION AND SYNTHESIS

This section integrates the current conditions described in the *Environmental Baseline* with the effects of the proposed action and the cumulative effects of future actions. The purpose of this synthesis is to develop an understanding of the likely short term and long term response of listed species and critical habitat to the proposed project.

A. Impacts of the Proposed Action on Central Valley Steelhead, and its Designated Critical Habitat

NMFS finds that the effects of the Project on California CV steelhead and its designated critical habitat will include a temporary increase in suspended sediment and turbidity, a short-term reduction of SRA habitat, harassment, injury, and possible predation-related mortality of individuals from pile driving, and harassment, injury and potential mortality of individuals entrained or salvaged from water diversion construction. With the exception of loss of SRA habitat, the June 15 to October 15 in water work window will minimize project-related effects by avoiding the peak migration periods of adult and juvenile salmonid migrations.

The most likely effects to listed salmonids from the proposed action are harassment of juvenile CV steelhead resulting from the noise of pile driving, and entrainment of juveniles into culvert pipes via water diversion. Pile driving is expected to result in temporary disruptions in the feeding, sheltering, and migratory behavior of adult juvenile salmon and steelhead. This disruption may injure or kill juveniles by causing reduced growth and increased susceptibility to predation. Adults should not be injured because the disruptions should only include temporary migration delays that should not prevent successful spawning. Pile driving is also not expected to prevent salmonids from passing upstream or downstream because pile driving will not be continuous through the day, and will not occur at night, when the majority of fish migrate. Pile driving effects will be minimized by avoiding the peak migration periods of listed anadromous salmonids. Death as a result of entrainment is expected to be minimized by salvaging and relocating fish away from the project site. A low mortality rate of juveniles (<10 percent) is expected to result from fish salvage.

Turbidity changes that are within the Regional Board standards may result in sudden localized turbidity increases that could injure juvenile salmonids by temporarily impairing their migration, rearing, feeding, or sheltering behavior. Project-related turbidity increases may also contribute to the susceptibility of juvenile salmonids to increased predation. Turbidity related injury and predation will be minimized by implementing the avoidance and contingency measures of the SWPPP, and by scheduling in-water work to avoid peak migration periods of listed anadromous salmonids.

The temporary loss of 0.443 acre of riparian vegetation will result in a small reduction of nearshore cover and food production until the vegetation in the disturbed areas is re-established (five to ten years). Revegetating the project area at a 3:1 ratio will minimize the effect of this habitat loss. Because of the diverse habitat conditions in the action area, and other forms of cover and food production available to salmon and steelhead within the action area, the loss of 0.443 acre of vegetation is not expected to significantly impair the essential behavioral patterns of listed anadromous fish and will, therefore, not result in a reduction in numbers. There will be a permanent loss of 0.002 acre of riverine habitat from the increased size of the bridge columns. To compensate for the loss of critical habitat, Caltrans will mitigate at a minimum 2:1 ratio through establishment of a conservation easement or payment of in-lieu fees at an approved NMFS conservation bank.

B. Impacts of the Proposed Action on CV steelhead DPS Survival and Recovery

The adverse effects to listed species within the action area are not expected to affect the overall survival and recovery of the DPS. This is largely due to the fact that although construction may cause adverse effects to some listed salmonids, the impacts will avoid the largest proportions of listed anadromous fish that migrate through the action area by limiting in-water work to months that do not coincide with peak migration periods. Additionally, most of the effects are not lethal. Construction-related harassment will be temporary and will not impede adult fish from reaching upstream spawning and holding habitat, or juvenile fish from migrating downstream. The project will compensate for temporary and permanent losses of critical habitat by planting riparian vegetation at the project site at a 3:1 ratio and at a nearby riverside NMFS approved mitigation site at a minimum 2:1 ratio. Riverine and riparian habitat will be restored to pre-project conditions after project construction is complete. No effects from interrelated or interdependent actions are anticipated to occur to the CV steelhead as a result of implementing the proposed project. The project does not contribute to cumulative effects to CV steelhead due to the implementation of avoidance, minimization, and mitigation measures that will help reduce those effects.

VIII. CONCLUSION

After reviewing the best available scientific and commercial information, the current status CV steelhead, and its designated critical habitat, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' BO that the McHenry Avenue Corridor Improvement Project, as proposed, is not likely to jeopardize the continued existence of California CV steelhead, and is not likely to destroy or adversely modify their designated critical habitats.

IX. 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 is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose 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 Caltrans so that they become binding conditions of any contracts or permits, as appropriate, for the exemption in section 7(o)(2) to apply. Caltrans has a continuing duty to regulate the activity covered by this incidental take statement. If Caltrans (1) fails to assume and implement the terms and conditions

or (2) fails to require the applicant and its contractor(s) 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, Caltrans or the applicant 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 or Extent of Take

NMFS anticipates incidental take of California CV steelhead from impacts directly related to pile driving, dewatering, and impairment of essential behavior patterns as a result of these activities. The incidental take is expected to be in the form of harm, harassment, or mortality of California CV steelhead resulting from the installation and removal of temporary and permanent piles and water diversion construction. Incidental take is expected to occur for any in-water work window seasons, from June 15 to October 15, when individuals of California CV steelhead could potentially be in the action area. Take is expected on migrating adults, and migrating, rearing and smolting juveniles.

NMFS cannot, using the best available information, quantify the anticipated incidental take of individual CV steelhead because of the variability and uncertainty associated with the population size of the species, annual variations in the timing of migration, and uncertainties regarding individual habitat use of the project area. However, it is possible to describe the ecological surrogates that will lead to the take:

1. Dewatering Activities

Although abundance of juvenile California CV steelhead is expected to be very low in the project action area, take of stranded juveniles during the dewatering activities from June 15 to October 15 will likely occur. Stranded juveniles will be captured and relocated directly downstream of the project site. There is potential for listed juvenile fish to be directly killed or injured as a result of handling during relocation. Kennedy (2008) observed 5 individuals per 100 square meters at the Oakdale Recreation reach of the Stanislaus River (just upstream of the project area). Since the total area to be dewatered will not be greater than 8,500 square feet, non-lethal take for this Project will be limited to 40 individuals and lethal take will be limited to less than five individuals. The mortality rate (expected to be less than 10 percent if consistent with the results of fish handling in similar fish salvage efforts) is a standard expected from the capturing, handling, and relocation of fish.

2. Pile Driving

The analysis of the effects of the Project anticipates the installation of 8 permanent 72-inch diameter steel pipe casings (in-water or placed through temporary embankment) and 8 permanent 48-inch diameter steel pipe casings (land-based) to be driven with a vibratory hammer. 180 permanent, 24-inch diameter PC/PS hexagonal concrete piles (land-based) will be driven with an impact hammer. All piles will be driven during the in-water work window between June 15 and October 15, during daylight hours, for two construction seasons.

Pile driving with an impact hammer is expected to result in incidental take in the form of injury and mortality to salmonids through exposure to temporary high SPLs (> 206 dB peak SPL or 187 dB SEL) within the water column during the installation of the temporary falsework and bridge pier and column activities. The number of salmonids that may be incidentally taken during activities is expected to be small. NMFS will use the area of sound pressure wave impacts extending into the water column from each pile, and the time period for pile driving as a surrogate for number of fish.

For the purposes of this analysis, sound pressure levels for the 48-inch steel pipe casings are conservatively assumed to have the same sound pressures as the 72-inch steel pipe casings. The estimates for sound pressures assume casing will be installed directly into the bed of the river. If temporary embankment/work pad(s) are installed prior to installing the pipe casing, sound pressures will be expected to be reduced. Based on the analysis, peak and cumulative sound pressures are estimated to be below thresholds for injury and/or mortality of listed fish, therefore no sound attenuation measures or monitoring will be required.

For listed salmonids located within a 104 m diameter from the pile during unattenuated pile driving of the 72-inch (and therefore 48-inch) CIDH piles, and within a 42, 20, 12, and 8 m diameter from the pile (based on their varying distances from the riverbank at 21, 33, 45, and 57 m respectively) during unattenuated pile driving of the 24-inch PC/PS concrete piles may be injured or killed. Beyond these distances, extending out to 430 m (for CIDH piles), and 124 m, 58 m, 36 m, and 24 m diameters respectively (for PC/PS concrete piles) corresponding with SPLs > 150 dB RMS, of the above events fish may exhibit behavioral responses such as agitation or rapid bursts in swimming speeds. If Caltrans' monitoring indicates that sound pressure levels greater than 206 dB peak (re: 1 μPa), or 187 dB SEL (re: 1 $\mu Pa^2 sec$), or 150 dB RMS (re: 1 μPa) extend beyond these distances the amount of incidental take may be exceeded.

The analysis of the effects of the proposed project anticipates that the turbidity levels produced by installation and removal of piles will not exceed those permitted under the project SWPPP and that if turbidity levels approach or exceed the acceptable criteria established by the Regional Board, construction activities will be halted until turbidity levels return to within acceptable levels.

If these ecological surrogates are not met and maintained, the proposed project will be considered to have exceeded anticipated take levels, thus requiring Caltrans to coordinate with NMFS within 24 hours on ways to reduce the amount of take down to anticipated levels. Anticipated incidental take will be exceeded if the criteria described above are not met, the Project is not implemented as described in the Biological Assessment (BA) prepared for this project, all conservation measures 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 Take

NMFS has determined that the aforementioned level of take resulting from the McHenry Avenue

Corridor Improvement Project is not likely to jeopardize California CV steelhead, and is not likely to destroy or adversely modify designated critical habitat.

C. Reasonable and Prudent Measures

NMFS has determined that the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the incidental take of listed California CV steelhead resulting from the Project. These reasonable and prudent measures also would minimize adverse effects on designated critical habitat.

1. Measures shall be taken to minimize incidental take of listed anadromous fish by restricting the in-water work to avoid vulnerable life stages.
2. Measures shall be taken to minimize incidental take of listed anadromous fish during water diversion construction.
3. Measures shall be taken to validate that erosion, sediment, and turbidity controls and contingency measures are effective.
4. Measures shall be taken to minimize the effect of temporary habitat loss of riverine and riparian habitat.
5. Measures shall be taken to maintain fish passage for salmonids through the project site.
6. Caltrans shall provide a report of project activities to NMFS by December 31 of each construction year.
7. Caltrans shall report any incidence of take to NMFS.
8. Measures shall be taken to minimize the amount and duration of pile driving and its potential impacts on listed salmonids, and to monitor the range and magnitude of compression shock waves generated by pile driving operations.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, Caltrans must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting and monitoring requirements. These terms and conditions are non-discretionary and must be incorporated as binding conditions of any contracts or permits between Caltrans and their contractors:

(1) Measures shall be taken to minimize incidental take of listed anadromous fish by restricting the in-water work to avoid vulnerable life stages.

> Conditions: Any construction work occurring below the Ordinary High Water Mark (OHWM) will occur from June 15 to October 15 of each construction year. This is a time when listed species are least likely to be impacted.

(2) Measures shall be taken to minimize incidental take of listed anadromous fish during water diversion construction.

Conditions: Caltrans will have a fish biologist prepare a fish salvage plan to recover any individual salmonids entrapped or entrained during water diversion construction process. In addition, Caltrans will submit the plan to NMFS prior to project initiation.

(3) Measures shall be taken to validate that erosion, sediment, and turbidity controls and contingency measures are effective.

Conditions: Caltrans shall ensure that proper sediment control and retention structures are effective and in place throughout the rainy season. Also, Caltrans shall obtain all appropriate permits through the appropriate Regional Board and have on file a SWPPP.

(4) Measures shall be taken to minimize the effect of temporary habitat loss of riverine and riparian habitat.

Conditions:
Caltrans shall develop a revegetation plan for the project that compensates for the removal of riparian vegetation at the proposed ratio of 3:1. This plan shall include a maintenance schedule for assuring successful revegetation.

a. For areas that cannot be restored onsite, Caltrans shall purchase riparian credits at a NMFS approved anadromous fish conservation bank at a 6:1 ratio for riparian habitat affected by the action to offset temporal impacts incurred from project activities.
b. Caltrans shall monitor and maintain all riparian plantings for five years, and provide irrigation, fertilization and replacement plantings as necessary to ensure full and rapid recovery of disturbed riparian habitat features.
c. Caltrans shall provide NMFS a post-construction field review and yearly field reviews for five years of the proposed project site, to assure conservation measures were adequately implemented and whether additional plantings are needed to establish adequate riparian vegetation. The first review should occur the year following construction completion. The field review shall include the following elements:

    i. Seasonal surveys to determine adequate cover and plant survival throughout the year is being met.
    ii. A survival ratio to ensure planting of new vegetation is implemented during the first five years when necessary.
    iii. Photo point monitoring shots at the established repair site to be used as a tool to determine success and survival rates. The photos shall be taken annually on the same date, as much as practicable.

(5) Measures shall be taken to maintain fish passage for salmonids through the project site.

Conditions: A temporary embankment/work pad(s) will be constructed of water bladders, clean, local fill material, and/or other methods that will not result in notably degraded water quality and will also divert the flow and maintain dry conditions around the work area. The flows will be diverted into temporary culvert pipes that pass through the embankment/work pad in order to provide ample passage for listed fish to move up

and down the river channel. In addition, Caltrans shall establish non-work periods of at least eight hours at night to allow for quiet migration conditions for listed salmonids. Absence of in-water work during the night time will allow for unimpeded movement through the action area by listed salmonids.

(6) Caltrans shall provide a report of project activities to NMFS by December 31 of each construction year.

Conditions: This report shall include a summary description of in-water constraint activities, avoidance and minimization measures taken, and any observed take incidents.

(7) Caltrans shall report any incidence of take to NMFS.

Conditions: Caltrans shall record the date, number, and specific location of all steelhead that are relocated for each construction-related activity in the project area in addition to any direct mortalities observed during dewatering and relocation. If a listed species is observed injured or killed by project activities, Caltrans shall contact NMFS within 48 hours at 650 Capitol Mall, Suite 5-100, Sacramento, CA 95814. Notification shall include species identification, the number of fish, and a description of the action that resulted in take. If possible, dead individuals shall be collected, placed in an airtight bag, and refrigerated with the aforementioned information until further direction is received from NMFS.

(8) Measures shall be taken to minimize the amount and duration of pile driving and its potential impacts on listed salmonids, and to monitor the range and magnitude of compression shock waves generated by pile driving operations.

Conditions:

a. All in-water pile driving work will occur from June 15 to October 15 each construction year. Real-time monitoring shall be conducted to ensure that underwater sound levels analyzed in this biological opinion do not exceed the established distances described for pile driving construction. These distances are:

    i. Unattenuated 72-inch (and 48-inch) permanent CIDH piles: 206 dB peak SPL at 0 m (0 m diameter), 187 dB accumulated SEL at 52 m (104 m diameter), and 150 dB RMS at 215 m (430 m diameter);
    ii. Unattenuated 24-inch PC/PS concrete piles at 21 m from riverbank: 206 dB peak SPL at 0 m (0 m diameter), 187 dB accumulated SEL at 21 m (42 m diameter), and 150 dB RMS at 62 m (124 m diameter);
    iii. Unattenuated 24-inch PC/PS concrete piles at 33 m from riverbank: 206 dB peak SPL at 0 m (0 m diameter), 187 dB accumulated SEL at 10 m (20 m diameter), and 150 dB RMS at 29 m (58 m diameter);
    iv. Unattenuated 24-inch PC/PS concrete piles at 45 m from riverbank: 206 dB peak SPL at 0 m (0 m diameter), 187 dB accumulated SEL at 6 m (12 m diameter), and 150 dB RMS at 18 m (36 m diameter);

v. Unattenuated 24-inch PC/PS concrete piles at 57 m from riverbank: 206 dB peak SPL at 0 m (0 m diameter), 187 dB accumulated SEL at 4 m (8 m diameter), and 150 dB RMS at 12 m (24 m diameter).

b. Caltrans shall monitor underwater sound during all impact hammer pile driving activities. If underwater sound exceeds the established thresholds at the distances provided above from the piles being driven, then NMFS must be contacted within 24 hours before continuing to drive additional piles.

c. Caltrans shall submit to NMFS a hydroacoustic monitoring report plan for approval at least 60 days prior to the start of construction activites. In addition, Caltrans shall submit to NMFS a daily hydroacoustic monitoring report (by COB of the day following the pile driving activities) that provide real-time data regarding the distance (actual or estimated using propagation models) to the thresholds (150 dB RMS, 187 dB accumulated SEL, and 206 dB peak SPL) stated in this BO to determine adverse effects to listed species. Specifically, the reports shall:

   i. Describe the locations of hydroacoustic monitoring stations that were used to document the extent of the underwater sound footprint during pile-driving activities, including the number, location, distances, and depths of hydrophones and associated monitoring equipment;
   ii. Include the total number of pile strikes per pile, the interval between strikes, the peak SPL and SEL per strike, and accumulated SEL per day for each hydroacoustic monitor deployed.
   iii. Include a monitoring and reporting program that will incorporate provisions to provide daily, monthly, and seasonal summaries of the hydroacoustic monitoring results (real-time data) to NMFS during the pile-driving season.

d. Pile driving shall occur only during restricted weekday working hours from 8 a.m to 5 p.m. This is to ensure that pile driving does not occur at dawn or dusk, during peak salmonid migration and feeding times. In addition, potential impacts incurred by juvenile salmonids during this time will be at a minimum.

e. Caltrans shall submit to NMFS a final hydroacoustic monitoring summary due 30 days following pile driving events for each temporary structure required for bridge construction (see Condition (8)(c)(iii) above). The reports must provide a review of the daily monitoring data and process, as well as any problems that were encountered.

Additionally, Caltrans shall maintain, monitor, and adaptively manage all conservation measures throughout the life of the project to ensure their effectiveness. For example, assurances shall be taken to ensure the success of revegetation efforts. Caltrans, for the purposes of agency review and approval, shall provide the finalized project plans to NMFS at least 14 days prior to implementation, which will include the following:

(1) Confirmation of in-water work window from June 15 to October 15;
(2) Use details for any chemically-treated substances that will be used during the in-stream

construction window;
(3) Compliance to SWPPP and other Regional Board requirements;
(4) Compliance with all pile driving requirements; and
(5) Notification strategy for informing NMFS upon initiation and conclusion of in-water work.

Caltrans shall provide a project summary and compliance report to NMFS within 60 days of completion of construction. This report shall describe construction dates, implementation of proposed project conservation measures, and the terms and conditions of the final biological opinion; observed or other known effects on California CV steelhead, and any occurrences of incidental take.

Updates and reports required by these terms and conditions shall be submitted by December 31 of each year during the construction period to:

Supervisor
Central Valley Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814-4607
FAX: (916) 930-3629
Phone: (916) 930-3600

X. 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 recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS proposes the following conservation recommendations that would avoid or reduce adverse impacts to listed anadromous fish species:

(1) Caltrans should support and promote aquatic and riparian habitat restoration within the California's CV, and implement practices that avoid or minimize negative impacts to salmon, steelhead, and sturgeon on all of their project sites within critical habitat.

(2) Caltrans should provide fiscal and staffing support to anadromous salmonid and sturgeon monitoring programs throughout the Delta to improve the understanding of migration and habitat utilization by salmonids and sturgeon in this region.

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.

XI. REINITIATION NOTICE

This concludes formal consultation on the McHenry Avenue Cooridor Improvement project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion, or (4) a new species is listed or critical habitat 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.

XII. LITERATURE CITED

Anderson, J. J. 1990. Assessment of the risk of pile driving to juvenile fish; presented to the Deep Foundations Institute. Fisheries Research Institute, University of Washington.

Anderson, J.T., C.B. Watry, and A. Gray. 2007. Upstream Fish Passage at a Resistance Board Weir Using Infrared and Digital Technology in the Lower Stanislaus River, California. 2006−2007. Annual Data Report. Prepared for: U.S. Fish and Wildlife Service, Anadromous Fish Restoration Program, Grant No. 813326G004.

Ayers and Associates. 2001. Two-dimensional modeling and analysis of spawning bed mobilization, lower American River. Prepared for the U.S. Army Corps of Engineers, Sacramento District Office.

Bailey E.D. 1954. Time pattern of 1953–54 migration of salmon and steelhead into the upper Sacramento River. California Department of Fish and Game. Unpublished report.

Bain, M.B., and N.J. Stevenson, editors. 1999. Aquatic habitat assessment: common methods. American Fisheries Society, Bethesda, Maryland.

Barrett, J. C., G. D. Grossman, and J. Rosenfeld. 1992. Turbidity-induced changes in reactive distance of rainbow trout. Transactions of the American Fisheries Society 121: 437-443.

Bash, J., C. Berman, and S. Bolton. 2001. Effects of turbidity and suspended solids on salmonids. Center for Streamside Studies, University of Washington.

Bilby, R.E. 1984. Removal of woody debris may affect stream channel stability. Journal of Forestry 82:609-613.

Bilotta, G.S. and Brazier, R.E. (2008) Understanding the influence of suspended solids on water quality and aquatic biota. Water Research, 42 (12). pp. 2849-2861. ISSN 0043-1354

Bisson, P.A., and R.E. Bilby. 1982. Avoidance of suspended sediment by juvenile coho salmon. North American Journal of Fisheries Management 2:371-374.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of anadromous salmonids. *In* W.R. Meehan (editor), Influences of forest and rangeland management on salmonid fishes and their habitats, pages 83-138. American Fisheries Society Special Publication 19. American Fisheries Society, Bethesda, MD.

Brandes, P.L., and J.S. McLain. 2001. Juvenile Chinook salmon abundance, distribution, and survival in the Sacramento-San Joaquin Estuary. *In*: Brown, R.L., editor. Contributions to the biology of Central Valley salmonids. Volume 2. California Department of Fish and Game Fish Bulletin 179:39-136.

Busby, P.J., T.C. Wainright, G.J. Bryant, L. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-27, 261 pages.

CALFED. 2000. Ecosystem Restoration Program Plan, Volume II. Technical Appendix to draft PEIS/EIR. July 2000.

California Department of Fish and Game. 1995. Adult steelhead counts in Mill and Deer Creeks, Tehama County, October 1993-June 1994. Inland Fisheries Administrative Report Number 95-3.

California Department of Fish and Game. 1998. Report to the Fish and Game Commission. A status review of the spring-run Chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento River Drainage. Candidate species status report 98-01. Sacramento, 394 pages.

California Department of Fish and Game. 2003. Memorandum to Madelyn Martinez (NOAA Fisheries) regarding steelhead populations in the San Joaquin River basin. 4 pages.

California Department of Transportation. 2011. Biological Assessment for the McHenry Avenue Corridor Improvement Project for NMFS. Prepared by Caltrans for U.S. Department of Transportation, (January 2011). 26 p.

California Department of Water Resources. 2009. Quantification of pre-screen loss of juvenile steelhead within Clifton Court Forebay. Prepared by K.W. Clark, M.D. Bowen, R.B. Mayfield, K.P. Zehfuss, J.D. Taplin, and C.H. Hanson for the Fishery Improvement Section, Bay Delta Office. xvii + 119 pages.

California Regional Water Quality Control Board-Central Valley Region. 1998. Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins, Fourth edition. Available: http://www.swrcb.ca.gov/CRWQCB5/home.html

California Regional Water Quality Control Board-Central Valley Region. 2001. Draft staff report on recommended changes to California's Clean Water Act, section 303(d) list. Available: http://www.swrcb.ca.gov/CRWQCB5/tmdl/

California Resources Agency. 1989. Upper Sacramento River fisheries and riparian management plan. Prepared by an Advisory Council established by SB1086, authored by State Senator Jim Nielson. 157 pages.

City of Lathrop. 2007. City demographics accessed via the internet. Available online at: www.ci.lathrop.ca.us/cdd/demographics.

City of Manteca. 2007. City demographics accessed via the internet. Available online at: www.ci.manteca.ca.us/cdd/demographics.

Clark, G. H. 1929. Sacramento-San Joaquin salmon (*Oncorhynchus tshawytscha*) fishery of California. California Fish and Game Bulletin. 17:73.

Cohen, A.N., and P.B. Moyle. 2004. Summary of data and analyses indicating that exotic species have impaired the beneficial uses of certain California waters: a report submitted to the State Water Resources Control Board on June 14, 2004. 25 pages.

Conomos, T.J., R.E. Smith, and J.W. Gartner. 1985. Environmental settings of San Francisco Bay. Hydrobiologia 129: 1-12.

Cordone, A.J., and D.W. Kelley. 1961. The influences of inorganic sediment on the aquatic life of streams. California Fish and Game 47:89-228.

D. Whitley. California Department of Transportation. Personal Communication, 2002.

Daughton, C.G. 2003. Cradle-to-cradle stewardship of drugs for minimizing their environmental disposition while promoting human health. I. Rationale for and avenue toward a green pharmacy. Environmental Health Perspectives 111:757-774.

Decato, R.J. 1978. Evaluation of the Glenn-Colusa Irrigation District fish screen. California Department of Fish and Game, Anadromous Fisheries Branch Administrative Report No. 78-20.

Dettinger, M.D. 2005. From climate-change sphaghetti to climate-change distributions for 21st century California. San Francisco Estuary and Watershed Science 3(1), Article 4 (14 pages) Available at: http://repositories.cdlib.org/jmie/sfews/vol3/art4.

Dettinger, M.D., D.R. Cayan, M.K. Meyer, and A.E. Jeton. 2004. Simulated hydrological responses to climate variations and changes in the Merced, Carson, and American River basins, Sierra Nevada, California, 1900-2099. Climatic Change 62:283-317.

Dolloff, C.A. 1993. Predation by river otters (*Lutra Canadensis*) on juvenile coho salmon (*Oncorhynchus kisutch*) and Dolly Varden (*Salvelinus malma*) in southeast Alaska. Canadian Journal of Fisheries and Aquatic Sciences 50: 312-315.

Dubrovsky, N.M., D.L. Knifong, P.D. Dileanis, L.R. Brown, J.T. May, V. Connor, and C.N. Alpers. 1998. Water quality in the Sacramento River basin. U.S. Geological Survey Circular 1215.

Dubrovsky, N.M., C.R. Kratzer, L.R. Brown, J.M. Gronberg, and K.R. Burow. 2000. Water quality in the San Joaquin-Tulare basins, California, 1992-95. U.S. Geological Survey Circular 1159.

Edwards, G.W., K.A.F. Urquhart, and T.L. Tillman. 1996. Adult salmon migration monitoring, Suisun Marsh Salinity Control Gates, September-November 1994. Technical Report 50. Interagency Ecological Program for the San Francisco Bay/Delta Estuary, 27 pages.

Feist, B.E., J. J. Anderson and R. Miyamoto. 1992. Potential impacts of pile driving on juvenile pink (*Oncorhynchus gorbuscha*) and chum (*O. keta*) salmon behavior and distribution. FRI-UW-9603. Fisheries Resources Institute, University of Washington. Seattle.

Garcia, A. 1989. The impacts of squawfish predation on juvenile Chinook salmon at Red Bluff Diversion Dam and other locations in the Sacramento River. U.S. Fish and Wildlife Service Report No. AFF/FAO-89-05.

Garland, R.D., K.F. Tiffan, D.W. Rondorf, and L.O. Clark. 2002. Comparison of subyearling fall Chinook salmon's use of riprap revetments and unaltered habitats in Lake Wallula of the Columbia River. North American Journal of Fisheries Management 22:1283-1289.

Gingras, M. 1997. Mark/recapture experiments at Clifton Court Forebay to estimate pre-screen loss of juvenile fishes: 1976-1993. Interagency Ecological Program Technical Report No. 55.

Goals Project. 1999. Baylands ecosystem habitat goals: A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco. San Francisco Bay Regional Water Quality Control Board, Oakland, CA.

Good, T.P., R.S. Waples, and P. Adams (editors). 2005. Updated status of federally listed ESU of West Coast salmon and steelhead. U.S. Department of Commerce, NOAA Technical Memo. NMFS-NWFSC-66, 598 p.

Goyer, R.A. 1996. Toxic effects of metals. *In* C.D. Klassen (editor), Casarett & Doull's toxicology: the basic science of poisons, fifth edition, pages 691-736. McGraw Hill. New York, NY.

Hallock, R.J. D.H. Fry, and D.A. LaFaunce. 1957. The use of wire fyke traps to estimate the runs of adult salmon and steelhead in the Sacramento River. California Fish and Game. Volume 43, No. 4, pages 271-298.

Hallock, R.J., W.F. Van Woert, and L. Shapavalov. 1961. An evaluation of stocking hatchery-reared steelhead rainbow trout (*Salmo gairdneri gairdneri*) in the Sacramento River system. California Fish and Game 114:73.

Hallock, R.J., R.F. Elwell, and D.H. Fry, Jr. 1970. Migrations of adult king salmon, *Oncorhynchus tshawytscha*, in the San Joaquin Delta. California Fish and Game 151. Sacramento. 92 p.

Hare, S.R., N.J. Mantua, and R.C. Frances. 1999. Inverse production regimes: Alaska and west coast Pacific salmon. Fisheries 24(1):6-14.

Hastings, M.C., AN. Popper, U. Finneran, and P. Lanford. 1996. Effects of low frequency sound on hair cells of the inner ear and lateral line of the teleost fish *Astronotus ocellatus.* J. Acoustical Soc. Am. 99(3): 1759-1766.

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

Herren, J.R. and S.S. Kawasaki. 2001. Inventory of water diversions in four geographic areas in California's Central Valley. Pages 343-355. *In:* Contributions to the Biology of Central Valley Salmonids. R.L. Brown, editor. Volume. 2. California Fish and Game. Fish Bulletin 179.

Huang, B. and Z. Liu. 2000. Temperature Trend of the Last 40 Years in the Upper Pacific Ocean. Journal of Climate 4: 3738–3750.

Hubbs, C. L., and A. B. Rechnitzer. 1952. Report on experiments designed to determine effects of underwater explosions on fish life. California Fish and Game 38:333-366.

Ingersoll, C.G. 1995. Sediment tests. *In* G.M. Rand (editor), Fundamentals of aquatic toxicology: effects, environmental fate, and risk assessment, second edition, pages 231-255. Taylor and Francis, Bristol, Pennsylvania.

Interagency Ecological Program Steelhead Project Work Team. 1999. Monitoring, assessment, and research on Central Valley steelhead: status of knowledge, review existing programs, and assessment needs. In Comprehensive Monitoring, Assessment, and Research Program Plan, Technical Appendices VII-11.

Intergovernmental Panel on Climate Change (IPCC). 2001. Climate Change 2001: the Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T.,Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 881 pages.

Jones & Stokes Associates, Inc. 2002. Foundation runs report for restoration action gaming trials. Prepared for Friant Water Users Authority and Natural Resource Defense Council.

Keller, E.A., and F.J. Swanson. 1979. Effects of large organic material on channel form and fluvial processes. Earth Surface Processes 4:361-380.

Kennedy, T. and T. C. Cannon. 2002.Stanislaus River salmonid density and distribution survey report (2000-2001): final draft. Prepared for the U. S. Fish and Wildlife Service, Central Valley Project Improvement Act Program. Sacramento, CA.

Kennedy, T. 2008. Stanislaus River salmonid density and distribution survey report (2005-2007): final draft. Prepared for the U.S Bureau of Reclamation Central Valley Project Improvement Act. Sacramento, CA.

Klimley, A.P. 2008. Personal Communication. Adjunct Associate Professor. University of California, Davis, California. December 2.

Kondolf, G.M., A. Falzone, and K.S. Schneider. 2001. Reconnaissance-level assessment of channel change and spawning habitat on the Stanislaus River below Goodwin Dam. Berkeley, California.

Lindley, S.T., R. Schick, A. Agrawal, M. Goslin, T.E. Pearson, E. Mora, J.J. Anderson, B. May, May, S. Greene, C. Hanson, A. Low, D. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2006. Historical population structure of Central Valley steelhead and its alteration by dams. San Francisco Estuary and Watershed Science.

Lindley, S.T., R.S, Schick, E. Mora, P.B. Adams, J.J. Anderson, S. Greene, C. Hanson, B.P. May, D.R. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science 5(1): Article 4. 26 pages. Available at: http://repositories.cdlib.org/jmie/sfews/vol5/iss1/art4.

Lloyd, D.S. 1987. Turbidity as a water quality standard for salmonid habitats in Alaska. North American Journal of Fisheries Management 7: 34-45.

MacDonald, Lee H., Alan W. Smart, and Robert C. Wissmar. 1991. Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska. EPA Region 10 and University of Washington Center for Streamside studies, Seattle, WA. 166 pp.

Mantua, N.J., and S.R. Hare. 2002. The Pacific decadal oscillation. Journal of Oceanography. 58:35-44.

Marston, D. 2004. Letter to Mike Aceituno, Office Supervisor, Sacramento, CA regarding steelhead smolt recoveries for the San Joaquin River Basin.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, E. P. Bjorkstedt. 2000. Viable salmon populations and the recovery of evolutionarily significant units. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-42, 156 p.

McEwan, D. and T.A. Jackson. 1996. Steelhead Restoration and Management Plan for California. California. Department of Fish and Game, Sacramento, California, 234 pages.

McEwan, D. 2001. Central Valley steelhead. *In* R .L. Brown (Editor), Contributions to the Biology of Central Valley Salmonids, Volume 1, pages 1-44. California Department of Fish and Game, Fish Bulletin 179.

McGill, R.R. Jr. 1987. Land use changes in the Sacramento River riparian zone, Redding to Colusa. A third update: 1982-1987. Department of Water Resources, Northern District, 19 pages.

McKinley, R.S., and P.H. Patrick. 1986. Use of behavioral stimuli to divert sockeye salmon smolts at the Seton Hydro-electric station, British Columbia. In: W.C. Micheletti, ed. 1987. Proceedings of the Electric Power Research Institute at steam and hydro plants. San Francisco.

Meehan, W.R. 1991. Introduction and overview. *In* W.R. Meehan (editor), Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19, pages 1-16. American Fisheries Society, Bethesda, MD.

Meehan, W.R., and T.C. Bjornn. 1991. Salmonid distributions and life histories. *In* W.R. Meehan (editor), Influences of forest and rangeland management on salmonid fishes and their habitats, pages 47-82. American Fisheries Society Special Publication 19. American Fisheries Society, Bethesda, MD.

Michny, F., and M. Hampton. 1984. Sacramento River Chico Landing to Red Bluff project, 1984, Juvenile salmon study. U.S. Fish and Wildlife Service, Division of Ecological Services. Sacramento, California.

Monroe, M., J. Kelly, and N. Lisowski. 1992. State of the estuary, a report of the conditions and problems in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. June 1992. 269 pages.

Mount, J.F. 1995. California rivers and streams: The conflict between fluvial process and land use. University California Press, Berkeley.

Moyle, P.B. 2002. Inland fishes of California. University of California Press, Berkeley.

National Marine Fisheries Service and California Department of Fish and Game. 2001. Final report on anadromous salmon fish hatcheries in California. Prepared by Joint Hatchery Review Committee. June 27, 2001.

National Marine Fisheries Service. 1996a. Factors for decline: a supplement to the notice of determination for west coast steelhead under the Endangered Species Act. National Marine Fisheries Service, Protected Resource Division, Portland, OR and Long Beach, CA.

National Marine Fisheries Service. 1996b. Making Endangered Species Act determinations of effect for individual or group actions at the watershed scale. Prepared by NMFS, Environmental and Technical Services Branch, Habitat Conservation Branch. 31 pages.

National Marine Fisheries Service. 1997. National Marine Fisheries Service Proposed Recovery Plan for the Sacramento River Winter-run Chinook Salmon. NMFS, Southwest Region, Long Beach, California, 217 pages with goals and appendices.

National Marine Fisheries Service. 1998. Factors Contributing to the Decline of Chinook Salmon: An Addendum to the 1996 West Coast Steelhead Factors For Decline Report. Protected Resources Division, National Marine Fisheries Service. Portland Oregon.

National Marine Fisheries Service. 2009. Letter from Rodney R. McInnis, NMFS, to Don Glaser, Bureau of Reclamation, transmitting a Biological and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project. June 4. 844 pages plus 5 appendices.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management. 16:693-727.

Newcombe, C.P. and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. North American Journal of Fisheries Management 11: 72-82.

Nichols, F.H., J.E. Cloern, S.N. Louma, and D.H. Peterson. 1986. The modification of an estuary. *Science* 231: 567-573.

Nielsen, J.L., S. Pavey, T. Wiacek, G.K. Sage, and I. Williams. 2003. Genetic analyses of Central Valley trout populations 1999-2003. USGA Alaska Science Center. Draft Technical Report, submitted to DFG, Sacramento, and FWS, Red Bluff.

Noakes, D. J. 1998. On the coherence of salmon abundance trends and environmental trends. North Pacific Anadromous Fishery Commission Bulletin. pages 454-463.

Nobriga, M., and P. Cadrett. 2003. Differences among hatchery and wild steelhead: evidence from Delta fish monitoring programs. Interagency Ecological Program for the San Francisco Estuary Newsletter 14: 3: 30-38.

Orsi, J. 1967. Predation study report, 1966-1967. California Department of Fish and Game

Peterson, J. H. and J. F. Kitchell. 2001. Climate regimes and water temperature changes in the Columbia River: Bioenergetic implications for predators of juvenile salmon. Canadian Journal of Fisheries and Aquatic Sciences 58: 1831-1841.

Phillips, R.W. and H.J. Campbell. 1961. The embryonic survival of coho salmon and steelhead trout as influenced by some environmental conditions in gravel beds. Annual Report to Pacific Marine Fisheries Commission. 14:60-73.

Pickard, A., A. Grover, and F. Hall. 1982. An evaluation of predator composition at three locations on the Sacramento River. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report No. 2. 20 pages.

Platts, W. S., M. A. Shirazi, and D. H. Lewis. 1979. Sediment particle sizes used by salmon for spawning, and methods for evaluation. EPA-600/3-79-043, 32 pp. Corvallis Environ. Res. Lab., Corvallis, Oregon.

Rand, G.M., P.G. Wells, and L.S. McCarty. 1995. Introduction to aquatic toxicology. *In* G.M. Rand (editor), Fundamentals of aquatic toxicology: effects, environmental fate, and risk assessment, second edition, pages 3-66. Taylor and Francis. Bristol, Pennsylvania.

Rasmussen, B. 1967. The Effect of Underwater Explosions on Marine Life. Bergen, Norway. 17 pp.

Reynolds, F.L., T.J. Mills, R. Benthin, and A. Low. 1993. Restoring Central Valley streams: a plan for action. California Department of Fish and Game, Inland Fisheries Division, Sacramento.

Robison, G.E., and Beschta, R.L. 1990. Identifying trees in riparian areas that can provide coarse woody debris to streams. Forest Service 36:790-801.

San Joaquin River Group Authority. 2007. 2006 Annual Technical Report: On implementation and monitoring of the San Joaquin River Agreement and the Vernalis Adaptive Management Plan. January. 137 pages.

Schaffter, R. 1980. Fish occurrence, size, and distribution in the Sacramento River near Hood, California during 1973 and 1974. California Department of Fish and Game.

Schaffter, R. 1997. White sturgeon spawning migrations and location of spawning habitat in the Sacramento River, California. California Department of Fish and Game 83:1-20.

Schmetterling, D.A., C.G. Clancy, and T.M. Brandt. 2001. Effects of riprap bank reinforcement on stream salmonids in the Western United States. Fisheries 26:8-13.

Shapovalov, L. and A.C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri)* and silver salmon (*Oncorhynchus kisutch*) with special reference to Waddell Creek, California, and recommendations regarding their management. California Department of Fish and Game, Fish Bulletin 98, 375 pages.

Slater, D.W. 1963. Winter-run Chinook salmon in the Sacramento River, California, with notes on water temperature requirements at spawning. U.S. Fish and Wildlife Service, Special Science Report Fisheries 461:9.

Snider, B., and R.G. Titus. 2000. Timing, composition, and abundance of juvenile anadromous salmonid emigration in the Sacramento River near Knights Landing, October 1996-September 1997. California Department of Fish and Game, Habitat Conservation Division, Stream Evaluation Program Technical Report No. 00-04.

Sommer, T.R., Harrell, W.C., and Nobriga, M.I. 2005. Habitat use and stranding risk of juvenile Chinook salmon on a seasonal floodplain. North American Journal of Fisheries Management. 25: 1493-1504.

S.P. Crammer and Associates, Inc. 2000. Stanislaus River data report. Oakdale CA.

S.P. Crammer and Associates, Inc. 2001. Stanislaus River data report. Oakdale CA.

Speegle, J. 2008. Personal Communication. Fishery Biologist (Data Manager). US Fish and Wildlife Service. Stockton, California. August 8.

Spence, B., G. Lomnicky, R. Hughes, and R. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. Technical Environmental Research Services Corp., Corvallis, Oregon.

Stephenson, A.E. and D.E. Fast. 2005. Monitoring and evaluation of avian predation on juvenile salmonids on the Yakima River, Washington. Annual Report 2004. March 2005.

Stevens, D.E. 1961. Food habits of striped bass, *Roccus saxatilis* (Walbaum) in the Rio Vista area of Sacramento River. Master's Thesis. University of California. Berkeley, California.

Stachowicz, J. J., J. R. Terwin, R. B. Whitlatch, and R. W. Osman. 2002. Linking climate change and biological invasions: Ocean warming facilitates non-indigenous species invasions. PNAS, November 26, 2002. 99:15497–15500.

Stillwater Sciences. 2000. Avoidance Behavior of Juvenile Chinook at a Rotary Screw Trap. 178 MB movie at http://www.delta.dfg.ca.gov/afrp/documents/highlights.mov

Stillwater Sciences. 2002. Merced River corridor restoration plan. Stillwater Sciences, Berkeley, California. 245 pages.

Stillwater Sciences. 2006. Biological Assessment for five critical erosion sites, river miles: 26.9 left, 34.5 right, 72.2 right, 99.3 right, and 123.5 left. Sacramento River Bank Protection Project. May 12, 2006.

Sweeney, B.W., Bott, T.L., Jackson, J.K., Kaplan, L.A., Newbold, J.D., Standley, L.J., Hession, W.C., and R.J. Horwitz. 2004. Riparian deforestation, stream narrowing, and loss of stream ecosystem services. National Academy of Sciences 101:14132-14137.

Tillman, T.L., G.W. Edwards, and K.A.F. Urquhart. 1996. Adult salmon migration during the various operational phases of Suisun Marsh Salinity Control Gates in Montezuma Slough: August-October 1993. Agreement to California Department of Water Resources, Ecological Services Office by California Department of Fish and Game, Bay-Delta and Special Water Projects Division, 25 pages.

United States Department of Interior. 1999. Final Programmatic Environmental Impact Statement for the Central Valley Project Improvement Act. October 1999. Technical Appendix, 10 volumes.

United States Environmental Protection Agency. 1994. Methods for measuring the toxicity and bioaccumulation of sediment associated contaminants with freshwater invertebrates. EPA 600-R-94-024. Duluth, Minnesota.

United States Fish and Wildlife Service. 1995. Sacramento-San Joaquin Delta Native Fishes Recovery Plan. Portland, Oregon.

United States Fish and Wildlife Service. 2000. Impacts of riprapping to ecosystem functioning, lower Sacramento River, California. U.S. Fish and Wildlife Service, Sacramento Field Office, Sacramento, California. Prepared for US Army Corps of Engineers, Sacramento District.

United States Geological Survey (USGS). 1976. Escalon quadrangle, California [map]. Photorevised. 1976. 1:24,000. 7.5-Minute Series. Reston, VA: United States Department of the Interior.

Van Rheenen, N.T., A.W. Wood, R.N. Palmer, D.P. Lettenmaier. 2004. Potential implications of PCM climate change scenarios for Sacramento-San Joaquin river basin hydrology and water resources. Climate Change 62:257-281.

Vogel, D.A., K.R. Marine, and J.G. Smith. 1988. Fish passage action program for Red Bluff Diversion Dam. Final report on fishery investigations. Report No. FR1/FAO-88-19. U.S. Fish and Wildlife Service, Northern Central Valley Fishery Resource Office. Red Bluff, CA.

Waples, R.S. 1991. Pacific Salmon, *Oncorhynchus spp*., and the definition of "species" under the Endangered Species Act. Marine Fisheries Review 53:11-21.

Waters, T.F. 1995. Sediment in streams: sources, biological effects, and control. American Fisheries Society Monograph 7.

Williams, J.G. 2006. Central Valley salmon: a perspective on Chinook and steelhead in the Central Valley of California. San Francisco Estuary and Watershed Science 4(3): Article 2. 416 pages. Available at: http://repositories.cdlib.org/jmie/sfews/vol4/iss3/art2.

Wright, D.A., and D.J. Phillips. 1988. Chesapeake and San Francisco Bays: A study in contrasts and parallels. Marine Pollution Bulletin 19 (9): 405-413.

Yoshiyama, R.M., E.R. Gerstung, F.W. Fisher, and P.B. Moyle. 1996. Historical and present distribution of Chinook salmon in the Central Valley Drainage of California. *In* Sierra Nevada Ecosystem Project, Final Report to Congress, Volume III. Assessments, Commissioned Reports, and Background Information. Centers for Water and Wildland Resources, University of California. Davis, California.

Zimmerman, C.E., G.W. Edwards, and K. Perry. 2008. Maternal origin and migratory history of *Oncorhynchus mykiss* captured in rivers of the Central Valley, California. Final Report prepared for the California Department of Fish and Game. Contract P0385300. 54 pages.

A.Federal Register Notices Cited

Volume 63 pages 13347-13371. March 19, 1998. National Marine Fisheries Service. Final Rule: Endangered and Threatened Species: Threatened Status for Two ESUs of Steelhead in Washington, Oregon, and California.

Volume 69 pages 33102-33179. June 14, 2004. Endangered and Threatened Species: Proposed Listing Determinations for 27 ESUs of West Coast Salmonids; Proposed Rule

Volume 70 pages 37160-37204. June 28, 2005. National Marine Fisheries Service. Final Listing Determinations for 16 ESUs of West Coast Salmon, and Final 4(d) Protective Regulations for Threatened Salmonid ESUs.

Volume 70 pages 52488-52627. September 2, 2005. Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California; Final Rule

Volume 71 pages 834-862. January 5, 2006. Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead; Final Rule

Volume 76 page 74386. December 6, 2011. Endangered and Threatened Species; 5-YearReviews for 4 Distinct Population Segments of Steelhead in California.

Enclosure 2

<u>Magnuson-Stevens Fishery Conservation and Management Act</u>

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended (16 U.S.C. § 1801 et seq.), requires that Essential Fish Habitat (EFH) be identified and described 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, permit, or carry out that may adversely affect EFH. NMFS is required to provide EFH conservation and enhancement recommendations to the Federal action agencies.

EFH is defined as those waters and 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 of the Stanislaus River, McHenry Avenue Corridor Improvement project is within the area 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 includes waters currently or historically accessible to salmon within the Central Valley ecosystem as described in Myers et al. (1998). Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley (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. However, this project is located on the Stanislaus River, where Sacramento River winter-run Chinook are not and have not been present historically; thus EFH will be discussed for only habitat utilized by CV spring-run Chinook salmon and CV fall-/late fall-run Chinook salmon.

Factors limiting salmon populations in the Stanislaus River include periodic reversed flows due to high water exports (drawing juveniles into large diversion pumps), loss of fish into unscreened agricultural diversions, predation by introduced species, and reduction in the quality and quantity of rearing habitat due to channelization, pollution, rip-rapping, *etc*. (Dettman *et al.*1987; California Resources Agency 1989).

A. Life History and Habitat Requirements

1. Pacific Salmon

General life history information for CV fall-run Chinook salmon is summarized below. Further detailed information on the other CV Chinook salmon evolutionarily significant units (ESUs) are available in the enclosed biological opinion, 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 (63 FR 11482).

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 spawning generally occurs in clean loose gravel in swift, relatively shallow riffles or along the edges of fast runs (NMFS 1997).

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. These smolts generally spend a very short time in the Delta and estuary before entry into the ocean. Whether entering the Delta or estuary as fry or larger juveniles, CV Chinook salmon depend on passage through the Delta for access to the ocean.

II. PROPOSED ACTION

Caltrans, in cooperation with San Joaquin County and Stanislaus County, proposes to widen and improve McHenry Avenue from 200 feet south of Jones Road in San Joaquin County to 1,700 feet south of East River Road in Stanislaus County. There are two bridges and one major intersection within this 1.1-mile-long segment of McHenry Avenue. Caltrans also proposes to replace the bridge on McHenry Avenue over the Stanislaus River to accommodate proposed roadway improvements. In addition, Caltrans proposes to replace the South San Joaquin Irrigation District Bridge on McHenry Avenue over the South San Joaquin Irrigation District/Oakdale Irrigation District Main Canal to accommodate proposed roadway improvements.

III. EFFECTS OF THE PROPOSED ACTION

The effects of the proposed action is described in detail on salmonid habitat are described at length in *Effects of the Action* of the preceding biological opinion, and generally are expected to apply to Pacific salmon EFH.

Effects to EFH stemming from construction activities that may contribute sediment and increase turbidity will be avoided or minimized by meeting Regional Water Quality Board objectives, Caltrans water pollution specifications, implementing applicable BMPs, staging equipment outside of the riparian corridor, limiting the amount of riparian vegetation removal, and replacing (if any) lost riparian vegetation at the project site.

EFH will be adversely affected by the disturbance of up to 0.45 acres of riparian vegetation as a result of construction activities. The majority of these impacts are expected to be temporary, as all disturbed areas outside the actual footprint of the new bridge would be restored to preconstruction conditions and any areas of disturbed vegetation would be replanted with native riparian vegetation. Additionally, all disturbed riparian areas will have the vegetation cut at ground level to encourage re-sprouting.

These effects to EFH may result in a temporary redistribution of some individuals, primarily migrating and rearing juvenile salmonids, but, due to the temporary nature of these disturbances, the adverse effects that are anticipated to result from the proposed project are not of the type, duration, or magnitude that would be expected to adversely modify EFH to the extent that it could lead to an appreciable reduction in the function and conservation role of the affected habitat. NMFS expects that nearly all of the adverse effects to EFH from this project will be of a short term nature and will not affect any associated Pacific salmon EFH beyond the construction period of the project.

IV. CONCLUSION

Based on our review of the material provided, and the best scientific and commercial information currently available, NMFS has determined that the proposed action would adversely affect EFH for Pacific salmon. However, the proposed action includes adequate measures (described in Enclosure 1 above) to avoid, minimize, or otherwise offset the adverse effects to EFH.

V. EFH CONSERVATION RECOMMENDATIONS

Considering that the habitat requirements of fall-run within the action area are similar to the Federally listed species addressed in the preceding biological opinion, NMFS recommends that Terms and Conditions 1-4, as well as the Conservation Recommendations in the preceding biological opinion prepared for the California Central Valley steelhead ESU be adopted as EFH Conservation Recommendations.

Those terms and conditions which require the submittal of reports and status updates can be disregarded for the purposes of this EFH consultation as there is no need to duplicate those submittals.

VI. STATUTORY REQUIREMENTS

Section 305 (b) 4(B) of the MSA requires that the Federal lead agency provide NMFS with a detailed written response within 30 days, and 10 days in advance of any action, to the EFH conservation recommendations, including a description of measures adopted by the lead agency for avoiding, minimizing, or mitigating the impact of the project on EFH (50 CFR '600.920[j]). In the case of a response that is inconsistent with our recommendations, the lead agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreement with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

VII. SUPPLEMENTAL CONSULTATION

Pursuant to 50 CFR 600.920(l), Caltrans 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.

VIII. LITERATURE CITED

Healey, M.C. 1991. Life history of Chinook salmon. *In* C. Groot and L. Margolis: Pacific Salmon Life Histories. University of British Columbia Press.

Kjelson, M.A., P.F. Raquel, and F.W. Fisher. 1982. Life history of fall-run juvenile Chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento-San Joaquin estuary, California, pages 393-411. *In* V.S. Kennedy (Editor), Estuarine Comparisons. Academic Press, New York, New York.

Lister, D.B., and H.S. Genoe. 1970. Stream habitat utilization by cohabiting under yearlings of (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) salmon in the Big Qualicum River, British Columbia. Journal of the Fishery Resources Board of Canada 27: 1215-1224.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-35, 443 pages.

National Marine Fisheries Service. 1997. Proposed recovery plan for the Sacramento River winter-run Chinook salmon. National Marine Fisheries Service, Southwest Region, Long Beach, California, 288 pages plus appendices.

Pacific Fishery Management Council. 1999. Description and identification of essential fish habitat, adverse impacts and recommended conservation measures for salmon. Amendment 14 to the Pacific Coast Salmon Plan, Appendix A. Pacific Fisheries Management Council, Portland, Oregon.

Reynolds, F.L., T.J. Mills, R. Benthin, and A. Low. 1993. Restoring Central Valley Streams: A Plan for Action. California Department of Fish and Game. Inland Fisheries Division.

U.S. Fish and Wildlife Service. 1998. Central Valley Project Improvement Act tributary production enhancement report. Draft report to Congress on the feasibility, cost, and desirability of implementing measures pursuant to subsections 3406(e)(3) and (e)(6) of the Central Valley Project Improvement Act. U.S. Fish and Wildlife Service, Central Valley Fish and Wildlife Restoration Program Office, Sacramento, California.

Federal Register Notices Cited

Volume 63 pages 11482-11520. March 9, 1998. Endangered and Threatened Species: Proposed Endangered Status for Two Chinook Salmon ESUs and Proposed Chinook Salmon ESUs; Proposed Redefinition, Threatened Status, and Revision of Critical Habitat for One Chinook Salmon ESU; Proposed Designation of Chinook Salmon Critical Habitat in California, Oregon, Washington, Idaho.