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

In response refer to:
2007/05277

MAR 26 2008

Mr. Tom Cavanaugh
U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

Dear Mr. Cavanaugh:

This document transmits NOAA's National Marine Fisheries Service's (NMFS) biological opinion (Enclosure 1) based on our review of the proposed Clear Creek Wastewater Treatment Plant Upgrade and Expansion Project in Shasta County, California, and its effects on Federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), threatened Central Valley steelhead (*O. mykiss*), their designated critical habitat; and the southern Distinct Population Segment of North American green sturgeon (*Acipenser medirostris*), in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your August 9, 2007, request for formal consultation was received on August 13, 2007. Formal consultation was initiated on August 13, 2007.

This biological opinion is based on information provided in the May 2007 Biological Assessment and discussions held at meetings with representatives of NMFS, the City of Redding, CH2M Hill, and North State Resources, Inc. A complete administrative record of this consultation is on file at the NMFS Sacramento Area Office.

Based on the best available scientific and commercial information, the biological opinion concludes that the proposed Clear Creek Wastewater Treatment Plant Upgrade and Expansion project may adversely affect listed species, but that the proposed project will not jeopardize the continued existence of the listed species or adversely modify their respective critical habitat. NMFS has included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to minimize incidental take associated with the Clear Creek Wastewater Treatment Plant Upgrade and Expansion project.

Also enclosed are Essential Fish Habitat (EFH) conservation recommendations for Pacific salmon as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended (16 U.S.C. 1801 *et seq.*; Enclosure 2). This document concludes that the Clear Creek Wastewater Treatment Plant Upgrade and Expansion Project will adversely affect the EFH of Pacific Salmon in the action area and adopts a subset of the terms and conditions of the incidental take statement and the ESA conservation recommendations of the biological opinion as the EFH conservation recommendations.

Section 305(b)4(B) of the MSA requires the Corps to 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 Corps 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 Corps must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

Please contact Douglas Hampton at (916) 930-3610, or via email at Douglas.Hampton@noaa.gov, if you have any questions or require additional information concerning this correspondence.

Sincerely,

for Rodney R. McInnis
Regional Administrator

Enclosures (2)

cc: Copy to file – ARN #151422SWR2007SA00097
NMFS-PRD, Long Beach, California

Enclosure 1

BIOLOGICAL OPINION

ACTION AGENCY: U.S. Army Corps of Engineers

ACTIVITY: Clear Creek Wastewater Treatment Plant Upgrade and Expansion Project

CONSULTATION CONDUCTED BY: NOAA's National Marine Fisheries Service

DATE ISSUED: March 26, 2008

I. CONSULTATION HISTORY

- NOAA's National Marine Fisheries Service (NMFS), Sacramento, California, was contacted on October 12, 2006, by North State Resources, Inc. (NSR), on behalf of the City of Redding (City), to obtain background information on management and recovery issues for Federal special-status fish species inhabiting the upper Sacramento River.

- On December 29, 2006, NMFS received a copy of the December 2006 *Draft Clear Creek Wastewater Treatment Plant Upgrade and Expansion Project Biological Assessment and Essential Fish Habitat Assessment* from NSR, for informal review and comment.

- On May 12, 2007, NMFS received a copy of the December 2006 public draft *Initial Study and Proposed Mitigated Negative Declaration* on the Project, from the City of Redding Transportation and Engineering Department.

- In a letter dated March 15, 2007, and received on March 23, 2007, NSR provided NMFS with an updated project description concerning the proposed disinfection system improvements. The City of Redding removed the proposed ultraviolet (UV) disinfection system from the current plant upgrade and expansion, and alternatively proposed to upgrade and expand the existing disinfection-by-chlorine system.

- On August 1, 2007, NMFS met with representatives from the City of Redding, CH2M Hill, North State Resources, Inc., and visited the site of the proposed Clear Creek Wastewater Treatment Plant outfall and diffuser.

- In a letter dated August 9, 2007, and received by NMFS on August 13, 2007, the U.S. Army Corps of Engineers (Corps) requested initiation of consultation under Section 7 of the Endangered Species Act with NMFS, on the City of Redding Clear Creek Wastewater Treatment Plant Upgrade and Expansion Project.

- On August 13, 2007, NMFS received a construction description for the WWTP outfall diffuser from CH2M HILL, a consultant for the proposed project. CH2M Hill also proposed a new, earlier in-water work window starting date for consideration.

- On January 11, 2008, NMFS conferenced with representatives from the City of Redding, the California Regional Water Quality Control Board, the California Department of Fish and Game, CH2M HILL, and North State Resources, for the purpose of discussing comments on a revised project description. The description was finalized at the conclusion of the meeting.

II. DESCRIPTION OF THE PROPOSED ACTION

The Clear Creek Wastewater Treatment Plant (CCWTP) is located at 2200 Metz Road, east of Highway 273 and south of Clear Creek, at the southern city limits of Redding, California. The proposed project site is at Sacramento River Mile (RM) 288.8, near the CCWTP outfall. The CCWTP was first built in 1966, and later upgraded in 1977; it currently receives wastewater flows from 75 percent of the households and businesses (approximately 65,000 people) in the Redding area. The City of Redding (City) proposes to rehabilitate existing facilities and expand the treatment capacity of the CCWTP to accommodate anticipated growth outlined in the 2000-2020 General Plan and anticipated future wastewater flows by the year 2025.

The proposed project upgrades will include improvements to existing deficiencies and replacement of aging equipment, and will accommodate additional capacity for the average dry-weather flow (ADWF) from May through October, and peak wet-weather flow (PWWF) from November through April. Total ADWF and PWWF capacity would be increased from 8.8 to 9.4 million gallons per day (mgd) and from 16.2 to 40 mgd, respectively. Additional goals of the proposed project include the prevention of wastewater seepage, enhancement of treatment and disposal options, improved odor control, improved CCWTP energy efficiency, upgrades to employee facilities, and provision of consistent and safe operations. The proposed project will be funded through the State Revolving Fund (SRF) loan program.

A. Project Operation Overview

The CCWTP treats and disposes nearly 8 mgd of wastewater during dry weather, and treats or stores for later treatment up to 45 mgd during wet weather. Wastewater entering the CCWTP is pumped to the headworks via Influent Pump Stations 1 and 2. At the headworks, bar screens (large metal racks) remove trash, sticks, plastic materials, rags, and other debris, to prevent damage to equipment used in the treatment process. Influent Pump Station No. 1 is located approximately 80 feet southeast of Influent Pump Station No. 2, and is adjacent to the confluence of Clear Creek and the Sacramento River. Pump Station No. 1 contains four pumps. The existing headworks are located adjacent to the grit chamber and grit and screenings building.

1. *Wastewater Treatment*

The CCWTP is a tertiary treatment plant (*i.e.*, having three levels of treatment in place to separate, treat, and filter wastewater and contaminants).

- *Primary Treatment* involves primary clarifiers which facilitate the removal of heavy, sinking sludge, and floating scum which is skimmed off the top. Both types of materials are pumped to the solids treatment process.

- *Secondary Treatment* involves the use of aeration basins and mixers to create a natural environment where microorganisms feed upon the remaining organic materials and nutrients in the wastewater. In the secondary clarifiers, microorganisms settle to the bottom allowing clear effluent to flow to the filters. Some of the settled microorganisms are recycled back to the aeration basins and the remainder are wasted from the process and treated.

- *Tertiary Treatment* involves filters and disinfection processes. Wastewater is filtered through sand and crushed coal to remove small particles. These particles are periodically flushed from the filters and sent to the solids treatment process. In the disinfection stage, water leaves the filters and enters the chlorine contact basin where chlorine is added to the water to kill bacteria and viruses. Sulfur dioxide is then added to neutralize the remaining chlorine before the treated water is discharged into the Sacramento River through the 30-inch outfall diffuser from the existing outfall building at RM 288.8.

2. *Solids Processing*

Sludge is produced and collected in the treatment process, and converted to stabilized "biosolids" through various means. Large tanks that use microorganisms to "digest" or "biodegrade" the solids convert them to byproducts such as methane gas, which can be burned to produce energy. Once digested, dewatering equipment is used to separate excess water from the biosolids and reduce volume. Biosolids are then spread out to dry before being transported for disposal.

3. *Treatment Ponds*

The CCWTP has five treatment ponds, all 8-foot deep, which are utilized at various points in the overall treatment process:

- Pond 1 is a wet weather equalization basin, approximately 10-acres in size with a storage capacity of 18.5 million gallons.

- Pond 2 is 8.6 acres in size, and is used for wet weather storage in times of high inflow.

- Pond 3 is comprised of two facultative sludge lagoons (Ponds 3A and 3B) that are used to store and treat biosolids. Ponds 3a and 3B are each approximately 9.7 acres in size, and have 15-hp floating brush aerators which are used to reduce odor from the ponds.

- Pond 4 is used for wet weather storage in times of high inflow, and is 8.7 acres in size.
- Pond 5 is an existing 9-acre wet weather storage and sludge-drying pond.

B. Project Activities

The proposed project will be implemented in construction sub-phases, with all sub-phases anticipated to be completed by April 2012. A Categorical Exemption Document was prepared for implementation of the first sub-phase, which was completed in April 2006. The proposed construction for each remaining project feature and facility will be implemented in sub-phases two through eight (Table 1). Sub-phase 4 is the only sub-phase that involves instream work, and thus will have direct effects on listed anadromous fish. Details of Sub-phase 4 are provided below. Details of the other sub-phases may be found in the May 2007 biological assessment, entitled the *City of Redding Clear Creek Wastewater Treatment Plan Upgrade and Expansion Project Biological Assessment/Essential Fish Habitat Assessment* (North State Resources 2007).

1. Sub-phase 4

Sub-phase 4 involves in-river construction, and will require the Contractor to move large equipment into the river channel to excavate the river bottom and install the new outfall diffusers.

a. *In-river Access*

A temporary trestle will be constructed using diesel-hammer-driven steel H-pile supports to allow equipment to work above the river channel. Deck platform materials will be placed at a sufficient elevation to clear the maximum anticipated river flows during construction. This temporary work bridge/trestle will not be continuous across the river. The flow channel northeast of the island will always remain unobstructed to allow safe passage to fish and boating traffic. Warning signs and buoys will be placed up and downstream to warn boaters of the obstruction. The trestle would be approximately 30 feet wide and up to 300 feet long. If the contractor is required to halt construction because of high river flows, the work trestle will remain in place. If high river flows persist, and a second work season is necessary, the trestle will remain in the river during the interim until the next allowable work season begins.

b. *Turbidity Management*

Upstream Turbidity Control. After the trestle is in place, the contractor will choose to install either a sheet pile wall or a "supersak" barrier upstream of the in-river work zone to create a quiescent pool to control turbidity. A supersak is a bag made of durable plastic, weighted down by its contents which may include sand, rocks, or as proposed for the project, spawning gravel. The supersak would be supported by banding material by which it can be secured and placed. If the supersak barrier is chosen, it will be put in place using a non-invasive method (i.e. by helicopter or a crane from a barge). After the supersak barrier is dismantled, its contents will remain in-river as fish spawning substrate to be distributed by river flow.

If sheet piles are the chosen method of turbidity control, they will be placed immediately upstream of the new diffuser outfall location and driven into the substrate by a vibratory hammer. If the contractor chooses the supersak alternative, they will be placed approximately 1,100 feet upstream of the new diffuser following the natural riffle that exists from the right bank toward the island.

If either the sheet pile or supersak alternative extends the full width of construction, the contractor may work in the river channel at flow rates up to 10,000 cubic feet per second (cfs). At flow rates greater than 10,000 cfs, the supersaks must be removed. If a sheet pile is used, the contractor must remove one-half of the full sheet pile wall. At flows between 10,000 and 20,000 cfs, the phased sheet pile options (up to 50% of the work flow area) are acceptable construction techniques as described in the river modeling technical memorandum (North State Resources 2007). At flows greater than 20,000 cfs, the contractor will remove all sheet piles and supersaks from the river.

Downstream Turbidity Control. A downstream turbidity barrier is not required for the project unless downstream turbidity levels exceed the allowable limits (see below). At that point, the contractor will be required to install downstream turbidity control measures or otherwise modify his operations to achieve water quality criteria compliance. Construction activities will not be allowed to entrap fish in the work zone. If the entire area should be enclosed, a fish rescue will be performed. A reasonable opening in the downstream turbidity control barrier must be maintained at all times to allow fish to move out of the work area.

Turbidity Monitoring. Turbidity will be monitored any time that in-river work is occurring. Once the contractor begins to excavate the river bottom, upstream turbidity will be monitored and recorded once daily to provide background level. Upstream turbidity may be monitored by standard grab sample taken from the riverbank.
Downstream turbidity will be monitored and recorded every hour. Downstream monitoring will be performed at the following locations:

- Monitoring Point #1: located 300 ft downstream of the new dry weather diffuser, sampled 100 feet from the right bank.

- Monitoring Point #2: located 1000 ft downstream of the new dry weather diffuser, sampled 150 feet from the right bank.

Downstream turbidity samples from both locations will be averaged over the 24-hour period and the average turbidity level will be compared with upstream grab sample data. Data from monitoring Point #2 will be compared to the background turbidity to determine the turbidity increase. Turbidity caused by in-river work activity will be maintained below permitted levels specified by the Central Valley Regional Water Quality Control Board (RWQCB).

c. *Diffuser Installation*

Open trench construction will be used to install both the wet and dry weather diffusers into the river bottom. A trench will be excavated to approximately 10 feet deep for each 42-inch-diameter diffuser. Each diffuser pipeline will be lowered into the trench, attached to driven H-piles and then backfilled. The diffusers will be installed so that the crown of the steel pipe is buried five feet beneath the riverbed with only the risers extending into the main river flow. Trench spoils will be stored temporarily in one of the existing unused drying beds/ponds onsite near the sheet pile wall until needed for backfill. A barge can be used to facilitate moving equipment and materials through the project area. Table 2 summarizes the updated pile driving considerations.

- A proposed 54-inch outfall underground pipeline with a span of 3,000 feet between the disinfection system and the diffuser, with help achieve a maximum hydraulic throughput of 60 mgd to support the project wet weather flows. The pipeline will be aligned parallel to the existing 42-inch outfall pipeline and approximately 40 feet west of the centerline of the dike road on the east side of the existing ponds. Flows from existing and proposed outfall pipelines will be combined through a "Y" connection, or within a new outfall building, and continue towards the river diffuser. The pipeline will be constructed using an open-trench method and will require approximately 9 feet of excavation for installation and engineered fill material to achieve the required cover. The pipeline excavation trench will be dewatered as needed, using sump pumps that will discharge the water into one of the existing storage ponds at the CCWTP. Excavated material will also be stored in one of the existing storage ponds until it is used to backfill the excavation. Construction traffic will use Road A on the south side of the main treatment facilities and the North Access Road to be constructed during Sub-phase 2. Disturbed areas will be backfilled with native soil and engineered backfill.

- The chosen diffuser design replaces the existing diffuser with a new multiport diffuser and also a wet weather three-port discharge system (pipeline and diffuser). The new diffuser will have a discharge capacity of 30 mgd and will be buried 5 feet beneath the river bed with only the risers extending into the main river flow. Risers will be either steel or rubber reducing elbows discharging downstream. Rubber check valves will aid in dilution and restrict debris from entering the diffuser manifold. The new 42-inch steel dry-weather diffuser pipe will extend 250 feet into the Sacramento River, perpendicular to the flow, with 18 diffuser ports on risers that will extend from the riverbed into the main river flow. The wet weather discharge will extend up to 100 feet in to the river and will be located 100 feet downstream of the existing diffuser manifold.

The existing outfall pipeline, outfall building, and diffuser will remain in service during in-river construction. The remainder of the trench will be excavated using an excavator either floating on a secured barge or located on a temporary work trestle in the river. Trench spoils will be temporarily placed on a barge or in one of the existing unused drying beds nearest to the trenching activities. After trench completion, steel anchor piles will be driven using a crane floating on a barge. The diffusion pipe and diffuser will be constructed onshore and then sunk into place and secured to the piles. Clean, washed spawning gravel will be imported to backfill over the diffuser, or the gravel previously removed during excavation may be washed and cleaned and used to backfill the excavation. The section of the pipe and diffuser that will be located within the riverbed will be buried approximately 5 feet deep from the crown of the pipe to the river bottom and supported by driven H-piles.

Table 1. Tentative Construction Schedule				
Construction Sub-phase	**Project Element**	**Starting Date**	**Ending Date**	**Duration (months)**
Sub-phase 2	North Access Road	June 2007	August 2007	2
	Facultative Sludge Lagoon (FSL) – Pond 5	June 2007	December 2007	6
	Potable Water Supply	June 2007	September 2007	3
Sub-phase 3	Influent Pump Station 1	July 2007	September 2007	2
	Filter Modifications	July 2007	October 2007	3
	Headworks	July 2007	October 2007	3
	New Dissolved Air Flotation Thickener (DAFT)	July 2007	April 2008	9
	Primary Clarifier Rehabilitation	July 2007	April 2008	9
	Aeration Basin Modifications	July 2007	July 2008	12
	New Secondary Clarifier	July 2007	November 2008	16
	Rehabilitate Existing DAFT	April 2008	September 2008	4.5
	Secondary Clarifier Rehabilitation	November 2008	June 2009	6
Sub-phase 4	Outfall	June 2008	December 2008	6
	Diffuser	June 2008	February 2009	8
	Outfall Building	June 2008	February 2009	8
Sub-phase 5	FSL – Pond 3	July 2009	January 2010	6
	Wet Weather Storage Pond – Pond 1	July 2009	April 2010	9
	Drying Beds – Ponds 2 and 4	July 2009	April 2010	9
Sub-phase 6	Disinfection System Upgrades	July 2009	July 2011	24
Sub-phase 7	Aeration Basin and Blower Building	July 2009	July 2011	24
Sub-phase 8	2-Water Supply	October 2010	January 2011	3
	Administration and Laboratory Building	October 2010	April 2012	18

C. Construction Criteria and Methods

All work will be conducted during daylight hours, defined as one half hour before sunrise to one half hour after sunset as published in the local newspaper. The construction of a new outfall pipe and diffuser (Sub-phase 4) will involve the placement of work equipment in-river to excavate the river bottom and install the new outfall diffusers. Turbidity will be minimized and controlled to the extent feasible at all times while working in-river to minimize water quality impacts. Turbidity thresholds required by the RWQCB will be adhered to during all in-river work activities.

A temporary trestle will be constructed using diesel-hammer-driven steel H-pile supports to allow equipment to work safely above the river channel. Deck platform materials would be placed at a sufficient elevation to clear the maximum anticipated river flows during construction. This temporary work bridge/trestle would not be continuous across the river. The flow channel northeast of the island would always remain unobstructed, thereby allowing safe passage to fish and boating traffic. Warning signs and buoys will be placed upstream and downstream to warn boaters of the obstruction. The trestle would be approximately 30 feet wide and up to 300 feet long. After the trestle is in place, a sheet pile or supersak flow barrier will be installed. If sheet piles are used they will be driven with a vibratory hammer. The flow barrier will be located on the upstream side of the project site and will be constructed in two or more segments between the western bank and the island. The flow barrier will create a quiescent area within the work zone to allow for trenching and turbidity control in a low-flow environment.

Table 2. Pile driving considerations.

	Trestle and Diffuser (H-piles)	Sheet Pile Wall
Driving Method	Diesel hammer	Vibratory Hammer.
Hammer Running Time per Pile	15 minutes per pile (5 piles per pier)	5 minutes per pile (90 piles/sheet pile wall).
Hammer Running Time for each Location	1.25 hours per pier (1 pier per day)	8 hours per day for 3 days.
Number of Locations in River	Seven piers at 30 feet spacing	Two sheet pile walls. Total length of both sheet pile walls will be approximately 300 feet. An open flow channel to the right of the island will be maintained at all times.

Diffuser Installation

After the turbidity barrier is in place, open trench construction will be used to install both wet and dry weather diffusers into the river bottom. Both outfall diffusers are expected to be constructed concurrently. A trench will be excavated approximately 8 feet in depth for each 42-inch-diameter diffuser. Each diffuser pipeline will be lowered into the trench, attached to driven H-piles and then backfilled. The diffusers will be installed so that the crown of the steel pipe is buried 5 feet beneath the riverbed with only the risers extending into the main river flow. Trench spoils can be stored temporarily in one of the existing unused drying beds/ponds onsite near the flow barrier until needed for backfill. A barge can be used to facilitate moving equipment and materials through the project area.

After completion of the trenching, anchor piles (H-piles) will be driven 25 feet in depth by a diesel hammer crane floating on a barge or supported from a temporary work trestle. The new diffuser will require 12 H-piles, and the wet weather discharge pipe will require 3 H-piles.

Existing Diffuser Decommissioning

The existing diffuser will be decommissioned upon operation of the new diffusers. It will be plugged with concrete at the existing outfall building. The structural steel piles would be abandoned in place.

D. Proposed Conservation Measures

Conservation measures have been identified and included in the project in order to avoid or minimize take of the listed anadromous fish species and minimize adverse effects of the proposed project construction activities on designated critical habitat for the listed fish species. These measures include seasonal work windows to avoid impacts to and take of vulnerable life stages of the listed species; erosion and sediment control practices to minimize effects on water quality and salmon spawning habitat; heavy equipment management practices to minimize injury or death of listed fishes; and replacement of riparian aquatic habitat values in the action area.

Due to the nearly year round presence of at least one freshwater life stage of listed fish species, use of seasonal work windows to entirely avoid injury or mortality of the listed anadromous salmonids and North American green sturgeon is not practicable. Therefore, to protect the most fragile and least mobile life stage (*i.e.*, incubating eggs in spawning habitat within the action area), in-water work will be restricted to the period between October 1 and April 15. Similarly, the seasonal work window for pile-driving and other percussive construction work shall also be restricted to the period between October 1 and April 15. This seasonal work window is focused on avoiding harm to incubating winter-run salmon eggs and larvae, and although it overlaps with the tail end of the incubation season for spring-run salmon, most spring-run salmon are expected to have hatched out by this time period.

The work window described above will also protect spawning and rearing North American green sturgeon and avoid percussion related adverse impacts to these fish as well. Adult North American green sturgeon are most abundant in the upper Sacramento River from mid-April to mid-June, with migration upstream of Red Bluff impeded by RBDD after mid-May. The greatest abundance of larval and post-larval green sturgeon in the upper Sacramento River occurs in June and July. However, the extent to which green sturgeon spawn within the vicinity of the proposed project is not known.

To minimize potential injury and mortality of juvenile and adult fish during excavation and placement of fill materials within the active channel, equipment shall be operated slowly and deliberately to alert and scare adult and juvenile fish away from the work area. The contractor shall be instructed that before submerging an excavator bucket, suction dredge cutting-head, or placing fill gravel below the water surface, the excavator bucket or dredge will be operated to "tap" the surface of the water. To avoid impacts to mobile life stages of salmonids and sturgeon that may be present in the water column when backfilling the diffuser pipeline trench, clean gravel fill materials shall be added slowly and deliberately to allow fish to move from the work area.

Construction site management measures to avoid and minimize the potential for adverse effects to the listed anadromous salmonids and green sturgeon shall include the following:

1. Construction site best management practices (BMP's) to control soil erosion and stormwater sediment runoff will be employed during the construction season when rainfall is likely to occur. The contractor will be required to develop a turbidity control plan that will describe the methods to be used to control turbidity in compliance with RWQCB 401 permit requirements.

2. The City will comply with turbidity monitoring and control requirements in the RWQCB 401 permit.

3. Any new or previously excavated gravel material placed in the Sacramento River channel shall meet the Caltrans Gravel Cleanliness Specification #85.

Permanent loss of shaded riverine aquatic (SRA) habitat in the action area is not anticipated. Temporary disturbance or loss of SRA habitat will be replanted at a ratio of 2:1 (new plantings per woody riparian plant destroyed) to compensate for habitat temporarily lost (e.g., areas where vegetation was cleared for installation of the new effluent pipeline). These replanting ratios will help ensure successful establishment of at least one vigorous plant for each plant removed to accommodate the project.

Any construction equipment that would come in contact with the Sacramento River will be inspected daily for leaks prior to entering the flowing channel. External oil, grease, and mud will be removed from equipment using steam cleaning. Untreated wash and rinse water must be adequately treated prior to discharge if that is the desired disposal option. Spill containment booms will be maintained onsite at all times during construction operations and/or staging of equipment or fueling supplies. Fueling trucks will maintain a spill containment boom at all times as well.

E. Project Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For the purposes of this biological opinion, the action area for the proposed project includes the footprint of the proposed construction activity and construction staging and storage areas, as well as the area within 100 feet of these boundaries. The action area also includes the area affected by the construction of the new diffuser pipeline and new multiport diffuser, which includes the entire width of the Sacramento River 2,900 feet downstream, and 2,500 feet upstream of the proposed diffuser alignment at RM 288.8. This designation encompasses the area of potential direct impacts to listed species from pile driving noise and turbidity and streambed excavation turbidity, as well as potential indirect effects associated with construction activities, including increased siltation of downstream spawning sites. The construction action area may be revised should verification of the area affected by pile driving activities expand beyond the current estimate. The action area also includes the area that may be affected by the operation of the refurbished and expanded CCWTP with new multiport diffuser and new diffuser pipeline. This includes all areas directly and indirectly affected by any discharge emanating from the CCWTP diffuser, as well as the underwater physical structure.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

The following listed and proposed threatened and endangered species (Evolutionarily Significant Units (ESU) or Distinct Population Segments (DPS)) and designated critical habitat occur in the action area and may be affected by the proposed Clear Creek Wastewater Treatment Plant Upgrade and Expansion project:

Sacramento River winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
endangered (June 28, 2005, 70 FR 37160)
Sacramento River winter-run Chinook salmon designated critical habitat
(June 16, 1993, 58 FR 33212)
Central Valley spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
threatened (June 28, 2005, 70 FR 37160)
Central Valley spring-run Chinook salmon designated critical habitat
(September 2, 2005, 70 FR 52488)
Central Valley steelhead DPS (*Oncorhynchus mykiss*)
threatened (signed December 22, 2005)
Central Valley steelhead designated critical habitat
(September 2, 2005, 70 FR 52488)
Southern DPS of North American green sturgeon (*Acipenser medirostris*)
threatened (April 7, 2006, 71 FR 17757)

A. Species and Critical Habitat Listing Status

In 2005, NMFS completed an updated status review of 16 salmon Evolutionarily Significant Units (ESU's), including Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon, and concluded the species' status should remain as previously listed (70 FR 37160). On January 5, 2006, NMFS published a final listing determination for ten steelhead Distinct Population Segments (DPS's), including Central Valley steelhead. The new listing determination became effective on February 6, 2006 (71 FR 834), and concludes that Central Valley steelhead will remain listed as threatened. The southern DPS of green sturgeon was listed as threatened (71 FR 17757) on April 7, 2006, effective on July 6, 2006.

1. Sacramento River Winter-Run Chinook Salmon and Critical Habitat

Sacramento River winter-run Chinook salmon originally were listed as threatened in November 1990 (55 FR 46515). Winter-run ESU status was reclassified as endangered, in January 1994 (59 FR 440) due to continuing decline and increased variability of run sizes since their listing as a threatened species, expected weak returns as a result of two small year classes in 1991 and 1993, and continuing threats to the population. Since then, the abundance of the winter-run population has increased significantly, prompting NMFS to include the Sacramento River winter-run ESU in the recent review of 27 West Coast salmonid ESUs (69 FR 33102). After NMFS issued a proposal for reclassification of winter-run status to "threatened," there were several concerns expressed in public comment over the adequacy and benefits of protective efforts noted in NMFS' proposal, suggesting that the true ESU status did not warrant reclassification of the ESU to threatened. Following review and consideration of this information, NMFS made a final decision to retain Sacramento River winter-run Chinook ESU listing status as endangered as described in the final determinations (70 FR 37160).

NMFS designated critical habitat for winter-run Chinook salmon on June 16, 1993 (58 FR 33212). Critical habitat was delineated as the Sacramento River from Keswick Dam, [river mile (RM) 302] to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta (Delta), including Kimball Island, Winter Island, and Brown's Island; all waters from Chipps island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge. The critical habitat designation identifies those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration and protection. Within the Sacramento River this includes the river water, river bottom (including those areas and associated gravel used by winter-run Chinook salmon as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing. In the areas west of Chipps Island, including San Francisco Bay to the Golden Gate Bridge, this designation includes the estuarine water column and essential foraging habitat and food resources utilized by winter-run Chinook salmon as part of their juvenile outmigration or adult spawning migrations.

2. Central Valley Spring-Run Chinook Salmon and Critical Habitat

NMFS listed the Central Valley spring-run Chinook salmon ESU as threatened, on September 16, 1999 (64 FR 50394), and published a final 4(d) rule for this ESU on January 9, 2002 (67 FR 1116). NMFS proposed that the Central Valley spring-run ESU retain its threatened status in the recent status review of West Coast Pacific salmonid ESU's (69 FR 33102), which was finalized in June, 2005 (70 FR 37160). NMFS proposed critical habitat for Central Valley spring-run (69 FR 71880) on December 10, 2004. A final rule designating critical habitat was published on September 2, 2005 (70 FR 52488). The rule became effective on January 2, 2006. Critical habitat was designated for watersheds along the Sacramento-San Joaquin corridor, in the following counties: Tehama, Butte, Glenn, Shasta, Yolo, Sacramento, Solano, Colusa, Yuba, Sutter, Trinity, Alameda, San Joaquin, and Contra Costa. Critical habitat includes the stream channels within the designated stream reaches, and their lateral extent as defined by the ordinary high-water line (33 CFR 329.11) or the bankfull elevation. Critical habitat in estuarine reaches is defined by the perimeter of the water body or the elevation of the extreme high water mark, whichever is greater. Critical habitat includes the primary constituent elements essential for the conservation of the ESU, *i.e.*, those sites and habitat components that support one or more life stages, including: freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine areas; with appropriate water quality and quantity, floodplain connectivity, forage base, natural cover and complexity.

3. Central Valley Steelhead and Critical Habitat

NMFS listed the Central Valley steelhead DPS as threatened on March 19, 1998 (63 FR 13347), and published a final 4(d) rule for Central Valley steelhead on July 10, 2000 (65 FR 42422). The DPS includes all naturally-produced Central Valley steelhead in the Sacramento-San Joaquin River Basins, excluding steelhead from San Francisco and San Pablo Bays and their tributaries. The Coleman National Fish Hatchery and Feather River Hatchery steelhead programs are now part of the Central Valley steelhead DPS (71 FR 834); these populations were previously included in the DPS but were not deemed essential for conservation and thus not part of the listed steelhead population. A final rule designating critical habitat was published on September 2, 2005 (70 FR 52488). Central Valley steelhead critical habitat was designated for watersheds along the Sacramento-San Joaquin corridor, including the following counties: Tehama, Butte, Glenn, Shasta, Yolo, Sacramento, Solano, Yuba, Sutter, Placer, Calaveras, San Joaquin, Stanislaus, Tuolumne, Merced, Alameda, and Contra Costa. Critical habitat includes the stream channels within the designated stream reaches, and their lateral extent as defined by the ordinary high-water line (33 CFR 329.11) or the bankfull elevation. Critical habitat in estuarine reaches is defined by the perimeter of the water body or the elevation of the extreme high water mark, whichever is greater. The PCEs of critical habitat essential for the conservation of the ESU are considered those sites and habitat components that support one or more life stages, including: freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine areas with appropriate water quality and quantity, floodplain connectivity, forage base, natural cover, and complexity.

4. Southern DPS of North American Green Sturgeon

In assessing North American green sturgeon status, NMFS determined that two DPS's exist. The northern DPS is made up of known North American green sturgeon spawning (or single stock populations) in the Rogue, Klamath, and Eel rivers. The southern DPS presently contains only a single spawning population in the Sacramento River (70 FR 17386). NMFS listed the southern DPS of North American green sturgeon as threatened on April 7, 2006 (71 FR 17757), which became effective as of July 6, 2006. The green sturgeon is being studied to depict an accurate life history and range of the species, and critical habitat has not yet been proposed for the southern DPS of green sturgeon. NMFS is also developing specific prohibitions against take of North American green sturgeon through section 4d of the ESA. Until these "4d rules" have been finalized and issued, there are no specific prohibitions against the take of North American green sturgeon under the ESA.

B. Species Life History and Population Dynamics

Pacific salmonids have diversified over time in response to: 1) geographic barriers to gene flow, 2) seasonal and long-term temporal stability, 3) connectivity to other regions permitting faunal interchange, and 4) regional ecologic interactions that sustained complex trophic structure and high diversity (Jacobs *et al.* 2004). Salmon have persisted amid catastrophic and cyclic environmental shifts (volcanic eruptions, tectonic rifts, monsoons, tsunamis, poor ocean productivity, El Nino and La Nina ocean currents, inland drought cycles, flooding, mudslides, *etc.*). Salmon and steelhead are keystone species in freshwater and marine food webs; their eggs, alevin, and fry are important food items for other fish, birds, and aquatic insects (Willson and Halupka 1995). Adult salmon returns sustain many animal groups in various interconnected food chains, and serve as the primary source of prey for some groups, *e.g.*, bears, eagles, mink, otter, sea lions, killer whales, and humans. Adult salmon and steelhead carcasses release accumulated nutrients to sustain productivity of riparian and lacustrine ecosystems for the next generation of salmonid juveniles (Willson and Halupka 1995).

1. <u>Sacramento River Winter-Run Chinook Salmon Status</u>

Winter-run Chinook salmon historically spawned in the headwaters of the McCloud, Pit, and Little Sacramento rivers and Hat and Battle creeks. Construction of Shasta Dam in 1943 and Keswick Dam in 1950 blocked access to all of these waters except Battle Creek, which has several small hydroelectric dams constructed in the early 1900's, blocking access to the suitable winter-run spawning habitat on the creek (Moyle *et al.* 1989, NMFS 1997). Most of the current winter-run Chinook salmon spawning and rearing habitat exists between Keswick Dam and the Red Bluff Diversion Dam (RBDD) in the Sacramento River.

Juvenile winter-run Chinook salmon increase in size and develop osmoregulation ability as they migrate down to the Delta at the confluence of the Sacramento and San Joaquin rivers. Peak winter-run emigration through the Delta generally occurs from January through April, but the range may extend from September up to June (Messersmith 1966; NMFS 1997).

Adult winter-run Chinook salmon enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate past RBDD from mid-December through early August (NMFS 1997). The majority of the run passes RBDD from January through May, and peaks in mid-March (Hallock and Fisher 1985). Generally, winter-run Chinook salmon spawn from near Keswick Dam, downstream to RM 243 near the city of Red Bluff, California. Spawning occurs from late April through mid-August with peak activity between May and June. Eggs and pre-emergent fry require water temperatures at or below 56°F for maximum survival during the spawning and incubation period (USFWS 1999). Fry emerge from mid-June through mid-October and move to river margins to rear. Emigration past RBDD begins in mid-July, typically peaks in September, and can continue through March in dry years (Vogel and Marine 1991, NMFS 1997). Winter-run Chinook salmon continue to rear in non-natal tributary streams to the Sacramento River during their out-migration. From 1995 to 1999, all winter-run Chinook salmon outmigrating as fry passed RBDD by October, and all outmigrating pre-smolts and smolts passed RBDD by March (Martin *et al.* 2001).

Since 1967, the estimated adult winter-run Chinook salmon population ranged from 186 in 1994 to 117,808 in 1969 (CDFG 2002). The estimate declined from an average of 86,000 adults in 1967-1969 to only 2,000 by 1987-1989, and continued declining to an average of 830 fish in 1994-1996. Since then, estimates have increased to an average of 3,136 fish for the period of 1998-2001. Winter-run Chinook salmon abundance estimates and cohort replacement rates since 1986 are shown in Table 3.

Table 3. Winter-run Chinook salmon population estimates from RBDD ladder counts and corresponding cohort replacement rates for years since 1986. Population estimates include both adult and grilse.

Year	Population Estimate	5 Year Moving Average of Population Estimate	Cohort Replacement Rate	5 Year Moving Average of Cohort Replacement Rate
1986	2596	-	0.27	-
1987	2186	-	0.20	-
1988	2885	-	0.07	-
1989	696	-	1.78	-
1990	430	1759	0.90	0.64
1991	211	1282	0.88	0.77
1992	1240	1092	1.05	0.94
1993	387	593	3.45	1.61
1994	186	491	4.73	2.20
1995	1297	664	2.31	2.48
1996	1337	889	2.46	2.80
1997	880	817	1.54	2.90
1998	3002	1340	2.74	2.76
1999	3288	1961	2.26	2.22
2000	1352	1972	6.08	3.02
2001	8224	3349	0.94	2.71
2002	7441	4661	2.11	2.83
2003	8218	5705	2.09	2.70
2004	7701	6587	0.32	2.31
2005	15730	9463	-	-
2006	17153	11249	-	-
2007	2488	10258	-	-

Although the population estimates display broad fluctuation since 1986 (*i.e.*, from 2,596 in 1986 to 186 in 1994 to 8,896 in 2004), there is an increasing trend in the 5-year moving average since 1997 (*i.e.*, from 491 for 1990-1994 to 6,826 for 2000-2004). The 5-year moving average of cohort replacement rates (CRR's) has fluctuated up and down (*e.g.*, the 1994-97-00 cohorts represent 4.73, 1.54, and 6.08 CRR's). The CRR for 2001 cohorts is less than half of the CRR of the 1998 generation (0.94 verses 2.74).

Recent trends in winter-run Chinook salmon abundance and cohort replacement remain positive, indicating some recovery since the listing. However, the population remains well below the recovery goals of the draft recovery plan, and is particularly susceptible to extinction because of the reduction of the merged genetic pool to one population. The ESU includes the naturally spawned population of winter-run Chinook salmon in the Sacramento River, and its hatchery winter-run component at Livingston Stone NFH.

Viable Salmonid Population Summary

Abundance. Redd and carcass surveys, and fish counts, suggest that the abundance of winter-run Chinook salmon has been increasing. The depressed 2007 abundance estimate is an exception to this trend and may represent a new cycle of poor ocean productivity. Population growth is estimated to be positive in the short-term trend at 0.26; however, the long-term trend is negative, averaging -0.14. Recent winter-run Chinook salmon abundance represents only 3 percent of the maximum post-1967, 5-year geometric mean, and is not yet well established (Good *et al.* 2005).

Productivity. ESU productivity has been positive over the short term, and adult escapement and juvenile production have been increasing annually (Good *et al.* 2005). The long-term trend for the ESU remains negative, however, as it consists of only one population that is subject to possible impacts from environmental and artificial conditions. The most recent CRR estimate suggests a reduction in productivity for the 1998-2001 cohorts.

Spatial Structure. The greatest risk factor for winter-run Chinook salmon lies with their spatial structure (Good *et al.* 2005). The remnant population cannot access historical winter-run habitat and must be artificially maintained in the Sacramento River by a regulated, finite cold water pool from Shasta Dam. Winter-run Chinook salmon require cold water temperatures in summer that simulate their upper basin habitat, and they are more likely to be exposed to the impacts of drought in a lower basin environment. Battle Creek remains the most feasible opportunity for the ESU to expand its spatial structure, which currently is limited to the upper 25-mile reach of the mainstem Sacramento River below Keswick Dam.

Diversity. The second highest risk factor for the Sacramento River winter-run Chinook salmon ESU has been the detrimental effects on its diversity. The present winter-run population has resulted from the introgression of several stocks that occurred when Shasta Dam blocked access to the upper watershed. A second genetic bottleneck occurred with the construction of Keswick Dam; there may have been several others within the recent past (Good *et al.* 2005).

2. <u>Central Valley Spring-run Chinook Salmon Status</u>

The Central Valley spring-run Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon (and their progeny) in the Central Valley. The Feather River Hatchery (FRH) spring-run Chinook salmon population has been included as part of the Central Valley spring-run Chinook salmon ESU as of June 28, 2005 (70 FR 37160). Extant spring-run populations in the southern Cascades ecoregion include those in Mill, Deer, and Butte creeks (Good *et al.* 2005). Spring-run populations of the northern Sierra ecoregion are found in the Yuba and Feather rivers. There are also small but relatively consistent populations of spring-run

Chinook salmon found in the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, and Clear Creek (CDFG 1998).

Historically, spring-run Chinook salmon were the dominant run in the Sacramento River basin, occupying the middle and upper elevation reaches (between 1,000 and 6,000 feet) of most streams and rivers with sufficient habitat for over-summering adults (Clark 1929). Clark estimated that there were 6,000 miles of salmon habitat in the Central Valley basin (much of which was high elevation spring-run Chinook salmon habitat) and that by 1928, 80 percent of this habitat had been lost. Yoshiyama *et al.* (1996) determined that, historically, there were approximately 2,000 miles of salmon habitat available prior to dam construction and mining and that only 18 percent of that habitat remains.

Central Valley spring-run Chinook salmon exhibit both ocean-type and stream-type life histories (CDFG 1998). Ocean-type spring-run Chinook salmon may begin outmigrating soon after emergence, whereas stream-type spring-run fish oversummer and emigrate as yearlings with the onset of increased fall storms (CDFG 1998). The emigration period for spring-run Chinook salmon extends from November to early May, with up to 69 percent of young-of-the-year outmigrants passing through the lower Sacramento River between mid-November and early January (Snider and Titus 2000). Outmigrants are also known to rear in non-natal tributaries to the Sacramento River and the Delta (CDFG 1998).

Spring-run Chinook salmon fry and fingerlings can enter the Delta as early as January and as late as June; a cohort's length of residency within the Delta is unknown but probably lessens as the season progresses into the late spring months (CDFG 1998). Shifts in juvenile salmonid abundance demonstrated with various sampling gear reflect discretionary use of the Delta by juvenile salmonids based on their size, age, and degree of smoltification. Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Myers *et al.* 1998). Fisher (1994) reported that 87 percent of Chinook trapped and examined at RBDD between 1985 and 1991 were 3 years old.

Adult spring-run Chinook salmon enter the Delta from the Pacific Ocean beginning in January and enter natal streams from March to July. This run timing is well adapted for gaining access to the upper reaches of river systems (between 1,500 and 5,200 feet in elevation) prior to the onset of high water temperatures and low flows that would inhibit access to these areas during the fall. In Mill Creek, Van Woert (1964) noted that of 18,290 spring-run Chinook salmon observed from 1953 to 1963, 93.5 percent were counted between April 1 and July 14, and 89.3 percent were counted between April 29 and June 30. During their upstream migration, adult Chinook salmon require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows are also necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38°F to 56°F (Bell 1991; CDFG 1998).

Upon entering fresh water, spring-run Chinook salmon are sexually immature and must hold in cold water for several months to mature. Typically, spring-run Chinook salmon utilize mid- to high-elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering. Spring-run Chinook salmon may also utilize tailwaters below dams if cold water releases provide suitable habitat conditions. Chinook salmon are semelparous (*i.e.*, breeds only once in its life history). Spring-run Chinook salmon spawn between September and October and, depending on water temperature, emerge between November and February.

Spring-run Chinook salmon were once the most abundant run of salmon in the Central Valley (Campbell and Moyle 1992), and were found in both the Sacramento and San Joaquin drainages. More than 500,000 spring-run Chinook salmon were caught in the Sacramento-San Joaquin commercial fishery in 1883 alone (Yoshiyama *et al.* 1998). The San Joaquin populations essentially were extirpated by the 1940s, with only small remnants of the run that persisted through the 1950s in the Merced River (Hallock and Van Woert 1959, Yoshiyama *et al.* 1998). Access to historic spawning habitat in the upper Sacramento, Feather, and Yuba rivers was eliminated with the construction of major dams during the1950's and 1960's.

Since 1969, the Central Valley spring-run Chinook salmon ESU has displayed broad fluctuations in abundance, ranging from 1,403 in 1993 to 25,890 in 1982 (CDFG, unpublished data, 2003). The average abundance for the ESU was 12,590 for the period of 1969 to 1979, 13,334 for the period of 1980 to 1990, and 6,554 from 1991 to 2001. Evaluating the abundance of the ESU as a whole, however, complicates trend detection. For example, although spring-run counts from RBDD seem to indicate that the mainstem Sacramento River population has undergone a significant decline, recent counts are not necessarily comparable to the older counts because coded wire tag information gathered from fall-run Chinook salmon returns since the early 1990's indicated that many of the fish classified as spring-run were in fact fall-run. This new information resulted in adjustments to ladder counts at RBDD that have reduced the overall number of fish that are categorized as spring-run Chinook salmon (Colleen Harvey-Arrison, CDFG, pers. comm.).

Sacramento River tributary populations in Mill, Deer, and Butte creeks are probably the best trend indicators for spring-run Chinook salmon abundance. These streams have shown positive escapement trends since 1991, yet recent escapements to Butte Creek, including 20,259 in 1998, 9,605 in 2001 and 8,785 in 2002, are responsible for the majority of tributary abundance (CDFG unpublished data 2002, 2003). The Butte Creek estimates do not include pre-spawning mortality. In the last several years as the Butte Creek population has increased, mortality of adult spawning fish has increased from 21 percent in 2002 to 60 percent in 2003 due to over-crowding and diseases associated with high water temperatures. This trend may indicate that the population in Butte Creek has reached its carrying capacity (Ward *et al.* 2003). Table 4 shows the population trends from the three tributaries since 1986, including the moving 5 year average, cohort replacement rate, and estimated juvenile production (JPE). Although recent tributary production is promising, annual abundance estimates display a high level of fluctuation and the overall number of Central Valley spring-run Chinook salmon remains well below estimates of historic abundance.

Table 4. Spring-run Chinook salmon population estimates from CDFG Grand Tab (February 2005) with corresponding cohort replacement rates for years since 1986.

Year	Deer/Mill/Butte Creek Escapement Run Size	5-Year Moving Average of Population Estimate	Cohort Replaceme nt Rate	5-Year Moving Average Cohort Replacement Rate	NMFS Calculated JPE[a]
1986	24,263	-	-	-	4,396,998
1987	12,675	-	-	-	2,296,993
1988	12,100	-	-	-	2,192,790
1989	7,085	-	0.29	-	1,283,960
1990	5,790	12,383	0.46	-	1,049,277
1991	1,623	7,855	0.13	-	294,124
1992	1,547	5,629	0.22	-	280,351
1993	1,403	3,490	0.24	0.27	254,255
1994	2,546	2,582	1.57	0.52	461,392
1995	9,824	3,389	6.35	1.70	1,780,328
1996	2,701	3,604	1.93	2.06	489,482
1997	1,431	3,581	0.56	2.13	259,329
1998	24,725	8,245	2.52	2.58	4,480,722
1999	6,069	8,950	2.25	2.72	1,099,838
2000	5,457	8,077	3.81	2.21	988,930
2001	13,326	10,202	0.54	1.94	2,414,969
2002	13,218	12,559	2.18	2.26	2,395,397
2003	8,902	9,394	1.63	2.08	1,613,241
2004	9,872	10,155	0.74	1.78	1,789,027
median	7,085	8,077	1.15	2.07	1,283,960

The extent of spring-run Chinook salmon spawning in the mainstem of the upper Sacramento River is unclear. Very few spring-run Chinook salmon redds (less than 15 per year) were observed from 1989-1993, and none in 1994, during aerial redd counts (USFWS 2003). Recently, the number of redds in September has varied from 29 to 105 during 2001 though 2003 depending on the number of survey flights (CDFG, unpublished data). In 2002, based on RBDD ladder counts, 485 spring-run Chinook salmon adults may have spawned in the mainstem Sacramento River, or entered upstream tributaries such as Clear or Battle creeks (CDFG 2004). In 2003, no adult spring-run Chinook salmon were believed to have spawned in the mainstem Sacramento River. Due to geographic overlap of ESU's and suspected hybridization since the construction of Shasta Dam, Chinook salmon that spawn in the mainstem Sacramento River during September are more likely to be identified as early fall-run rather than spring-run Chinook salmon.

The initial factors that led to the decline of Central Valley spring-run Chinook salmon were related to gold mining and the loss of upstream habitat behind impassible dams. Since this initial loss of habitat, other factors have contributed to the decline of Central Valley spring-run Chinook salmon and affected the ESU's ability to recover. These include a combination of physical, biological, and management factors such as climatic variation, water management, hybridization, predation, and harvest (CDFG 1998). Although protective measures likely have led to recent increases in Central Valley spring-run Chinook salmon abundance, the ESU still is below levels observed from the 1960's through 1990. Because threats to the spring-run Chinook salmon ESU continue to persist, and because the ESU is confined to relatively few remaining streams and continues to display broad fluctuations in abundance, the population is at moderate risk of extinction.

Viable Salmonid Population Summary

Abundance. The Central Valley spring-run Chinook salmon ESU has experienced a trend of increasing abundance in some natural populations, most dramatically in the Butte Creek population (Good *et al.* 2005). There has been more opportunistic utilization of migration-dependent streams overall. The FRH spring-run stock has been included in the ESU based on its genetic linkage to the natural population and the potential development of a conservation strategy for the hatchery program.

Productivity. The 5-year geometric mean for the extant Butte, Deer, and Mill Creek spring-run populations ranges from 491 to 4,513 fish (Good *et al.* 2005), indicating increasing productivity over the short-term and projected as likely to continue (Good *et al.* 2005). The productivity of the Feather River and Yuba River populations and contribution to the Central Valley spring-run ESU currently is unknown.

Spatial Structure. Spring-run Chinook salmon presence has been reported more frequently in several upper Central Valley creeks, but the sustainability of these runs is unknown. Butte Creek spring-run cohorts have recently utilized all available habitat in the creek; the population cannot expand further and it is unknown if individuals have opportunistically migrated to other systems. The spatial structure of the spring-run ESU has been reduced with the extirpation of all San Joaquin River basin spring-run populations.

Diversity. The Central Valley spring-run ESU is comprised of two genetic complexes. Analysis of natural and hatchery spring-run Chinook salmon stocks in the Central Valley indicates that the southern Cascades spring-run population complex (Mill, Deer, and Butte creeks) retains genetic integrity. The genetic integrity of the Sierra Nevada spring-run population complex has been somewhat compromised. The Feather River spring-run have introgressed with the fall-run, and it appears that the Yuba River population may have been impacted by FRH fish straying into the Yuba River. Additionally, the diversity of the spring-run ESU has been further reduced with the loss of the San Joaquin River basin spring-run populations.

3. Central Valley Steelhead Status

All identified steelhead stocks in the Central Valley are considered to be winter-run steelhead (McEwan and Jackson 1996). Steelhead are similar to Pacific salmon in their life history requirements. They are propagated in freshwater, emigrate to the ocean, and return to freshwater to spawn. Unlike other Pacific salmon, steelhead are iteroparous (*i.e.*, capable of spawning more than once before they die).

The majority of the Central Valley steelhead spawning migration occurs from October through February, and spawning takes place from December to April in streams with cool, well oxygenated water. Van Woert (1964) and Harvey (1995) observed that in Mill Creek the steelhead migration is continuous, and although there are two peak periods, 60 percent of the run is passed by December 30. Similar bimodal run patterns have also been observed in the Feather River (Ryan Kurth, DWR, pers. comm.), and the American River (John Hannon, Reclamation, pers. comm.), indicating the importance of mainstem tributaries as rearing and refugia habitat for the DPS.

Egg incubation time is dependent upon water temperature. Eggs held between 50°F and 59°F hatch within 3 to 4 weeks (Moyle 1976). Fry usually emerge from redds after about 4 to 6 weeks depending on redd depth, gravel size, siltation, and water temperature (Shapovalov and Taft 1954). Newly emerged fry move to shallow stream margins to escape high water velocities and predation (Barnhart 1986). As fry grow larger they move into riffles and pools and establish feeding locations. Juveniles can rear in freshwater for 1 to 4 years (Meehan and Bjornn 1991) but typically spend 2 years in freshwater, emigrating episodically from natal springs during fall, winter, and spring high flows (Colleen Harvey-Arrison, CDFG, pers. comm.). Adults spend 1 to 4 years at sea before returning to freshwater to spawn as four- or five-year-olds (Moyle 1976).

Hallock *et al.* (1961) found that juvenile steelhead in the Sacramento River basin migrated downstream during most months of the year, but that the peak period of emigration occurred in the spring, with a much smaller peak in the fall. Steelhead smolts show up at the Tracy and Banks pumping plants between December and June. Adult steelhead migrate upstream in the Sacramento River mainstem from July through March, with peaks in September and February (Bailey 1954; Hallock *et al.* 1961). The timing of upstream migration is generally correlated with high flow events (*e.g.*, freshets or sand bar breaches) and associated lower water temperatures.

Steelhead were historically well distributed throughout the Sacramento and San Joaquin rivers (Busby *et al.* 1996). Steelhead were found from the upper Sacramento and Pit River systems, south to the Kings and possibly the Kern River systems, and in both east- and west-side Sacramento River tributaries (Yoshiyama *et al.* 1996). The present distribution has been greatly reduced (McEwan and Jackson 1996). The California Advisory Committee on Salmon and Steelhead (1988) reported a reduction of steelhead habitat from 6,000 miles historically to 300 miles. The California Fish and Wildlife Plan (CDFG 1965) estimated there were 40,000 steelhead in the early 1950's. Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead through the 1960's in the Sacramento River upstream of the Feather River.

Existing wild steelhead stocks in the Central Valley are confined mostly to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill creeks, and the Yuba River. Populations may exist in Big Chico and Butte creeks, and a few wild steelhead are produced in the American and Feather rivers (McEwan and Jackson 1996). Until recently steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected self-sustaining populations of steelhead in the Stanislaus, Mokelumne, Calaveras, 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 (Demko *et al.* 2000). After 3 years of operating a fish counting weir on the Stanislaus River only one adult steelhead has been observed moving upstream, although several large rainbow trout have washed up on the weir in late winter (S.P. Cramer & Associates, Inc. 2004). It is possible that naturally- spawning populations exist in many other streams but are undetected due to lack of monitoring programs (Interagency Ecological Program (IEP) Steelhead Project Work Team 1999).

Reliable estimates of steelhead abundance for different basins are not available (McEwan 2001); monitoring of steelhead populations in the Sacramento River and its tributaries is limited to the direct counts made at Coleman NFH weir and at RBDD, FRH and Nimbus Hatchery. The only consistent data available on steelhead numbers in the San Joaquin River basin come from the California Department of Fish and Game (CDFG) mid-water trawling samples collected on the lower San Joaquin River at Mossdale. These data indicate a decline in steelhead numbers in the early 1990's, which have remained low through 2002 (CDFG 2003). In 2003, a total of 12 steelhead smolts were collected at Mossdale (CDFG, unpublished data). McEwan and Jackson (1996) estimate the total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults. Steelhead counts at the RBDD have declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the 1990's (McEwan and Jackson 1996, McEwan 2001). Trawling data collected in the Sacramento River and at Chipps Island indicate that the vast majority of out-migrating juvenile steelhead are of hatchery origin, with juvenile numbers having decreased overall from the 2001-2002 juvenile estimates (R. Burnester, USFWS, pers. comm.). Nobriga and Cadrett (2003) compared coded wire tagged (CWT) and untagged (wild) steelhead smolt catch ratios at Chipps Island trawl from 1998-2001 to estimate that about 100,000 to 300,000 steelhead juveniles are produced naturally each year in the Central Valley. In the draft *Updated Status Review of West Coast Salmon and Steelhead* (Good *et al.* 2005), the Biological Review Team (BRT) made the following conclusion based on the Chipps Island data:

> "If we make the fairly generous assumptions (in the sense of generating large estimates of spawners) that average fecundity is 5,000 eggs per female, 1 percent of eggs survive to reach Chipps Island, and 181,000 smolts are produced (the 1998-2000 average), about 3,628 female steelhead spawn naturally in the entire Central Valley. This can be compared with McEwan's (2001) estimate of 1 million to 2 million spawners before 1850, and 40,000 spawners in the 1960's".

Both the BRT (Good *et al.* 2005) and the Artificial Propagation Evaluation Workshop (69 FR 33102) concluded that the Central Valley steelhead DPS presently are "in danger of extinction." However, in the proposed status review NMFS concluded that the DPS in-total is "not in danger of extinction, but is likely to become endangered within the foreseeable future" citing predicted benefits of restoration efforts and a yet-to-be-funded monitoring program (69 FR 33102). Steelhead already have been extirpated from most of their historical range in this region. Habitat concerns in this DPS focus on the widespread degradation, destruction, and blockage of freshwater habitat within the region, as well as water allocation problems. Hatchery steelhead production within this DPS also raises concerns about the potential ecological interactions between introduced stocks and native stocks. Because the Central Valley steelhead population has been fragmented into smaller isolated tributaries without any large source population, and the remaining habitat continues to be degraded by water diversions, the population is at high risk of extinction (Good *et al.* 2005).

The factors affecting the survival and recovery of Central Valley steelhead are similar to those affecting Central Valley spring-run Chinook salmon and primarily are associated with habitat loss (McEwan 2001). The future of Central Valley steelhead is uncertain because limited data is available concerning their status. Central Valley steelhead populations generally show a continuing decline, an overall low abundance, and fluctuating return rates (Good *et al.* 2005).

Viable Salmonid Population Summary

Abundance. All indications are that natural Central Valley steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good *et al.* 2005); 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 dominant over 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 nonclipped 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 where found 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 Central Valley 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 Central Valley steelhead DPS.

4. Southern DPS North American Green Sturgeon Status

North American green sturgeon is an anadromous species that generally migrate upstream into fresh water between late February and late July (CDFG 2002). In the Klamath River the water temperature tolerance of immigrating adult North American green sturgeon reportedly ranges from 44.4°F to 60.8°F (6.9°C to 16°C); North American green sturgeon were not found in areas of the river outside this surface water temperature range (USFWS 1995). Mature males range from 139 to 199 centimeters (cm) fork length (FL) and 15 to 30 years of age (Van Eenennaam *et al.* 2001). Mature females range from 157 to 223 cm FL and 17 to 40 years of age. Maximum ages of adult North American green sturgeon are likely to range from 60 to 70 years (Moyle 2002).

Adult North American green sturgeon are thought to spawn every three to five years (70 FR 17386), but new information suggests that spawning could occur as frequently as every two years (Stephen Lindley, NMFS, pers. comm., 2004). North American green sturgeon spawn from March to July, with peak activity between April and June (Moyle *et al.* 1995). Specific spawning habitat preferences are unclear, but eggs are likely broadcast over large cobble where they settle into the cracks (Moyle *et al.* 1995). North American green sturgeon reportedly prefer to spawn in water temperatures ranging from 46.4°F to 57.2°F (8°C to 14°C) (USFWS 1995; Environmental Protection Information Center *et al.* 2001; Moyle 2002). Water temperatures above 68°F (20°C) are reportedly lethal to North American green sturgeon embryos (Cech *et al.* 2000; Beamesderfer and Webb 2002). North American green sturgeon females produce between 60,000 and 140,000 eggs (Moyle *et al.* 1992), and they are the largest eggs (diameter 4.34 mm) of any sturgeon species (Cech *et al.* 2000).

North American green sturgeon larvae hatch roughly 200 hours after spawning (at 54.9°F), and are dissimilar to other sturgeon species in that they lack a distinct swim-up or post-hatching stage (Moyle 2002; NMFS 2002). Optimal growth rates for North American green sturgeon juveniles reportedly occur at water temperatures of 59°F (Cech *et al.* 2000). North American green sturgeon larvae first feed at 10 days post hatch and grow quickly reaching a length of 66 mm and a weight of 1.8 g in three weeks of exogenous feeding. Metamorphosis to the juvenile stage is complete at 45 days. Juveniles continue to grow rapidly, reaching 300 mm in one year. Juveniles spend from one to four years in fresh and estuarine waters and disperse into salt water at lengths of 300 to 750 mm.

The North American green sturgeon is the most marine oriented of the Pacific Coast sturgeon species (Good *et al.* 2005). Individuals apparently remain near the estuaries at first, but then migrate considerable distances in the ocean as they grow. Based on recoveries of North American green sturgeon tagged in the San Francisco Bay estuary, most North American green sturgeon migrate northward, in some cases as far as British Columbia (Moyle 2002; NMFS 2002). Similarly, tagged North American green sturgeon from the Sacramento and Columbia rivers are primarily captured to the north in coastal and estuarine waters, with some fish tagged in the Columbia River being recaptured as far north as British Columbia (Washington Department of Fish and Wildlife (WDFW) 2002). While there is some bias associated with recovery of tagged fish through commercial fishing, the pattern of a northern migration is supported by the large concentration of North American green sturgeon in the Columbia River estuary, Willapa Bay, and Grays Harbor, which peaks in August. These fish tend to be immature; mature fish and at least one ripe fish have been found in the lower Columbia River, however (WDFW 2002). Genetic evidence suggests that most Columbia River green sturgeon are a mixture of fish spawned in other river systems including the Sacramento, Klamath, and Rogue rivers (Israel *et al.* 2002).

Some general information is available on North American green sturgeon feeding habits. Adult North American green sturgeon scour the Sacramento-San Joaquin Delta benthos for invertebrates including shrimp, mollusks, amphipods, isopods, and small, disabled or dead fish (Environmental Protection Center *et al.* 2001). The primary diet for juvenile North American green sturgeon reportedly consists of small crustaceans, such as amphipods and opossum shrimp (CDFG 2001). As juvenile North American green sturgeon develop, they reportedly eat a wider variety of benthic invertebrates, including clams, crabs, and shrimp (CDFG 2001).

Population abundance information concerning the Southern DPS of North American green sturgeon is scant as described in the status review (NMFS 2002). Limited population abundance information comes from incidental captures of North American green sturgeon from the white sturgeon (*Acipenser transmontanus)* monitoring program by the CDFG sturgeon tagging program (CDFG 2002). CDFG (2002) utilizes a multiple-census or Peterson mark-recapture method to estimate the legal population of white sturgeon captures in trammel nets. By comparing ratios of white sturgeon to green sturgeon captures, CDFG provides estimates of adult and sub-adult North American green sturgeon abundance. Estimated abundance between 1954 and 2001 ranged from 175 fish to more than 8,000 per year and averaged 1,509 fish per year. Unfortunately, there are many biases and errors associated with these data, and CDFG does not consider these estimates reliable. Fish monitoring efforts at the Red Bluff Diversion Dam and Glen Colusa Irrigation District on the upper Sacramento River have captured between 0 and 2,068 juvenile North American green sturgeon per year, mostly between the months of June and July (NMFS 2002). The only existing information regarding changes in the abundance of the Southern DPS of North American green sturgeon includes changes in abundance at the John Skinner Fish Protection Facility (State facility) between 1968 and 2001. The estimated average annual number of North American green sturgeon taken at the State Facility prior to 1986 was 732; from 1986 on the average annual number was 47 (70 FR 17386). For the Tracy Fish Collection Facility (Federal facility), the average annual number prior to 1986 was 889; from 1986 to 2001 it was 32 (70 FR 17386). In light of the increased exports, particularly during the previous 10 years, it is clear that the abundance of the Southern DPS of North American green sturgeon is dropping. Catches of sub-adult and adult North American green sturgeon by the IEP between 1996 and 2004 ranged from 1 to 212 green sturgeon per year with the higher number occurring in 2001. The portion of these catches that were made up of the Southern DPS of North American green sturgeon is unknown, however, as these captures were primarily located in San Pablo Bay which is known to consist of a mixture of both the Northern and Southern population segments. Additional analysis of North American green and white sturgeon taken at the State and Federal facilities indicates that take of both North American green and white sturgeon per acre-foot of water exported has decreased substantially since the 1960's (70 FR 17386).

Larval and post larval North American green sturgeon are caught each year in rotary screw traps at the Red Bluff Diversion Dam (Gaines and Martin 2001). A total of 2,608 juvenile sturgeon were captured from 1994-2000. All were assumed to be North American green sturgeon since 124 of these fish were grown by University of California Davis researchers to an identifiable size and all were North American green sturgeon. Young sturgeon appear in catches from early May through August. Most range in size from 1 to 3 inches. Catch rates were greatest in 1995 and 1996 and were lowest in 1999 and 2000 (Gaines and Martin 2001).

North American green sturgeon have not been detected during intensive salmonid monitoring efforts in Clear, Battle, Butte, Deer and Mill creeks, all of which are tributaries to the Sacramento River (Matt Brown, USFWS, pers. comm., 2004; Colleen Harvey-Arrison, CDFG, pers. comm., 2004). Sampling on these tributaries includes monitoring adult passage at fish ladders (Battle Creek), snorkel surveys (Deer, Butte, Clear and Battle creeks), and rotary screw trapping (Deer, Mill, Clear, Battle and Butte creeks). Much of this monitoring has occurred during periods when adult North American green sturgeon would be expected to be in the rivers spawning, and when juvenile North American green sturgeon would be expected to be hatching, rearing, and migrating through the river systems (S.P. Cramer & Associates, Inc. 2004).

Similar monitoring activities have likewise failed to detect North American green sturgeon in the American River (Mike Healey, CDFG, pers. comm., 2004; John Hannon, U.S. Bureau of Reclamation, pers. comm., 2004; Trevor Kennedy, Fishery Foundation of California, pers. comm., 2004). These sampling efforts included snorkeling, rotary screw trapping, and seining, and were conducted during periods when adult and juvenile North American green sturgeon would have been expected to be in the river (S.P. Cramer & Associates, Inc. 2004).

Green and white sturgeon adults have been observed periodically in small numbers in the Feather River (S.P. Cramer & Associates, Inc. 2004). There are at least two confirmed records of adult North American green sturgeon. There are no records of larval or juvenile sturgeon of either species, even prior to the 1960's when Oroville Dam was built. There are reports that North American green sturgeon may reproduce in the Feather River during high flow years (CDFG 2002), but these are not specific and unconfirmed (S.P. Cramer & Associates, Inc. 2004).

Extremely limited information on North American green sturgeon on the lower Yuba River indicates that small numbers of adults occur sporadically below Daguerre Point Dam and no successful spawning has been detected through multiple years of rotary screw trapping (CDFG unpublished data).

C. Habitat Condition and Function for Species' Conservation

Critical habitat for winter-run Chinook salmon was designated on June 16, 1993. Critical Habitat for Central Valley (CV) spring-run Chinook salmon and Central Valley steelhead was designated on September 2, 2005 (70 FR 52488). Critical habitat for the southern DPS of North American green sturgeon has not yet been designated.

The freshwater habitat of salmon and steelhead in the Central Valley varies in function depending on location. Spawning areas are located in accessible, upstream reaches of the Sacramento or San Joaquin Rivers and their watersheds where viable spawning gravels and water conditions are found. Spawning habitat condition is strongly affected by water flow and quality, especially temperature, dissolved oxygen, and silt load, all of which can greatly affect the survival of eggs and larvae.

Migratory corridors are downstream of the spawning area and include 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, unscreened or poorly screened diversions, and degraded water quality.

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 presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system (*e.g.*, the lower Cosumnes River and Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]). However, the channelized, leveed, and rip-rapped 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.

NMFS expects that habitat essential for green sturgeon will be similar to that which supports listed salmonids. Green sturgeon require suitable substrate for spawning, adequate water temperatures (< 17° C) for successful egg incubation and larval rearing, a sufficient forage base, and unobstructed migratory passage from the Delta to the upper Sacramento River spawning reaches.

D. Factors Affecting Salmonid Species and Habitat

A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species in the Central Valley. For example, NMFS prepared range-wide status reviews for west coast Chinook salmon (Myers *et al.* 1998) and steelhead (Busby *et al.* 1996). Also, the NMFS BRT published a draft updated status review for west coast Chinook salmon and steelhead in November 2003 (Good *et al.* 2005). Information also is available in Federal Register notices announcing ESA listing proposals and determinations for some of these species and their critical habitat (*e.g.*, 58 FR 33212; 59 FR 440; 62 FR 24588; 62 FR 43937; 63 FR 13347; 64 FR 24049; 64 FR 50394; 65 FR 7764). The Final Programmatic Environmental Impact Statement/Report (EIS/EIR) for the CALFED Bay-Delta Program (CALFED 1999) and the Department of the Interior's (DOI) Final Programmatic EIS for the Central Valley Project Improvement Act (CVPIA) (DOI 1999) provide summaries of historical and recent environmental conditions for salmon and steelhead in the Central Valley. The following general description of the factors affecting the viability of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead is based on a summarization of these documents.

In general, the human activities that have affected the listed anadromous salmonids and their habitats addressed in this opinion consist of: (1) dam construction that blocks previously accessible habitat; (2) water development and management activities that affect water quantity, flow timing, and quality; (3) land use activities such as agriculture, flood control, urban development, mining, road construction, and logging that degrade aquatic and riparian habitat; (4) hatchery operation and practices; (5) harvest activities; (6) predation; and (7) ecosystem restoration actions.

1. Habitat Blockage

Hydropower, flood control, and water supply dams of the Central Valley Project (CVP), State Water Project (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 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 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82 percent is not accessible today.

In general, large dams on every major tributary to the Sacramento River, San Joaquin River, and the Delta block salmon and steelhead access to the upper portions of the respective watersheds. On the Sacramento River, Keswick Dam blocks passage to historic spawning and rearing habitat in the upper Sacramento, McCloud, and Pit Rivers. Whiskeytown Dam blocks access to the upper watershed of Clear Creek. Oroville Dam and associated facilities block passage to the upper Feather River watershed. Englebright Dam blocks passage on the Yuba River. Nimbus Dam blocks access to most of the American River basin. Friant Dam construction in the mid-1940's has been associated with the elimination of spring-run Chinook salmon in the San Joaquin River upstream of the Merced River (DOI 1999). On the Stanislaus River, construction of New Melones Dam and Goodwin Dam blocked both spring and fall-run Chinook salmon (CDFG 2001).

As a result of the dams, Sacramento River winter-run Chinook salmon, CV Chinook salmon, and CV steelhead populations on these rivers 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 a major stressor to adults and juvenile salmonids.

The Suisun Marsh Salinity Control Gates (SMSCG), located on Montezuma Slough, were installed in 1988 and are operated with gates and flashboards to decrease the salinity levels of managed wetlands in Suisun Marsh. The SMSCG can delay or block passage of adult Chinook salmon migrating upstream (Edwards *et al.* 1996, Tillman *et al.* 1996).

2. Water Development

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted stream flows and altered the natural cycles by which juvenile and adult salmonids base their migrations. Depleted flows have contributed to higher temperatures, lower dissolved oxygen levels, and decreased recruitment of gravel and large woody debris (LWD). Furthermore, more uniform year-round flows have resulted in diminished natural channel formation, altered foodweb processes, and slower regeneration of riparian vegetation. These stable flow patterns have reduced bedload movement (Ayers 2001) and caused spawning gravels to become embedded and reduced channel width, which has decreased the available spawning and rearing habitat below dams.

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the Central Valley. Hundreds 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 intakes 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 (USFWS 2003).

Outmigrant juvenile salmonids in the Delta have been subjected to adverse environmental conditions created by water export operations at the CVP/SWP. Specifically, juvenile salmonid survival has been reduced from: (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 American shad (*Alosa sapidissima*).

3. Land Use Activities

Land use activities continue to have large impacts on salmonid habitat in the Central Valley. 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 four or five miles (California Resources Agency 1989). By 1979, riparian habitat along the Sacramento River had diminished to 11,000 to 12,000 acres, or about 2 percent of historic levels (McGill 1987). The degradation and fragmentation of riparian habitat had resulted mainly from flood control and bank protection projects, together with the conversion of riparian land to agriculture and urban development (Jones and Stokes Associates, Incorporated 1993).

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is a primary cause of salmonid habitat degradation (NMFS 1996). Sedimentation can adversely affect salmonids during all freshwater life stages by; clogging, or abrading gill surfaces, adhering to eggs, and restricting 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 dissolved oxygen levels. Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning, and egg and fry survival (Hartmann *et al.* 1987).

Land use activities associated with road construction, urban development, logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality 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 (Meehan and Bjornn 1991). 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). 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).

Since the 1850's, 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 Chipp's Island, respectively (Goals Project 1999). In Suisun Marsh, salt water 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.

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 California Department of Water Resources (CDWR) on water quality in the Delta over the last 30 years show a steady decline in the food sources available for juvenile salmonids and an increase in the clarity of the water. These conditions likely have contributed to increased mortality of juvenile Chinook salmon and steelhead as they move through the Delta.

4. Hatchery Operations and Practices

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 (DOI 1999). For example, Nimbus Hatchery on the American River rears Eel River steelhead stock and releases these fish in the Sacramento River.

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 1960's, 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. Feather River Hatchery (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 (Colleen Harvey-Arrison and Paul Ward, CDFG, pers. comm., 2002), 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 CV spring-run Chinook salmon and CV steelhead populations by overproducing the natural 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 CV spring-run 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 2001). Thus, the ability of natural populations to successfully reproduce has likely been diminished.

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

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

5. <u>Ocean and Sport Harvest</u>

Extensive ocean recreational and commercial troll fisheries for Chinook salmon exist along the Central California coast, and an inland recreational fishery exists in the Central Valley for Chinook salmon and steelhead. Ocean harvest of Central Valley Chinook salmon is estimated using an abundance index, called the Central Valley Index (CVI). The CVI is the ratio of Chinook salmon harvested south of Point Arena (where 85 percent of Central Valley Chinook salmon are caught) to escapement. Coded wire tag (CWT) returns indicate that Sacramento River salmon congregate off the coast between Point Arena and Morro Bay.

Historically in California, almost half of the river sportfishing effort was in the Sacramento-San Joaquin River system, particularly upstream from the city of Sacramento (Emmett *et al.* 1991). Since 1987, the Fish and Game Commission has adopted increasingly stringent regulations to reduce and virtually eliminate the in-river sport fishery for winter-run Chinook salmon. Present regulations include a year-round closure to Chinook salmon fishing between Keswick Dam and the Deschutes Road Bridge and a rolling closure to Chinook salmon fishing on the Sacramento

River between the Deschutes River Bridge and the Carquinez Bridge. The rolling closure spans the months that migrating adult winter-run Chinook salmon are ascending the Sacramento River to their spawning grounds. These closures have virtually eliminated impacts on winter-run Chinook salmon caused by recreational angling in freshwater. In 1992, the California Fish and Game Commission adopted gear restrictions (all hooks must be barbless and a maximum of 5.7 cm in length) to minimize hooking injury and mortality of winter-run Chinook salmon caused by trout anglers.

In-river recreational fisheries historically have taken CV spring-run Chinook salmon throughout the species' range. During the summer, holding adult CV spring-run Chinook salmon are easily targeted by anglers when they congregate in large pools. Poaching also occurs at fish ladders, and other areas where adults congregate; however, the significance of poaching on the adult population is unknown. Specific regulations for the protection of CV spring-run Chinook salmon in Mill, Deer, Butte and Big Chico Creeks were added to the existing CDFG regulations in 1994. The current regulations, including those developed for winter-run Chinook salmon, provide some level of protection for CV spring-run Chinook salmon (CDFG 1998).

There is little information on steelhead harvest rates in California. Hallock *et al.* (1961) estimated that harvest rates for Sacramento River steelhead from the 1953-54 through 1958-59 seasons ranged from 25.1 percent to 45.6 percent assuming a 20 percent non-return rate of tags. Staley (1975) estimated the harvest rate in the American River during the 1971-1972 and 1973-74 seasons to be 27 percent. The average annual harvest rate of adult steelhead above RBDD for the three-year period from 1991-92 through 1993-94 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 (CDFG 2004). Overall, this regulation has greatly increased protection of naturally produced adult CV steelhead.

6. Predation

Accelerated predation also may be a factor in the decline of winter-run Chinook salmon and CV spring-run Chinook salmon, and to a lesser degree CV steelhead. Additionally, human-induced habitat changes such 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 RBDD, Anderson Cottonwood Irrigation Dam, and Glenn Colusa Irrigation District Pumping Plant, areas where rock revetment has replaced natural river bank vegetation, and at south Delta water diversion structures (*e.g.*, Clifton Court Forebay; CDFG 1998). Predation at RBDD on juvenile winter-run Chinook salmon is believed to be higher than normal due to factors such as flow dynamics associated with the operation of this structure. Due to their small size, early emigrating winter-run Chinook salmon may be very susceptible to predation in Lake Red Bluff when the RBDD gates remain closed in summer and early fall (Vogel *et al.* 1988). In passing the dam, juveniles are subject to conditions which greatly disorient them, making them highly susceptible to predation by fish or birds. Sacramento pikeminnow (*Ptychocheilus grandis*) and striped bass congregate below the dam and prey on juvenile salmon.

The U.S. Fish and Wildlife Service (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 experiments at the SWP's Clifton Court Forebay to estimate pre-screen losses using hatchery-reared juvenile Chinook salmon. Pre-screen losses ranged from 69 percent to 99 percent. Predation from striped bass is thought to be the primary cause of the loss (Gingras 1997).

Other locations in the Central Valley where predation is of concern include flood bypasses, release sites for salmonids salvaged at the State and Federal fish facilities, and the SMSCG. Predation on salmon by striped bass and pikeminnow at salvage release sites in the Delta and lower Sacramento River has been documented (Orsi 1967; Pickard *et al.* 1982). Predation rates at these sites are difficult to determine. CDFG conducted predation studies from 1987-1993 at the SMSCG to determine if the structure attracts and concentrates predators. The dominant predator species at the structure was striped bass, and juvenile Chinook salmon were identified in their stomach contents (NMFS 1997).

7. <u>Ecosystem Restoration</u>

a. *CALFED*

Two programs under CALFED, the Environmental Restoration Program (ERP) and the Environmental Water Account (EWA), were created to improve conditions for fish, including listed salmonids, in the Central Valley. Restoration actions implemented by the ERP include the installation of fish screens, modification of barriers to improve fish passage, habitat acquisition, and instream habitat restoration. The majority of these recent actions address key factors affecting listed salmonids, and emphasis has been placed in tributary drainages with high potential for CV steelhead and CV 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.

A sub-program of the ERP called the Environmental Water Program has been established to support ERP projects through enhancement of instream flows that are biologically and ecologically significant. This program is in the development stage and the benefits to listed salmonids are not yet clear.

The EWA is geared to providing water at critical times to meet ESA requirements and incidental take limits without water supply impacts to other users. In early 2001, EWA released 290,000 acre-feet of water at key times to offset reductions in south Delta pumping to protect winter-run Chinook salmon, and other Delta fish species. The actual number of fish saved was very small. The anticipated benefits to fisheries from EWA were much higher than what has actually occurred.

b. *CVPIA*

The CVPIA implemented in 1992 requires that fish and wildlife get equal consideration with water allocations from the CVP. From this act arose two programs that benefit listed salmonids: the Anadromous Fish Restoration Program (AFRP) and the Water Acquisition Program (WAP). The AFRP has 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 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. Acquired water has been used successfully to improve fish habitat for CV spring-run Chinook salmon and CV steelhead by maintaining or increasing instream flows in Butte and Mill Creeks and the San Joaquin River at critical times.

c. *Iron Mountain Mine Remediation*

The Environmental Protection Agency's (EPA) Iron Mountain Mine remediation involves the removal of toxic metals in acidic mine drainage from the Spring Creek Watershed with a state-of-the-art lime neutralization plant. Contaminant loading into the Sacramento River from Iron Mountain Mine has shown measurable reductions since the early 1990s. Decreasing the heavy metal contaminants that enter the Sacramento River should increase the survival of salmonid eggs and juveniles. However, during periods of heavy rainfall upstream of the Iron Mountain Mine, BOR substantially increases Sacramento River flows in order to dilute heavy metal contaminants being spilled from Spring Creek debris dam. This rapid change in flows can cause juvenile salmonids to become stranded or isolated in side channels below Keswick Dam.

d. *SWP 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 CV spring-run Chinook salmon and CV steelhead include water exchange programs on Mill and Deer Creeks; enhanced law enforcement efforts from San Francisco Bay upstream throughout 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 CV steelhead.

The Spring-run Salmon Increased Protection project provides overtime wages for CDFG wardens to focus on reducing illegal take and illegal water diversions on upper Sacramento River tributaries and adult holding areas, where the fish are vulnerable to poaching. This project covers Mill, Deer, Antelope, Butte, Big Chico, Cottonwood, and Battle Creeks, and has been in effect since 1996. Through the Delta-Bay Enhanced Enforcement Program, initiated in 1994, a team of 10 wardens focus their enforcement efforts on salmon, steelhead, and other species of concern from the San Francisco Bay Estuary upstream into the Sacramento and San Joaquin River basins. These two enhanced enforcement programs, in combination with additional concern and attention from local landowners and watershed groups on the Sacramento River tributaries which support CV spring-run Chinook salmon summer holding habitat, have been shown to reduce the amount of poaching in these upstream areas.

The provisions of funds to cover over-budget costs for the Durham Mutual/Parrot Phelan Screen and Ladders project expedited completion of the construction phase of this project which was completed during 1996. The project continues to benefit salmon and steelhead by facilitating upstream passage of adult spawners and downstream passage of juveniles.

The Mill and Deer Creek Water Exchange projects are designed to provide new wells that enable diverters to bank groundwater in place of stream flow, thus leaving water in the stream during critical migration periods. On Mill Creek several agreements between Los Molinos Mutual Water Company (LMMWC), Orange Cove Irrigation District (OCID), CDFG, and CDWR allows CDWR to pump groundwater from two wells into the LMMWC canals to pay back LMMWC water rights for surface water released downstream for fish. Although the Mill Creek Water Exchange project was initiated in 1990 and the agreement was for a well capacity of 25 cfs, only 12 cfs has been developed to date (BOR and OCID 1999). In addition, it has been determined that a base flow of greater than 25 cfs is needed during the April through June period for upstream passage of adult CV spring-run Chinook salmon in Mill Creek (BOR and OCID 1999). In some years, water diversions from the creek are curtailed by amounts sufficient to provide for passage of upstream migrating adult CV spring-run Chinook salmon and downstream migrating juvenile CV steelhead and CV spring-run Chinook salmon. However, the current arrangement does not ensure adequate flow conditions will be maintained in all years. CDWR, CDFG, and USFWS have developed the Mill Creek Adaptive Management Enhancement Plan to address the instream flow issues. A pilot project using one of the 10 pumps originally proposed for Deer Creek was tested in summer 2003. Future testing is planned with implementation to follow.

E. Factors Affecting the Southern DPS of North American Green Sturgeon

The principal factor for the decline of North American green sturgeon reportedly comes from the reduction of spawning habitat to a limited area of the Sacramento River (70 FR 17391). Keswick Dam is an impassible barrier blocking North American green sturgeon access to what are thought to have been historic spawning grounds upstream (70 FR 17386). In addition, a substantial amount of what may have been spawning and rearing habitat in the Feather River above Oroville Dam has also been lost (70 FR 17386). There is a lack of historical information on presence or absence of North American green sturgeon spawning in the Feather River, and it remains unclear whether suitable spawning habitat currently is available or has ever been available in the section of the Feather River that is currently accessible (S.P. Cramer & Associates, Inc. 2004).

Potential adult migration barriers to the Southern DPS of North American green sturgeon include RBDD, Sacramento Deep Water Ship Channel locks, Fremont Weir, Sutter Bypass, and the Delta Cross Channel Gates on the Sacramento River, and Shanghai Bench and Sunset Pumps on the Feather River (70 FR 17391). The threat of screened and unscreened agricultural, municipal, and industrial water diversions in the Sacramento River and Delta to North American green sturgeon are largely unknown as juvenile sturgeon are often not identified, and the current CDFG and NMFS' screen criteria are not specifically designed to protect sturgeon. Based on the temporal occurrence of juvenile North American green sturgeon and the high density of water diversion structures along rearing and migration routes, the potential threat of these diversions are found to be serious and in need of study (70 FR 17391).

CDFG (1992) found a strong correlation between mean daily freshwater outflow (April to July) and white sturgeon year class strength in the Sacramento-San Joaquin Estuary, suggesting that insufficient flow rates are likely to pose a significant threat to the Southern DPS of North American green sturgeon. It is postulated that low flow rates could dampen survival by hampering the dispersal of larvae to areas of greater food availability, hampering the dispersal of larvae to all available habitat, delaying the transportation of larvae downstream of water diversions in the Delta, or decreasing nutrient supply to the nursery, thus stifling productivity (CDFG 1992). The subject studies primarily involve the more abundant white sturgeon; however, the threats to North American green sturgeon are thought to be similar (70 FR 17391). It is important to note, however, that white sturgeon spend more time in a riverine environment than North American green sturgeon, and the aforementioned correlation may not be applicable. The full relationship between flow and North American green sturgeon year class strength has not yet been determined.

The installation of the Shasta Dam temperature control device in 1997 is thought to have improved the situations related to high water temperatures in the upper Sacramento River, although Shasta Dam has a limited storage capacity and cold water reserves could be depleted in long droughts. Water temperatures at RBDD have not been higher than 62 °F since 1995 and are within the North American green sturgeon egg and larvae optimum range for growth and survival of 59 to 66 °F (Mayfield and Cech 2004). Conversely, CDFG (2002) has indicated that water temperatures may be inadequate for spawning and egg incubation in the Feather River during many years as the result of releases of warmed water from Thermalito Afterbay. It is likely that high water temperatures (greater than 63 °F) may deleteriously affect sturgeon egg and larval development, especially for late-spawning fish in drier water years (70 FR 17386).

Non-native species are an ongoing problem in the Sacramento-San Joaquin River and Delta systems (CDFG 2002). One risk for North American green sturgeon associated with the introduction of non-native species involves the replacement of relatively uncontaminated food items with those that may be contaminated. For example, the non-native overbite clam, *Potamocorbula amurensis*, introduced in 1988, has become the most common food of white sturgeon and was found in the only North American green sturgeon examined thus far (CDFG

2002). The overbite clam is known to bioaccumulate selenium, a toxic metal (CDFG 2002; Linville *et al.* 2002). The significance of this threat to North American green sturgeon is unclear. North American green sturgeon also are likely to experience predation by introduced species including striped bass, but the actual impacts of predation have yet to be estimated (70 FR 17392).

Contamination of the Sacramento River increased substantially in the mid-1970s when application of rice pesticides increased (70 FR 17386). Estimated toxic concentrations for the Sacramento River during 1970-1988 may have deleteriously affected striped bass larvae (Bailey *et al.* 1994). White sturgeon also may accumulate PCBs and selenium (White *et al.* 1989). While North American green sturgeon spend more time in the marine environment than white sturgeon and, therefore, may have less exposure, the Biological Review Team for North American green sturgeon has concluded that contaminants also pose some risk for North American green sturgeon. However, this risk has not been quantified or estimated.

Existing efforts are being carried out to protect North American green sturgeon. The Central Valley Project Improvement Act (CVPIA) is a Federal act directing the Secretary of the Interior to amend previous authorizations of California's Central Valley Project to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic use, and fish and wildlife enhancement as a project purpose equal to power generation. Since the CVPIA was enacted in 1992, USFWS and the U.S. Bureau of Reclamation have led an effort to implement a significant number of activities across the Central Valley including projects such as (1) river restoration, (2) land purchases, (3) fish screen projects, (4) water acquisitions for the environment, and (5) special studies and investigations. The Anadromous Fish Restoration Program (AFRP), a component of the CVPIA, implements a doubling program in an attempt to *"implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991."* The AFRP specifically applies the doubling effort toward Chinook salmon, Central Valley steelhead, striped bass, and white and North American green sturgeon. Though most efforts of the AFRP have primarily focused on Chinook salmon as a result of their listing history and status, North American green sturgeon may receive some unknown amount of benefit from these restoration efforts. For example, the acquisition of water for flow enhancement on tributaries to the Sacramento River, fish screening for the protection of Chinook salmon and Central Valley steelhead, or riparian revegetation and instream restoration projects likely would have some ancillary benefits to sturgeon. The AFRP also has invested in one North American green sturgeon research project that has helped improve our understanding of the life history requirements and temporal distribution patterns of North American green sturgeon within the southern DPS (70 FR 17398).

The California Bay-Delta Program (CALFED) is a cooperative effort of more than 20 State and Federal agencies designed to improve water quality and reliability of California's water supply while recovering the Central Valley ecosystem. The CALFED program contains four key objectives, which include water quality, ecosystem quality, water supply and levee system integrity. Many notable beneficial actions have originated and been funded by the CALFED program including such projects as floodplain and instream restoration, riparian habitat protection, fish screening and passage projects, research regarding non-native invasive species and contaminants, restoration methods, and watershed stewardship and education and outreach programs (70 FR 17398). Prior Federal Register notices have reviewed the details of CVPIA and CALFED programs and potential benefits towards anadromous fish, particularly Chinook salmon and Central Valley steelhead (69 FR 33102).

Information received from CALFED regarding potential projects that may serve as conservation measures for North American green sturgeon indicated a total of 118 projects of various types and levels of progress funded between 1995 and 2004. Projects primarily consisted of fish screen evaluation and construction projects, restoration evaluation and enhancement activities, contaminations studies, and dissolved oxygen investigations related to the San Joaquin River Deep Water Ship Channel. Two evaluation projects specifically addressed North American green sturgeon while the remaining projects primarily address anadromous fish in general, particularly listed salmonids. The new North American green sturgeon information from research will be used to enhance our understanding of the risk factors affecting the species, thereby improving our ability to develop effective management measures. However, at present they do not directly help to alleviate threats that this species faces in the wild (70 FR 17398). All ongoing fish screen and passage studies are designed primarily to meet the minimum qualifications outlined by the NMFS and CDFG fish screen criteria. Though these improvements will likely benefit salmonids, there is no evidence showing that these measures will decrease the likelihood of North American green sturgeon mortality. While one of CALFED's goals is to recover a number of at-risk species (including North American green sturgeon) and the program has and continues to provide funding for a variety of laboratory-based research projects, there are no specific actions aimed at alleviating the primary risks that threaten the continued existence of North American green sturgeon in the wild (70 FR 17398).

Other potential conservation measures such as the opening of the RBDD gates have helped North American green sturgeon passage in the Sacramento River during the early part of their spawning season, but it is not known how effective this measure has been. In addition, the fish ladders on RBDD do not allow North American green sturgeon to pass after May 15, when the RBDD gates are closed each year (70 FR 17386). Fish salvaging efforts at the Tracy Fish Collection Facility and the Skinner Delta Fish Protective Facility in the South Delta have been operating for decades, but it is unknown whether efforts to relocate adults have resulted in restoration of spawning potential and whether the salvage of juveniles is effective (70 FR 17398). Other conservation measures targeted at anadromous salmonids, such as improving river thermal and flow regimes, are likely to improve conditions for North American green sturgeon as well (70 FR 17398).

Both white and green sturgeon are protected by the same fishing regulations in the Sacramento-San Joaquin system. No commercial take is permitted and angling take is restricted to one fish per day between 117 and 183 cm TL. An additional closure in central San Francisco Bay occurs between January 1 and March 15, coinciding with the herring spawning season to protect sturgeon feeding on herring eggs (CDFG 2002). Active sturgeon enforcement often is employed in areas where sturgeon are concentrated and particularly vulnerable to the fishery (70 FR 17397).

The protective efforts described above, when evaluated pursuant to NMFS' *"Policy for Evaluation of Conservation Efforts,"* do not as yet, individually or collectively, provide sufficient certainty of implementation and effectiveness to counter the extinction risk assessment conclusion that the southern DPS of North American green sturgeon is likely to become an endangered species in the foreseeable future throughout its range (70 FR 17398).

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the status of the species within the action area. 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).

A. Status of listed and proposed species and critical habitat within the action area

The action area provides spawning habitat for winter- and spring-run Chinook salmon, steelhead, and North American green sturgeon. The action area also functions as a migratory corridor for adult and juvenile winter- and spring-run Chinook salmon, steelhead and North American green sturgeon, and as juvenile rearing habitat for all of these species. Due to the life history timing of winter- and spring-run Chinook salmon, steelhead and North American green sturgeon, it is possible for one or more of the following life stages: adult migrants, spawners, incubating eggs, or rearing and emigrating juveniles to be present within the action area throughout the year.

1. Status of Species

Reliable estimates of the number of winter- and spring-run Chinook salmon, steelhead and North American green sturgeon adults and juveniles within the action area are not available, however general Chinook salmon redd abundance and spawning distribution for winter-and spring-run Chinook salmon can be determined through CDFG aerial redd surveys.

a. *Chinook Salmon*

CDFG conducts frequent aerial redd surveys of the upper Sacramento River from the Red Bluff Diversion Dam to Keswick Dam throughout the year. The CDFG surveys are not of sufficient precision or uniform frequency to allow accurate quantification of the number of redds present in the immediate vicinity of the action area, however, these surveys indicate that the action area is within the primary spawning range of winter- and spring-run Chinook salmon. Records were examined for the area extending from Keswick Dam to the Airport Road Bridge for the period from 2001 through 2006. The CDFG surveys show that of all the Chinook salmon redds counted in the Sacramento River, anywhere from 43 to 80 percent of them were constructed in the section of the river upstream from the Airport Road Bridge for the years 2001 to 2006.

Sacramento River winter-run Chinook salmon currently are present only in the Sacramento River below Keswick Dam, and are composed of a single breeding population (NMFS 1997; see *III. Status of the Species and Critical Habitat*). Spawning individuals occasionally are observed in other streams such as Clear and Battle creeks, although water temperatures in these streams are not currently suitable throughout the spawning and incubation period. Consequently, successful juvenile production is not expected in the smaller tributaries. Based on the analysis of CDFG's aerial redd survey data for the period from 2001 to 2006, NMFS estimates that between 95 and 99 percent of the population of adult and juvenile Sacramento River winter-run Chinook salmon migrate through the upper Sacramento River to spawn upstream of the Airport Road Bridge and must therefore pass through the action area.

In addition to the spawning habitat within the action area, the diversity of other habitat types contribute to important rearing conditions. Pools, riffles, shallow water margins, and nearshore brushy riparian vegetation provide essential juvenile rearing components including slow water refugia, turbulent overhead cover, and aquatic insect production.

b. *Central Valley Steelhead*

Steelhead and/or rainbow trout redds have also been observed within the action area during aerial redd surveys, although these redds have not been counted or documented (Doug Killam, CDFG, pers. comm. 2005).

c. *North American Green Sturgeon*

The current area occupied by North American green sturgeon in the Sacramento River is uncertain. Adult green sturgeon have recently been video documented immediately below RBDD in 2004 (Doug Killam, CDFG, pers. comm. 2005). Migrating green sturgeon that get past RBDD before the gates close on May 15 (in most years) face no migration barriers through the action area and upstream to ACID on the north end of Redding. It is therefore reasonable to assume that green sturgeon may occur with the action area. Newly hatched juvenile green sturgeon are captured each summer in the rotary screw traps which sample the water coming out of RBDD (Gaines and Martin 2001) providing firm evidence that spawning occurs upstream of RBDD.

2. <u>Status of Critical Habitat</u>

The action area is within designated critical habitat for Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon and CV steelhead. Habitat requirements for these species are similar. The essential features of freshwater salmonid habitat within the action area include: adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions.

Riverine habitat within the action area includes the Sacramento River and Clear Creek. The Sacramento River in this area is a large perennial stream that provides all of the PCEs of critical habitat for the three listed salmonids. The Sacramento River flows through a moderately confined channel dominated by run and riffle habitats, with mainly boulder, cobble, and large gravel substrates. Vegetation within the river is sparse; however, submergent and emergent species such as white-water buttercup (*Ranunculus aquatilis*) and rushes occupy stream margins and backwater areas.

Valley-foothill riparian habitat dominates the river margins throughout much of the action area with the exception of the area directly under the bridge which is generally devoid of most vegetation. The dominant species in the canopy layer of the riparian zone include Fremont cottonwood (*Populus fremontii*), valley oak (*Quercus lobata*), and black locust (*Robinia pseudoacacia*). Sub-canopy trees include white alder (*Alnus rhombifolia*), and Oregon ash (*Fraxinus latifolia*). Understory vegetation includes, lianas of wild grape (*Vitis californica*), dense thickets of California blackberry (*Rubus ursinus*), exotic Himalayan blackberry (*Rubus discolor*), and several species of willow (*Salix spp.*). The forb herbaceous layer consists of rushes (*Juncus* sp.), sedges (*Carex* sp.), and Douglas sagewort (*Artemisia douglasia*).

Section 3406(b)(13) of the CVPIA requires the Bureau of Reclamation (BOR) to restore and replenish spawning gravel, and re-establish meander belts in rivers. To meet these requirements in the upper Sacramento River, spawning gravel augmentation projects have placed suitable spawning substrate into various locations in the Sacramento River. In 2000, BOR placed 39,000 tons of clean washed spawning gravel into the river below Keswick Dam. Other construction projects have compensated for adverse effects to salmonids using spawning gravel augmentation.

The flows in the upper Sacramento are regulated by releases from Keswick and Shasta Dams. Summer releases are closely managed to meet water temperature objectives for spawning winter- and spring-run Chinook salmon and to provide water for irrigation. From May through August Keswick releases average approximately 12,000 cfs and water temperatures are held at or below 56 °F. Releases are reduced from September through December and under dry conditions can often drop to between 5,000 and 4,000 cfs. Flow reductions of this magnitude have been found to dewater salmonid redds built along the shallow margins and point bars throughout the upper river (Doug Killam, CDFG, pers. comm. 2002). January, February, and March have the greatest probability of high flows, but they can also have some of the lowest flows of the year depending on the amount and timing of precipitation and available storage behind Shasta Dam. In dry years winter flows in the action area are frequently held below 4,000 cfs and can potentially go as low as 3,250 cfs. Again, if salmonid redds are built under higher flow conditions (either earlier in the year or during weather related flow peaks), large, sustained flow reductions can cause the dewatering of redds built in shallow water.

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

Factors affecting the listed and proposed species and critical habitat within the action area include river flows, water temperatures, spawning gravel suitability, water quality, interactions with other species, and the quality and abundance of riparian habitat. River flow and temperature criteria were established in the 1993 biological opinion for the CVP and State Water Project Operations, Criteria, and Plan, which led to the construction of the Shasta Dam temperature control device, and have resulted in improved temperature management. Although these criteria were developed to meet winter-run Chinook salmon needs, spring-run Chinook salmon, steelhead and North American green sturgeon also have benefited. Gravel augmentation and natural recruitment has resulted in large areas of high quality spawning gravel. There is excellent climax riparian habitat within the large island/side channel complexes immediately upstream and downstream of the action area, but the shoreline along the wastewater treatment plant has only a thin strip of small, shrubby plants with few trees or overhanging cover.

Ongoing improvements to the upper reaches of the Sacramento River including gravel augmentation, screening of diversions and riparian habitat restoration are expected to further improve conditions for anadromous fish and critical habitat, but the incremental benefit of these actions is not yet known. Even with these improvements, some problems persist that may affect anadromous fish and reduce the quality of the PCEs of critical habitat within the action area. Some of the remaining problems include episodic discharges of heavy metals from the Superfund Iron Mountain Mine site, major fall and winter flow reductions causing dewatering of redds, potential competition and genetic introgression between spring- and fall-run Chinook salmon due to overlapping spawning habitats, and degraded rearing conditions in the river due to a lack of mature riparian habitat.

The frequency of acid mine drainage exceeding target levels below Keswick Dam has decreased over the last ten years, however, exceedances of dissolved copper targets have occurred during each of the last six years, and metal concentrations remain high enough to have sublethal effects on adult fish and lethal effects on eggs and larvae (California Regional Water Quality Control Board 2001). Although acid mine drainage has, over the years, reduced the number of Chinook salmon and steelhead within the action area, recent remedial actions at Iron Mountain Mine are thought to have curtailed the direct poisoning of listed species.

Fall flow reductions have been found to negatively impact PCEs for salmonid spawning by causing extensive redd dewatering throughout the Sacramento River spawning areas (Doug Killam, CDFG, pers. comm. 2002). The largest reductions have been occurring in early to mid-November, following the peak in water demand for rice decomposition. While reductions in this time period primarily impact fall-run Chinook salmon, they also have the potential to impact late spawning spring-run Chinook salmon and early spawning steelhead.

The construction of Shasta and Keswick Dams, and the resultant exclusion of spring-run Chinook salmon from their historic upper Sacramento River spawning habitat has forced mainstem-spawning spring-run Chinook salmon to spawn in the middle reaches of the river (between Keswick and Red Bluff Dams) in areas easily accessible to fall-run Chinook salmon. Because spring-run Chinook salmon hold over the summer and spawn during a similar time period as do fall-run Chinook salmon (September through October depending on habitat conditions), there is a potential for the two races to have negative interactions such as competition for prime spawning sites, superimposition of redds in the same location and genetic introgression caused by individuals of the different races spawning together and creating crossed progeny.

C. Likelihood of species survival and recovery in the action area

Winter- and spring-run Chinook salmon, steelhead and green sturgeon are expected to continue to utilize the action area as a migratory corridor, and for spawning and rearing. Despite its relatively small size, the value of the action area as a migratory corridor, and its suitability as spawning and rearing habitat, make it an important node of habitat for the survival and recovery of local populations of listed and proposed species. Because the action area is within the most important habitat available to winter-run Chinook salmon, the continuity and connectivity of the action area to the rest of this habitat is important for the survival and recovery of that ESU.

Although the habitat within the action area may be important for the survival and recovery of local populations of spring-run Chinook salmon and steelhead, the distribution of these species throughout the geographical range of the ESU, and their primary abundance in other streams and rivers, means that the value of the habitat within the action area may not be essential for the survival and recovery of spring-run Chinook salmon and steelhead.

The abundance or even occurrence of North American green sturgeon within the action area is undocumented. The information that is available indicates that, as with winter-run Chinook salmon, the mainstem Sacramento River may be the last viable spawning habitat for the southern DPS of North American green sturgeon (Good *et al.* 2005). Because of similarities in their migration and spawn timing, it is likely that many of the same factors affecting winter-run Chinook salmon are also significant to green sturgeon. However, the action area does not appear to provide the preferred spawning habitat for green sturgeon (deep, turbulent pools) as it does for winter-run Chinook salmon, and therefore may be somewhat less important to green sturgeon survival and recovery than it is for winter-run Chinook salmon.

V. EFFECTS OF THE ACTION

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 construction, and operations and maintenance of the Clear Creek Wastewater Treatment Plant Upgrade and Expansion project on endangered Sacramento River winter-run Chinook salmon, threatened CV spring-run Chinook salmon, threatened CV steelhead, the southern DPS of North American green sturgeon, and the designated critical habitats for the listed salmonids. Impacts related to the construction, and operations and maintenance of the Clear Creek Wastewater Treatment Plant Upgrade and Expansion project will be assessed. The proposed project is likely to cause adverse short-term effects to listed species and critical habitat during construction, while providing long-term reliable wastewater treatment that meets or exceeds all State and Federal regulations protecting Sacramento River water quality through the year 2025. The project includes integrated design features to avoid and minimize many potential impacts as well as conservation measures to compensate for unavoidable temporal and spatial impacts.

In the *Description of the Proposed Action* section of this biological opinion, NMFS provided an overview of the action. In the *Status of the Species* and *Environmental Baseline* sections of this biological opinion, 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 also requires NMFS to determine if Federal actions would appreciably diminish the value of critical habitat for the conservation of listed species (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, we evaluate the available evidence to identify the direct and indirect physical, chemical, and biotic effects of proposed actions on individual members of listed species or aspects of the species' environment (these effects include direct, physical harm or injury to individual members of a species; modifications to something in the species' environment - such as reducing a species' prey base, enhancing populations of predators, altering its spawning substrate, altering its ambient temperature regimes; or adding something novel to a species' environment - such as introducing exotic competitors or disruptive noises). Once we have identified the effects of an action, we evaluate the available evidence to identify a species' probable response (including behavioral responses) to those effects to determine if those effects could reasonably be expected to 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; decreasing the age at which individuals stop reproducing; among others). We then use the evidence available 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.

A. Approach to the Assessment

1. Information Available for the Assessment

To conduct this assessment, NMFS examined an extensive amount of information 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, government and non-government reports, including the May 2007, biological assessment for this project entitled the *City of Redding Clear Creek Wastewater Treatment Plant Upgrade and Expansion Project Biological Assessment / Fish Habitat Assessment* (North State Resources 2007). 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. Assumptions Underlying this Assessment

In the absence of definitive data or conclusive evidence, NMFS will 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 data. The progression of the reasoning will be stated for each assumption, and supporting evidence will be cited.

B. Assessment

The assessment will consider the nature, duration, and extent of the effects of the proposed action relative to the migration timing, behavior, and habitat requirements of Federally listed anadromous fish. Adverse effects to these species and/or their designated critical habitat may result from changes in water quality from construction activities and damage to incubating eggs and harassment of juveniles and adults from pile driving and installation of the new diffusers. The proposed project includes integrated design features to avoid and minimize many of these potential impacts.

Impacts to listed anadromous fisheries associated with the proposed action would be limited to the action area. Effluent would achieve complete vertical mixing at approximately 400 feet downstream and complete horizontal mixing across the full width of the diffuser at approximately 800 feet downstream from the release point with a minimum dilution ratio of approximately 77:1, based on bathymetry and flow studies conducted in 2004. Most of the adverse effects identified are temporary in nature and limited to the in-water construction phase, which would last less than one year for construction of the new outfall diffuser(s). Current water quality near the existing WWTP outfall meets or exceeds water quality objectives to protect cold freshwater habitat. The proposed action would improve the plant's capacity to maintain compliance with water quality objectives in view of increasing inflows consistent with the City's General Plan. Compliance monitoring will continue to be required as part of the City of Redding's Clear Creek WWTP NPDES permit (NPDES Permit #CA0079731).

1. Construction Impacts

Potential construction-related impacts include exposure of migrating and spawning adults, incubating eggs, and rearing juveniles of the listed salmonid species and green sturgeon to noise and high sound pressure levels associated with pile-driving in the river channel; increased turbidity, bank erosion, and suspended sediments that may adversely affect all life stages of the listed fish species; temporal disturbance of shaded riverine aquatic (SRA) habitat and loss of potential spawning habitat; potential spill of hazardous materials into the Sacramento River; and impaired fish passage in the immediate vicinity of the in-water construction site.

a. *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 walls of the steel pile expand and contact, forming a compression wave that moves through the pile. The outward movement of the pile wall sends a pressure wave propagating outward from the pile and through the riverbed and water column in all directions.

The effect of pile driving on fish depends on the duration, frequency (Hz), and pressure (dB) of the compression wave. The range and intensity of a compression wave is related to the size of the hammer and the medium through which the wave travels. Large hammers will result in high pressures, or decibels, and dense mediums will result in effective transmission of compression waves. Small hammers will result in low pressures and inconsistent mediums (mediums with variable or changing densities) will result in transmission loss, or attenuation, of the wave. The pressure of a compression wave will decrease with distance and the range of the wave will decrease in proportion to the rate of transmission loss. Salmonids hear within a range of 10 to 400 Hz, with the greatest sensitivity between 180 and 190 Hz (Feist *et al.* 1992). Rassmusen (1967) found that immediate mortality of juvenile salmonids may occur at sound pressure levels exceeding 204 dB.

Feist *et al.* (1992) found that pile driving in Puget Sound created sound within the range of salmonid hearing that could be detected at least 600 m away. Abundance of juvenile salmon near pile-driving rigs was reduced on days when the rigs were operating compared to non-operating days. 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). Burner and Moore (1962) found that large juvenile and adult fish rarely respond to sudden or loud sound stimuli. However, experiments by 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 of the pilings fish were no longer startled. This suggests that pile driving or associated activity (*e.g.*, human movement, work boat operation, *etc.*) can cause avoidance of habitat in the immediate vicinity of the project site, but that fish also may become acclimated to the noise. If fish move into an area of higher predator concentration (*e.g.*, deeper water), they may experience increased susceptibility to predation and decreased survival. Fish that become acclimated may be exposed to additional project-related impacts.

Because inconsistent mediums, such as water, will result in a higher rate of transmission loss, environmental factors such as water depth, water turbulence, air bubbles, and substrate consistency are important to consider when estimating the distance a compression wave will travel. A compression wave traveling through shallow water and substrates with variable consistencies (variable particle size class distribution) will attenuate more rapidly than compression waves traveling through a constant medium such as deep water or bedrock. As a compression wave moves away from the source, the wave length increases and intersects with the air/water interface. Once the compression wave contacts the air, it attenuates rapidly and does not return to the water column.

Since little is known about the effects of compression shock waves on fish eggs incubating within a gravel matrix, the effect of pile driving on salmon and steelhead eggs is less clear. Salmon and steelhead eggs are very fragile and thus susceptible to mechanical shock prior to the eyed egg stage (Jenson and Alderice 1983, Piper *et al.* 1982). During this period of development, high pressure compression shock waves may cause egg mortality in redds that are close to pile-driving activities.

Pile driving activities are scheduled to occur between October 1, 2008, and April 15, 2009. This pile driving work-window falls outside of the primary spawning and incubation seasons for winter-run Chinook salmon and North American green sturgeon. Because pile driving has the potential to occur throughout much of the steelhead spawning and incubation period (*i.e.*, December through May), steelhead eggs are the most likely to be impacted by pile driving. There is also a potential for the eggs of late-spawning spring-run Chinook salmon that spawn within the impact zone to be affected (*i.e.*, eggs fertilized after September 26).

With regards to spring-run Chinook salmon, the percent of the total Central Valley ESU that spawn in the mainstem Sacramento River is very low (*i.e.*, average of 2.6 percent over the past 5 years; CDFG 2004), and the area to be affected by pile driving is a small proportion of the total suitable spawning area within the mainstem Sacramento River (*i.e.*, 900 feet out of a total of 35 miles or 0.48 percent of total area). By combining these figures, the total percentage of Central Valley spring-run Chinook salmon eggs that would be expected to be killed by pile driving during the construction phase of the proposed project would be 0.12 percent. Additionally, salmonid eggs, larvae, and juveniles are naturally vulnerable life stages and typically face a high likelihood of mortality (*e.g.* 80 percent or greater from spawning to the fry/smolt stage (Healey 1991)). The loss of such a small additional percentage of eggs or larvae is not likely to detectably influence the number of adults returning to spawn in the resulting year class. Therefore, any potential pile driving impacts to incubating spring-run Chinook salmon eggs are not expected to be of a magnitude that would appreciably reduce the likelihood of survival and recovery of this species.

Due to the lack of population and distribution data on Central Valley steelhead, it is more difficult to estimate the percentages of steelhead eggs that may be impacted by the proposed pile driving activities. There have been no studies to determine the percentage of Central Valley steelhead that spawn in the Sacramento River. However, there are several factors that can be examined in developing an estimation of the level of impacts that pile driving is likely to have on incubating steelhead eggs.

1. Steelhead are generally more likely to spawn in upper headwaters and smaller tributary streams than in large mainstem rivers like the Sacramento. There are several documented

populations in tributaries such as Battle, Deer, Mill, and Butte creeks as well as the Yuba, American and Feather Rivers. It is therefore reasonable to assume that a significant proportion of the Central Valley steelhead ESU does not spawn in the mainstem Sacramento River.

2. Cold winter water temperatures create a large area of the Sacramento River with water temperatures that are suitable for salmonid spawning during the primary steelhead spawning season (approximately 60 miles from Keswick Dam to Red Bluff Diversion Dam). The 900 foot section of the action area within which steelhead eggs might be impacted amounts to only 0.28 percent of this total area.

3. Pile driving activities are not expected to occur throughout the entire allowable work window. A tentative construction schedule (North State Resources 2007) calls for driving sheet piles for three to six days (8 hours per day) and driving steel H-piles for a total of twelve days over a period of several months. Only those steelhead eggs that are laid within 450 feet of large piles and are fertilized within 12 days of pile driving activities are likely to be killed.

Given this information, it is reasonable to assume that a very small fraction of the total egg production for the Central Valley steelhead ESU will be affected by the proposed pile driving activities and that the resulting loss of reproductive potential will not be of a magnitude that would appreciably reduce the likelihood of survival and recovery of this species.

Due to similarities in construction techniques, as well as river and substrate conditions between the proposed project's action area and recent bridge replacement projects near the City of Redding, sound effects from pile driving are expected to be similar, and maximum sound levels should be below the 204 dB threshold known to cause internal tissue damage and death to fish. However, the levels may be high enough to affect adult and juvenile salmonids by startling fish and causing avoidance of habitats within 600 meters of the noise source. This is a conservative estimate based on observations in Puget Sound and does not take into account specific on-site variables such as river flow and riverbank morphology that may reduce the actual distance. Pile driving will produce underwater sound pressure levels that may affect salmonid behavior and physiology through disruption of migration, feeding behavior, and potential increased exposure of juveniles to predation by forcing them from nearshore refugia.

NMFS anticipates that pile driving will be detectable to salmonids up to 600 meters from the source, and that the sounds generated will harass juvenile salmon and 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 also may 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. Additionally, given the limited and intermittent use of the hammers (*i.e.*, expected to be hours or days) the magnitude of potential adverse effects is expected to be low.

b. *Loss of Potential Spawning Habitat*

Although suitable spawning habitat occurs within limited sections of the action area, the proposed location(s) and alignment(s) of the new outfall diffuser(s) would avoid those sections. Spawning salmon are regularly observed by CDFG surveyors on suitable riffle habitats that occur across the river channel near the opposite bank, and both upstream and downstream of the proposed diffuser alignment(s) approximately 200 to 300 feet from any proposed permanent disturbance. However, the habitat in the immediate vicinity of the proposed in-water work is not suitable for spawning salmon due to large cobble substrates that dominate the streambed. Therefore no permanent impacts to suitable spawning habitat is expected to result from the proposed action

Installation the flow barrier upstream of the primary work area would be the most significant cause of temporary reductions in the amount and quality of available spawning habitat. Suitability of spawning habitat will be affected through modification of flow patterns and current velocities which may reduce the suitability of spawning habitat for an undetermined distance above and below the action area. There may be a net long-term improvement in the PCEs that make up spawning habitat as a result of project implementation, however, since the clean gravel contained in the supersak will be left in the river channel and allowed to wash downstream and replenish spawning areas.

Given the proximity of the action area and the associated in-water construction activities to potential spawning habitat, there could also be direct or indirect effects on salmon spawning habitat in the form of increased suspended sediment and turbidity that would be caused by installation and removal of piles and excavation of the riverbed required for installation of the diffuser pipe(s). The potential effects of temporary suspended sediment and turbidity increases on incubating eggs, juveniles, and adults are discussed further in the following section examining exposure to increased turbidity and suspended sediment.

A 1980 survey of spawning sites available between Keswick Dam and Red Bluff Dam, indicated that there were approximately 96,000 sites available (CDFG 2001). Based on the large number of potential spawning sites and the relatively small number of returning winter-run Chinook salmon at this time (the most abundant of the three listed salmonids in this area, generally between 7,000 and 15,000 adults over the last 5 years), the short-term loss of this small amount of potential spawning habitat is not expected to significantly impact spawning salmonids or appreciably reduce the reproductive success of winter- or spring-run Chinook salmon or steelhead.

c. *Exposure to Increased Turbidity and Suspended Sediment*

In-river construction work may increase suspended sediments and elevate turbidity above natural levels. Activities that could contribute sediment and increase turbidity include sheet and H-pile driving and removal, placement and removal of a temporary work trestle and upstream flow barrier (i.e., either a sheet pile wall or supersak), installation of the new outfall diffuser(s) and removal of the existing diffuser, and the use of near-river access roads and staging areas.

High turbidity can affect fish by reducing feeding success, causing avoidance of rearing habitats, and disrupting upstream and downstream migration. Displacement of juveniles from preferred habitats may cause increased susceptibility of juveniles to predation. Bisson and Bilby (1982) reported that juvenile coho salmon avoid turbidities exceeding 70 NTUs, and Sigler *et al.* (1984) in Bjornn and Reiser (1991) found that turbidities between 25 and 50 NTUs reduced growth of juvenile coho salmon and steelhead. Turbidity should affect Chinook salmon in much the same way it affects juvenile steelhead and coho salmon because of similar physiological and life history requirements between the species. Increased sediment delivery and high levels of turbidity also can cause infiltration of fine sediment into spawning gravels. This can lead to decreased substrate permeability and intergravel flow, resulting in oxygen depletion and mortality of incubating eggs and pre-emergent fry (Lisle and Eads 1991). Increased sediment delivery can also fill interstitial substrate spaces resulting in reduced abundance and availability of aquatic invertebrates for food (Bjornn and Reiser 1991).

Effects of project-related turbidity and introduction of sediment to the Sacramento River water could affect the behavior, growth, and migration of listed and proposed species in the action area. Adherence to the preventative and contingency measures of the SWPPP will minimize project related-sediment plumes caused by in-river construction by removing excavation materials to locations outside of the river channel and halting work in the event of a plume being detected. Sediment management and preventative measures will minimize the amount of project-related sediment introduced to the waterway through the deployment of a silt curtain around the in-water work area. In the event that a project-related sediment plume does occur, it would be of short duration, since work would be suspended, and would be expected to result in a temporary change in the distribution of fish in the action area, lasting only as long as the plume was present.

These types of events are unlikely to affect migrating adults to the extent of injuring them, but may injure some juvenile fish, which are actively feeding and growing, as well as smaller and less mobile, by temporarily disrupting normal behaviors that are essential to growth and survival. Injury would be caused when disruption of these behaviors increases the likelihood that individual fish will face increased competition for food and space, and experience reduced growth rates or possibly weight loss. Project-related turbidity increases may also affect the sheltering abilities of some juvenile fish and may decrease their likelihood of survival by increasing their susceptibility to predation. However, because of the short duration of the turbidity events, the injury and death that may occur to listed and proposed species from changes in feeding behavior, distribution and predation, are not expected to result in appreciable reductions in the species' likelihood of surviving and recovering in the wild.

d. *Loss of Shaded Riverine Aquatic (SRA) Habitat*

Riparian vegetation adjacent to the river, including SRA habitat, is a PCE of critical habitat for winter-run Chinook salmon. Riparian habitat is an important element of critical habitat because it provides cover, shelter, shade, and contributes to food production (Platts 1991).

Most of the SRA function within the project area is provided by the sparse riparian foothill and valley oak woodland vegetation communities located mostly on top of the levee banks. The riverbanks in the action area are levee structures including riprap and other revetments that lack complex natural riparian vegetation structure. Vegetation in this area consists primarily of California and Himalayan blackberry (*Rubus spp.*), tree-of-heaven (*Ailanthus altissima*), valley oak, mugwort, poison oak, and blue elderberry. Placement of the new outfall pipeline 15 feet from the centerline of the levee road will cause disturbance to vegetation within 30 feet on either side of the outfall alignment. The current quality of riparian vegetation in this reach and its contribution to SRA habitat is low.

Construction activities associated with the proposed project will result in adverse impacts to this PCE of critical habitat. These impacts are expected to be temporary, however, as any riparian vegetation disturbed or removed by construction of the proposed new outfall pipe will be replaced at a ratio of 2:1 (City of Redding Ordinance 2301, Section 3).

Disturbance of riparian habitat will temporarily affect winter- and spring-run Chinook salmon, steelhead and green sturgeon by reducing the amount of overhanging and submerged vegetation, and consequently the amount of cover available for fish, and the food supply provided when terrestrial insects fall into the river from overhanging vegetation. Disturbance of riparian vegetation is not expected to affect water temperature because the extent of shade to be lost is not sufficient to influence the effects of water temperature controlled through cold water releases from Shasta Reservoir.

The impacts to riparian vegetation are expected to affect a small section of critical habitat and the species utilizing the action area for 10 to 20 years following construction, or until current vegetation conditions become re-established. Willows and low shrubs will revegetate most quickly and may contribute to fish habitat in fewer than ten years; however, the larger trees such as cottonwoods and oaks that contribute the large woody component of SRA may take more than 20 years to be replaced. Since the area is dominated by low shrubs, most of the existing habitat features should be maintained or replaced within ten years. Juvenile fish utilizing the action area during this recovery period could be injured from the reduced levels of overhead cover and food supply, and increased exposure to predators. Because of the small size of the affected area, the limited term of the expected impacts, the abundance of other forms of overhead cover and shade (*e.g.*, pools and riffles), and abundant aquatic food production in this area of the river, it is unlikely that the expected reduction in riparian habitat values will appreciably reduce the listed species' likelihood of surviving and recovering in the wild.

e. *Potential Spill of Hazardous Materials*

Fuel spills or use of toxic compounds during project construction could release toxic contaminants into the Sacramento River and could injure or kill salmon and steelhead. NMFS expects that adherence to BMPs that dictate the use, containment, and cleanup of contaminants will minimize the risk of introducing such products to the waterway because the prevention and contingency measures will require frequent equipment checks to prevent leaks, will keep stockpiled materials away from the water, and will require that absorbent booms are kept on-site to prevent petroleum products from entering the river in the event of a spill or leak. If BMPs are successfully implemented, NMFS does not expect fuel spills or toxic compounds to cause injury or death to individual fish.

f. *Impaired Fish Passage*

The combined configuration of a sheet pile wall, work trestle, silt curtains, and/or a supersak occupying space in the river will reduce the width of the river and increase water velocities. An increase in water velocities will not prevent juveniles from passing downstream to rear, but has the potential to hinder the upstream migration of adult salmon, steelhead, and green sturgeon. The Sacramento River averages about 575 feet wide in the vicinity of the action area, but over half of the river channel's width would remain unimpeded to fish passage through the project area for the duration of in-water work according to the proposed project's design criteria. At the I-5 Bridge Replacement project near the City of Anderson, the gravel work pad and cofferdams constricted the channel width to approximately 100 feet. This constriction apparently did not result in velocities capable of preventing the upstream migration of adult salmon and steelhead because in 2001, 98.8 percent of winter-run Chinook salmon and 68.6 percent of fall-run Chinook salmon spawned upstream of the I-5 Bridge Replacement project. These spawning distributions are similar to previous years, prior to the construction period. Because in-water construction techniques for the proposed project will maintain a greater width of unconfined channel, and are expected to result in similar or less restrictive flow conditions as those found at the I-5 Bridge, no effects to fish passage, other than the potential delays related to avoidance of pile driving and other sounds (discussed above) are anticipated.

2. <u>Operations and Maintenance Impacts</u>

a. *Increased Treated Effluent Discharge Effects*

The water quality of increased effluent discharge has the potential to directly or indirectly affect all life stages of listed fish and their designated critical habitat. The United States Environmental Protection Agency (EPA) and the Regional Board has classified the Clear Creek Wastewater Treatment Plant effluent discharge as a major discharge. The Regional Board's Basin Plan designates beneficial uses, establishes water quality objectives, and contains implementation programs and policies to achieve these objectives for all waters of the Sacramento and San Joaquin river basins. Based on the Basin Plan's water quality objectives, specific effluent requirements are defined in the Clear Creek Wastewater Treatment Plant NPDES Waste Discharge Requirements Order No. R5-2003-013, City of Redding NPDES No. CA0079731 (North State Resources 2007). Several of these criteria for treated effluent discharge that are particularly important to aquatic life, including the listed anadromous fish species being considered in this Biological Opinion, are addressed in the following sections.

(1) Toxic Pollutants. Federal regulations require effluent limitations for all pollutants that are or may be discharged at a level that will cause or have a reasonable potential to cause, or contribute

to an in-stream excursion above a narrative or numerical standard. Based on information submitted as part of the City of Redding's NPDES permit application, in studies, and by monitoring and reporting programs, the Regional Board found that the discharge has reasonable potential to cause or contribute to in-stream excursions for above water quality standards for several constituents (North State Resources 2007). However, neither the reported effluent levels of these constituents, nor the NPDES permitted levels for the Clear Creek Wastewater Treatment Plant, rise to levels known to be acutely or chronically toxic to aquatic life (USEPA 1999).

(2) Biochemical Oxygen Demand. Biochemical oxygen demand (BOD) measures the amount of oxygen consumed by microorganisms in decomposing organic matter in water. BOD also measures the chemical oxidation of inorganic matter (*i.e.,* the extraction of oxygen from water via chemical reaction), and therefore BOD directly affects the amount of dissolved oxygen in rivers and streams. The greater the BOD, the more rapidly oxygen is depleted in the river. Consequences of high BOD and reduced dissolved oxygen on fish include reduced growth, behavioral changes, stress, increased susceptibility to pathogens, and ultimately death. Federal regulations, 40 CFR, part 133, provide technology-based effluent limitations for BOD and total suspended solids (TSS). Pursuant to those regulations, the BOD and TSS 30-day average discharge limit for secondary treatment systems shall not exceed 30 mg/L, and the 7-day average shall not exceed 45 mg/L, and the 30-day BOD percent removal shall not be less than 85 percent. However, special consideration of water quality objectives has historically been given for critical salmonid spawning areas in the Sacramento River from Redding to Hamilton City. Therefore, the NPDES permit for the Clear Creek Wastewater Treatment Plant requires more stringent effluent limits for BOD and TSS including a monthly average limit of 10 mg/L, weekly average limit of 15 mg/L, and a monthly average removal rate 85 percent. The Clear Creek Wastewater Treatment Plant currently discharges an average BOD of 3.0 mg/L, or 220 pounds/day, based on a flow of 8.8 mgd, which remains well below the permitted BOD effluent limits for this facility. The proposed action is expected to improve the efficacy of the secondary wastewater treatment process, especially during wet weather inflow conditions at the Clear Creek Wastewater Treatment Plant. Therefore, no significant degradation of dissolved oxygen would likely occur in the receiving water or likely impact associated critical habitat for the listed salmonids being considered in this Biological Opinion.

(3) Chlorine. The City of Redding plans to continue to use chlorine for disinfection of the treated wastewater at the Clear Creek Wastewater Treatment Plant. Chlorine is much more toxic to fish than humans (Brooks and Bartos 1984). Combined chlorine residual is the total amount of chlorine present in various forms (*e.g.,* chloramines, hypo-chlorous acid). Free chlorine reacts readily with organic matter, including gill tissue, causing acute necrosis and asphyxiation in fish (Noga 2000). The recommended maximum one-hour average and four-day average concentrations for chlorine in freshwaters to protect aquatic life are 0.02 mg/L and 0.01 mg/L, respectively (USEPA 1999). Under current operations and following the proposed action, chlorine residuals in the Clear Creek Wastewater Treatment Plant effluent (<0.01 mg/L according to the City of Redding NPDES permit #0079731 monitoring report for the period 2000-2005) are rapidly diluted to concentrations that do not adversely affect freshwater aquatic life.

(4) pH. The Basin Plan requires that the pH of surface waters shall not be depressed below 6.5 or raised above 8.5, nor shall a discharge alter pH of the receiving water by more than 0.5 units. Federal regulations at 40 CFR 133.102(c) describe the minimum level of effluent quality to be attained by secondary treatment facilities for pH to be within a range of 6.0 and 9.0. Under current operations and following the proposed action, the pH of the Clear Creek Wastewater Treatment Plant effluent ranges between 6.4 – 6.95 as reported in the City of Redding NPDES permit #0079731 monitoring report for the period 2000-2005. This falls well within the regulated range and does not represent an adverse impact to freshwater aquatic life, including the listed anadromous fish species being considered in the Biological Opinion.

3. Growth-Inducement Effects

The Clear Creek Wastewater Treatment Plant (CCWTP) is being rehabilitated and expanded to accommodate an additional 0.6 million gallon per day (mgd) of average dry weather flow (ADWF) for a total of 9.4 mgd, and an additional 23.8 mgd of peak wet-weather flow (PWWF) for a total of 40 mgd. The Wastewater Utilities Master Plan (North State Resources 2007) predicted future flow rates for both ADWF and PWWF based on projected future growth from the City of Redding (City) Planning Department population projections. The majority of the CCWWTP service area is within the city limits of Redding, with existing small pockets of land under the jurisdiction of Shasta County and the Redding Rancheria. Future ADWF was estimated to be 7.5 mgd in 2010 and 17.5 mgd at ultimate buildout in the CCWWTP service area. The City's General Plan was amended in April 2000. The EIR that was prepared identified growth-inducing impacts relative to new development planned for the City. The General Plan addresses potentially adverse impacts by implementing policies, programs, and proposals for adequate infrastructure and protection of environmentally sensitive resources.

The General Plan (City of Redding 2000) concludes that, "The General Plan goals, policies, guidelines, and mitigation options, together with all other appropriate legal routes necessary for adherence to other applicable policies and regulations, would reduce impacts to a less-than-significant level and should adequately protect biological resources in the city of Redding." While expansion of the WWTP will allow future growth to occur within the service area, this project is being undertaken to accommodate new growth already anticipated by the City. Policies and procedures are in place to help ensure that provisions of the ESA are adhered to and impacts to federally listed species and their habitats are avoided, minimized, and/or compensated. By implementing the policy measures outlined in the General Plan EIR and enforcing existing permit requirements, cumulative and growth-inducement impacts to federally-listed species resulting from the Clear Creek Wastewater Treatment Plant Upgrade and Expansion project are expected to be less than significant.

VI. CUMULATIVE EFFECTS

For purposes of the ESA, cumulative effects are defined as the effects of future State, tribal, local, or private actions affecting endangered and threatened species that are reasonably certain to occur in the action area being considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Non-Federal actions that may affect the action area include angling and State angling regulation changes, voluntary State or private sponsored habitat restoration activities, agricultural practices, water withdrawals/diversions, mining activities, and increased population growth resulting in urbanization and development of streamside/floodplain habitats. While state angling regulations have moved towards restrictions on selected sport fishing to protect listed fish species, listed ESUs in the upper Sacramento River continue to be negatively effected by impacts resulting from the targeted take of steelhead, incidental hooking of Chinook salmon, hook and release mortality, and trampling of redds by wading anglers. Habitat restoration projects may have short-term negative effects associated with in-water construction work, but these effects typically are temporary, localized, and the outcome is expected to benefit listed species. Increased water turbidity levels for prolonged periods of time may result from agricultural practices, mining activities, and increased urbanization and/or development of riparian habitat, and could adversely affect the ability of young salmonids to feed effectively, resulting in reduced growth and survival. Turbidity may cause harm, injury, or mortality to juvenile Chinook or steelhead in the vicinity and downstream of the project area. High turbidity concentration can cause fish mortality, reduce fish feeding efficiency and decrease food availability (Berg and Northcote 1985, McLeay *et al.* 1984, NMFS 1996). Farming and ranching activities within or adjacent to the action area may have negative effects on water quality due to runoff laden with agricultural chemicals. Water withdrawals/diversions may result in entrainment of individuals into unscreened or improperly screened diversions, and may result in depleted river flows that are necessary for migration, spawning, rearing, flushing of sediment from spawning gravels, gravel recruitment, and transport of large woody debris. Future urban development and bank protection projects (i.e., rip-rap) may adversely affect water quality, riparian function, and stream productivity.

Bank protection projects have significant potential to cause adverse effects to anadromous fish and their habitat as well. The effects of bank protection projects on anadromous fish have been thoroughly studied (USFWS 2000, Schmetterling *et al.* 2001, Garland *et al.*. 2002) and modeled (COE 2004, Stillwater Sciences 2006). Bank protection projects affect salmonids habitat availability and the processes that develop and maintain preferred habitat by reducing floodplain connectivity, changing riverbank substrate size, and decreasing riparian habitat and SRA. Simple slopes protected with rock revetment generally create nearshore hydraulic conditions characterized by greater depths and faster, more homogenous water velocities than occur along natural banks. Higher water velocities typically inhibit deposition and retention of sediment and woody debris. These changes reduce habitat quality along the shoreline by eliminating the shallow, slow-velocity river margins used by juvenile fish as refuge and escape from fast currents, deep water, and predators. Individual bank protection sites typically range from a few hundred to several thousand feet in length, and generally result in two levels of impacts to the environment: (1) site-level impacts which affect the basic physical habitat structure at an individual bank protection site; and (2) reach-level impacts which are the accumulative impacts to ecosystem functions and processes that accrue from multiple bank protection sites within a given river reach (USFWS 2000).

During the period from 1980 to 1990 the population of Redding increased by 27 percent, and from 1990 to 2000 it increased by 11 percent. For the next 25 years the projected population of the Redding area is expected to increase by 29.9 percent. Increased development is expected to occur concurrent with Redding's population expansion. Population growth and urbanization may adversely affect water quality in the action area as the amount of impervious surface area increases, resulting in peaking hydrographs of contaminated urban runoff. There are currently a number of infrastructure projects planned or underway on the Sacramento River in the vicinity of the Clear Creek WWTP; however, none of these is located within the action area and all are subject to federal permitting and approvals. The Cypress Avenue and Highway 44/299 Bridge widening projects will occur simultaneously between 2007 and 2010. These bridges occur approximately 6 and 7 miles upstream of the WWTP, respectively. Shasta County is also planning to replace the Deschutes Road Bridge over the Sacramento River, approximately 10 river miles downstream of the WWTP. The City of Redding is also planning to construct upgrades to the Lake Redding Boat Ramp, 10 miles upstream, in 2007. Each of the previously mentioned projects have either completed section 7 consultation and other environmental compliance permitting or are currently preparing to undergo these processes.

VII. INTEGRATION AND SYNTHESIS OF EFFECTS

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. §1536), requires Federal agencies to ensure that their actions are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat that has been designated for those species. Regulations that implement section 7(b)(2) of the ESA define *jeopardize the continued existence of* as engaging in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). With respect to threatened and endangered species, then, Federal agencies are required to ensure that their actions would not be reasonably expected to appreciably reduce the species' likelihood of both surviving and recovering in the wild, by reducing the species' reproduction, numbers, or distribution. The final step of our assessment uses the results from our effects analyses to ask (1) what is likely to happen to local populations given the exposure and responses of individual members to the effects of the proposed actions, and (2) what is likely to happen to the ESUs or DPSs that those populations comprise. These questions form the foundation for our jeopardy analyses.

A. Baseline Conditions

Populations of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead and the southern DPS of North American green sturgeon have declined drastically over the last century. They have been cut off from much of their historic spawning grounds by impassible dams and endured a general degradation of the remaining accessible habitat below those dams. Winter-run Chinook salmon and the southern DPS of North American green sturgeon are thought to be limited to single spawning populations in the mainstem Sacramento River. The current status of listed salmonids, based upon their risk of extinction, has not significantly improved since the ESUs were listed (Good *et al.* 2005).

Within the action area, specific baseline stressors include: controlled flows from Keswick Dam resulting in unnatural flow fluctuations, redd dewatering, and juvenile stranding; Increased heavy metal concentrations caused by discharges from Iron Mountain Mine resulting in chronic, sublethal concentrations of copper and other metals, with the potential for more severe spills and higher concentrations in the future; and degraded riparian habitat due to streamside development and bank revetment. There is excellent climax riparian habitat within the large island/side channel complexes immediately upstream and downstream of the action area, but the shoreline along the wastewater treatment plant has only a thin strip of small, shrubby plants with few trees or overhanging cover.

The action area is within the primary spawning habitat of the last remaining population of Sacramento River winter-run Chinook salmon, but the actual area that will be impacted by the proposed action provides poor spawning habitat due to inappropriate substrate size and flow conditions. DFG surveys have not detected recent salmonid spawning within the immediate action area. The primary spawning grounds of spring-run Chinook salmon and steelhead are found downstream of the action area in tributaries to the Sacramento River, with a small proportion of these fish spawning upstream of the action area, in the mainstem Sacramento River, Clear Creek, and other small tributaries. North American green sturgeon also spawn in the mainstem Sacramento River. However the shallow, fast moving habitat within and upstream of the action area is not the typically preferred spawning habitat for green sturgeon, and it is much more likely that they would spawn in the deep-water canyons downstream of the action area, between Anderson and Red Bluff. The action area's primary function is as migratory and rearing habitat for upstream migrating adults and downstream migrating juveniles. Only those fish that spawn (or are spawned) within or upstream of the action area during the year of construction would be affected by the proposed action.

B. Summary of Effects of the Action

1. <u>Construction Effects</u>

Under the proposed Clear Creek Wastewater Treatment Plant Upgrade and Expansion project, adverse impacts to listed species stemming from increased sedimentation and periods of high turbidity are expected to occur. These impacts may cause physiological stress to the extent that the normal behavior patterns (*e.g.*, feeding, sheltering and migration) of affected individuals may be disrupted. Potential impacts are expected to be minimized by meeting RWQCB water quality objectives, implementing BMPs for erosion control, staging equipment outside of the riparian corridor, and limiting the amount of riparian vegetation removal at the project site.

Any riparian vegetation that is removed during the proposed construction activities will be replanted at a 2:1 ratio. Impact minimization efforts and proposed replanting of affected riparian vegetation is expected to return the riparian habitat qualities to a level that will meet or exceed the current condition within 5 to 10 years.

Although the action area currently provides poor quality salmonid spawning habitat, the placement of a flow barrier in the river channel may cause a temporary reduction in the amount and quality of suitable spawning habitat in the immediate vicinity of the construction site. Over the long term, the amount and quality of spawning habitat PCEs are expected to be slightly improved over the baseline conditions, however, due to the fact that clean gravel contained in the supersaks will be left in the river channel (subject to approval from the Reclamation Board) and allowed to wash downstream and replenish spawning areas.

The elevated noise levels caused by pile driving activities are expected to cause temporary behavioral changes and/or loss or reduction of hearing in affected fish. Migrating salmonids may avoid the elevated noise of the pile driving operations by swimming around the area with the highest noise levels or holding outside of the high noise areas until there is a break in the pile driving actions. There is a potential for these fish to suffer a temporary loss of hearing sensitivity at the expected noise levels generated by the pile drivers. Loss of hearing sensitivities in the listed and proposed fish will expose them to higher risks of predation. Fish with impacted hearing capacities will have a lower ability to detect predators and may be unable to maintain position in the water column (inner ear equilibrium factors).

Noise from pile driving may also cause startling and/or avoidance of habitat by fish in the immediate vicinity of the project site. The startling of fish can cause injury by temporarily disrupting normal behaviors that are essential to growth and survival such as feeding, sheltering, and migrating. Disruption of these behaviors may occur for specific periods between October 1 and April 15 during daylight operation hours of the pile driving hammer. Construction lapses, including daily breaks and nighttime non-working periods, as well as long periods when no pile driving is scheduled to occur, will allow fish to migrate through the action area and minimize the extent of impacts to populations.

Engineering analysis of the proposed project estimates that sound pressure from driving large steel "H" piles could reach as high as 200 dB at the source and is likely to kill pre-eyed salmon and steelhead eggs for up to 450 feet away from the pile. Pile driving activities are scheduled to occur between October 1 and April 15, outside of the primary spawning and incubation seasons for winter-run Chinook salmon and North American green sturgeon. Because pile driving has the potential to occur throughout the tail end of the spring-run Chinook salmon spawning and incubation period (September through December), and much of the steelhead spawning and incubation period (December through May), spring run Chinook salmon and steelhead eggs are the most likely to be impacted by pile driving.

The percentage of Central Valley spring-run Chinook salmon eggs that is estimated to be potentially exposed to pile driving would be 0.12 percent of a single year's juvenile production. Due to the lack of population data on Central Valley steelhead, it is more difficult to estimate the percentages of steelhead eggs that may be impacted by the proposed pile driving activities. Several factors are expected to moderate the potential impacts on steelhead eggs, including:

- The majority of steelhead spawn in smaller tributary streams and are less likely to spawn in the mainstem Sacramento River.

- Steelhead spawning that does occur in the Sacramento River can be spread out over a large area due to cold water temperatures, and the project impact area makes up only 0.28 percent of this total suitable area.

- The construction area immediately downstream of the where the flow barrier will be deployed and where pile driving and trenching will occur is only marginally suitable for spawning compared to areas on the opposite side of the channel which will remain unobstructed.

- Pile driving activities are not expected to occur throughout the entire allowable work window, and only those steelhead eggs that are laid within 450 feet of large piles and 150 feet of sheet piles, and are fertilized within 12 days of pile driving activities are likely to be impacted.

Given this information, it is reasonable to assume that a very small fraction of the total egg production for Central Valley spring-run Chinook salmon and Central Valley steelhead will be exposed to, and therefore affected by, the proposed pile driving activities.

2. <u>Operations and Maintenance Impacts</u>

The effluent to be discharged into the action area from the Clear Creek Wastewater Treatment Plant over the long term is expected to meet all of the water quality objectives set forth in the State Water Quality Control Board's basin plan and the City of Redding NPDES permit #0079731. Neither the reported effluent levels of controlled/monitored constituents, nor the NPDES permitted levels of these elements for the Clear Creek Wastewater Treatment Plant, are expected to reach levels known to be acutely or chronically toxic to aquatic life (USEPA 1999).

C. Likelihood of ESU and DPS Survival and Recovery

In examining the potential impacts of the Clear Creek Wastewater Treatment Plant Upgrade and Expansion project on the survival and recovery of threatened Central Valley spring-run Chinook salmon, North American green sturgeon, and Central Valley steelhead, one must determine whether or not those impacts are likely to reduce the abundance, productivity, spatial structure, and genetic and life-history diversity of these fish in such a way that their likelihood of recovery and survival within the action area is appreciably diminished. The next step is to then determine how any such local impacts are likely to affect the overall ESU/DPS throughout the Central Valley.

1. <u>Likelihood of survival</u>

In considering the current baseline conditions, future cumulative effects, and the likely effects of the proposed action, NMFS has determined that the low level impacts of the proposed project occurring over the short construction period will be unlikely to cause an appreciable reduction in the population numbers, reproductive success or the distribution of listed fish in the Sacramento river to the point of appreciably reducing these populations= likelihood of survival into the future.

2. Likelihood of recovery

Because the effects of the action will be of a short duration and are expected to have only minor impacts on a single year class of juvenile fish, the proposed action is not expected to appreciably reduce these listed populations= likelihood of recovery or preclude the implementation of any future recovery actions in the upper Sacramento River.

3. Likelihood of Destruction or Adverse Modification of Critical Habitat

Because the action will have only temporary effects on a proportionately small area of critical habitat, and those effects are expected to be minimal and short in duration, the project is not likely to destroy or adversely modify the conservation value of the designated critical habitat or degrade the functions for which the habitat is currently being used.

VIII. CONCLUSION

After reviewing the best available scientific and commercial information, the current status of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and the southern DPS of North American green sturgeon, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that the Clear Creek Wastewater Treatment Plant Upgrade and Expansion project, as proposed, is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, or the southern DPS of North American green sturgeon, and is not likely to destroy or adversely modify the conservation value of their designated critical habitat.

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 the City so that they become binding conditions of any grant or permit, as appropriate, for the exemption in section 7(o)(2) to apply. The City has a continuing duty to regulate the activity covered by this incidental take statement. If the City: (1) fails to assume and implement the terms and conditions, or (2) fails to require the contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the City 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 Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and North American green sturgeon through construction-related impacts at the project site. Specifically, NMFS anticipates that juvenile listed salmonids and green sturgeon may be killed, injured, or harassed during construction activities. NMFS does not anticipate take of adults.

NMFS cannot, using the best available information, specifically quantify the anticipated amount of incidental take of individual Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and North American green sturgeon because of the variability and uncertainty associated with the response of listed species to the effects of the project, the varying population size of each species, annual variations in the timing of spawning and migration, and individual habitat use within the project area. However, it is possible to designate ecological surrogates for the extent of take anticipated to be caused by the project, and to monitor those surrogates to determine the level of take that is occurring. The three most appropriate ecological surrogates for the extent of take caused by the project are the amount and duration of pile driving conducted during project construction, the level of instream turbidity created by construction activities associated with the project, and the levels of toxic or hazardous compounds (primarily chlorine) found in the effluent released into the river during the long term operation of the project.

1. Ecological Surrogates

- The analysis of the effects of the proposed project anticipates that the construction of a sheet pile flow barrier would require driving sheet piles for three to six days (8 hours per day), and the construction of the temporary work trestle and anchors for the new diffusers will require driving approximately 60 steel H-piles during approximately twelve days of pile driving over a period of 7 months (October 1 through April 15)

- The analysis of the effects of the proposed project anticipates that turbidity levels will remain within the RWQCB standards listed in the Description of the Proposed Action section, and that increased turbidity from project construction activities will be limited to the instream work window of October 1 through April 15, and may extend downstream as far as 600 meters.

- The analysis of the effects of the proposed project anticipates that specific effluent requirements defined in the Clear Creek Wastewater Treatment Plant NPDES Waste Discharge Requirements Order No. R5-2003-013, City of Redding NPDES No. CA0079731 will be met throughout the life of the project. Specifically, that BOD and TSS monthly average limit of 10 mg/L, weekly average limit of 15 mg/L, and a monthly average removal rate 85 percent will not be exceeded, that the maximum one-hour average and four-day average concentrations for chlorine of 0.02 mg/L and 0.01 mg/L respectively will not be exceeded, and that pH of the effluent will range from 6.0 and 9.0.

If these ecological surrogates are not met and maintained, the proposed project will be considered to have exceeded anticipated take levels, triggering the need to reinitiate consultation on the project.

B. Effect of the Take

NMFS has determined that the level of take resulting from continued operation of the proposed project is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, CV steelhead, CV spring-run Chinook salmon, or the Southern DPS of North American green sturgeon, and is not likely to destroy or adversely modify designated critical habitat for these species.

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 anadromous fish.

1. Measures shall be taken to minimize injury and mortality from project construction, operations, and maintenance.

2. Measures shall be taken to maintain, monitor, and adaptively manage all conservation measures throughout the life of the project to ensure their effectiveness.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, The Corps and the applicant must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Measures shall be taken to minimize injury and mortality from project construction, operations, and maintenance.

    a. All driven piles shall be located and constructed so that, wherever feasible, piles can be left in place and reused in subsequent stages of the construction process.

b. The work window for pile driving and other in-water work shall be restricted to the period from October 15 through April 15. However; in-water work (including pile driving) may begin as early as October 1, provided that a qualified fisheries biologist confirms through weekly surveys commencing on September 1, that no Chinook salmon redds have been created within 150 yards of the pile driving areas within 30 days of the commencement of the work.

c. In order to reduce pile driving effects and improve spawning habitat within and downstream of the action area, the Corps shall require the City to employ the use of supersaks to create the flow barrier upstream from the diffuser alignment rather than installing sheet piles. However; if it can be shown that the use of supersaks or similar technology is infeasible or ineffective in producing the appropriate conditions within the work area, with prior written approval from NMFS, sheet piles may be used to construct or reinforce the flow barrier.

2. Measures shall be taken to maintain, monitor, and adaptively manage all project elements and conservation measures throughout the life of the project to ensure their effectiveness.

   a. The Corps or the City shall provide NMFS with a project summary and compliance report to NMFS within 60 days of completion of the proposed action. This report shall describe construction dates, implementation of project conservation measures, compliance monitoring and compliance with the terms and conditions of this biological opinion; observed or other known effects on listed fish, if any; and any occurrences of incidental take of the Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, or Southern DPS of North American green sturgeon.

   b. The Corps or the City shall provide NMFS with a detailed operations and maintenance plan for the long term operation of the Clear Creek Wastewater Treatment Plant within one year of completion of the proposed action.

   c. The Corps or the City shall notify NMFS upon initiation of in-water construction.

   d. The Corps or the City shall conduct acoustic monitoring within the water column and the substrate of the Sacramento River to determine the range and magnitude of compression shock waves generated by pile driving operations in the action area. Acoustic monitoring must be designed to detect if, and at what range, pile driving activities generate noise levels found to be lethal to juvenile salmonids (204 dB).

Reports and notifications required by these terms and conditions shall be submitted to:

Supervisor
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento California 95814-4706
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. These conservation recommendations include discretionary measures that the City can implement to avoid or minimize adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. NMFS provides the following conservation recommendations that would avoid or reduce adverse impacts to listed salmonids:

1. The Corps should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects within the Sacramento River.

To be kept informed of actions minimizing or avoiding adverse effects, or benefitting listed and proposed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

XI. REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed Clear Creek Wastewater Treatment Plant Upgrade and Expansion project. Reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in any incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the action, including the avoidance, minimization, and compensation measures listed in the *Description of the Proposed Action* section is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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Enclosure 2

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS

Agency:	U.S. Army Corps of Engineers
Activity:	Clear Creek Wastewater Treatment Plant Upgrade and Expansion Project
Consultation Conducted By:	NOAA's National Marine Fisheries Service

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

This document represents NOAA's National Marine Fisheries Service's (NMFS) Essential Fish Habitat (EFH) consultation based on our review of information provided by the U.S. Army Corps of Engineers (Corps) on the Clear Creek Wastewater Treatment Plant Upgrade and Expansion project in Shasta County, California. The Magnuson-Stevens Fishery Conservation Act (MSA), as amended (U.S.C 180 *et seq*.), requires that EFH be identified and described in Federal fishery management plans. Federal action agencies must consult with NMFS on activities 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. The geographic extent of freshwater EFH for Pacific salmon in the Sacramento River includes waters currently or historically accessible to Pacific salmon including the action area which lies within hydrologic unit 18020101 (lower Sacramento River).

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 essential fish habitat, "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 biological opinion for the Clear Creek Wastewater Treatment Plant Upgrade and Expansion project addresses Chinook salmon listed under both the Endangered Species Act (ESA) and the MSA that potentially will be affected by the proposed action. These salmon include Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), and Central Valley spring-run Chinook salmon (*O. tshawytscha)*. This EFH consultation will concentrate on Central Valley fall-/late fall-run Chinook salmon (*O. tshawytscha*) because they are covered under the MSA but not listed under the ESA.

Historically, Central Valley fall-run Chinook salmon generally spawned in the Central Valley and lower-foothill reaches up to an elevation of approximately 1,000 feet. Much of the historical fall-run spawning habitat was located below existing dam sites and the run therefore was not as severely affected by water projects as other runs in the Central Valley.

Although fall-run Chinook salmon abundance is relatively high, several factors continue to affect habitat conditions in the Sacramento River including loss of fish to unscreened agricultural diversions, predation by warm-water fish species, lack of rearing habitat, regulated river flows, high water temperatures, and reversed flows in the Sacramento-San Joaquin Delta (Delta) that draw juveniles into State and Federal water project pumps.

A. Life History and Habitat Requirements

Central Valley fall-run Chinook salmon enter the Sacramento River from July through December, and late fall-run enter between October and March. Fall-run Chinook salmon generally spawn from October through December, and late fall-run fish spawn from January to April. The physical characteristics of Chinook salmon spawning beds vary considerably. Chinook salmon will spawn in water that ranges from a few centimeters to several meters deep provided that the there is suitable sub-gravel flow (Healey 1991). Spawning typically occurs in gravel beds that are located in marginally swift riffles, runs, and pool tails with water depths exceeding one foot and velocities ranging from 1 to 3.5 feet per second. Preferred spawning substrate is clean, loose gravel ranging from one to four inches in diameter with less than five percent fines (Reiser and Bjornn 1979).

Fall-run Chinook salmon eggs incubate between October and March, and juvenile rearing and smolt emigration occur from January through June (Reynolds *et al.* 1993). Shortly after emergence most fry disperse downstream towards the Delta while finding refuge in shallow waters with bank cover formed by tree roots, logs, and submerged or overhead vegetation (Kjelson *et al.* 1982). 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). Smolts generally spend a very short time in the Delta and estuary before entry into the ocean.

II. PROPOSED ACTION

The Clear Creek Wastewater Treatment Plant (CCWTP) is located at 2200 Metz Road, east of Highway 273 and south of Clear Creek, at the southern city limits of Redding, California. The proposed project site is at Sacramento River Mile (RM) 288.8, near the CCWTP outfall. The CCWTP was first built in 1966, and later upgraded in 1977; it currently receives wastewater flows from 75 percent of the households and businesses (approximately 65,000 people) in the Redding area. The City of Redding (City) proposes to rehabilitate existing facilities and expand the treatment capacity of the CCWTP to accommodate anticipated growth outlined in the 2000-2020 General Plan and anticipated future wastewater flows by the year 2025.

The proposed project upgrades will include improvements to existing deficiencies and replacement of aging equipment, and will accommodate additional capacity for the average dry-weather flow (ADWF) from May through October, and peak wet-weather flow (PWWF) from November through April. Total ADWF and PWWF capacity would be increased from 8.8 to 9.4 million gallons per day (mgd) and from 16.2 to 40 mgd, respectively. Additional goals of the proposed project include the prevention of wastewater seepage, enhancement of treatment and disposal options, improved odor control, improved CCWTP energy efficiency, upgrades to employee facilities, and provision of consistent and safe operations. The proposed project will be funded through the State Revolving Fund (SRF) loan program.

The proposed project will be implemented in construction sub-phases, with all sub-phases anticipated to be completed by April 2012. A Categorical Exemption Document was prepared for implementation of the first sub-phase, which was completed in April 2006. The proposed construction for each remaining project feature and facility will be implemented in sub-phases two through eight. Sub-phase 4 is the only sub-phase that involves instream work, and thus will have direct effects on listed anadromous fish. Details of Sub-phase 4 are provided in the *Description of the Proposed Action* section of the preceding biological opinion (Enclosure 1). Details of the other sub-phases may be found in the May 2007 biological assessment, entitled the *City of Redding Clear Creek Wastewater Treatment Plan Upgrade and Expansion Project Biological Assessment/Essential Fish Habitat Assessment* (North State Resources 2007).

III. EFFECTS OF THE PROJECT ACTION

The effects of the proposed action on Pacific Coast salmon EFH would be similar to those discussed in the *Effects of the Proposed Action* section of the preceding biological opinion (Enclosure 1) for endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, and threatened Central Valley steelhead. A summary of the effects of the proposed action on Central Valley fall-/late fall-run Chinook salmon are discussed below.

Adverse effects to Chinook salmon habitat will result from construction-related impacts, operations and maintenance impacts, and impacts related to the temporary disturbance of aquatic and riparian habitat at the project site. Primary construction-related impacts include turbidity and suspended sediment created during pile driving activities, temporary work trestle installation and removal, and dredging. Habitat impacts include the temporary disturbance of approximately 500 linear feet of existing nearshore aquatic habitat along the Sacramento River levee. These actions will cause a temporary reduction in habitat availability, and nearshore habitat complexity and suitability.

In-channel construction activities such as dredging, pile-driving, and sheet pile installation will cause temporary increases in suspended sediment and turbidity. Turbidity will be minimized by implementing the proposed conservation measures such as implementation of best management practices (BMPs) and adherence to Central Valley Regional Water Quality Control Board water quality standards. Fuel spills or use of toxic compounds during project construction could release toxic contaminants into the Sacramento River and could injure or kill listed fish. Adherence to BMPs that dictate the use, containment, and cleanup of contaminants will minimize the risk of introducing such products to the waterway because the prevention and contingency measures will require frequent equipment checks to prevent leaks, keep stockpiled materials away from the water, and require that absorbent booms are kept on-site to prevent petroleum products from entering the river in the event of a spill or leak.

Overall, NMFS expects that the temporary disturbance of nearshore aquatic habitat in the action area may adversely affect the EFH of Chinook salmon through the reduction of habitat complexity necessary for growth, refugia, and survival. However, it is expected that adverse effects will be small, and reduced over time with the successful implementation of the project's conservation measures.

IV. CONCLUSION

Upon review of the effects of the Clear Creek Wastewater Treatment Plant Upgrade and Expansion project, NMFS believes that the project will result in adverse effects to the EFH of Pacific salmon protected under the MSA.

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 (Enclosure 1), NMFS recommends that Terms and Conditions 1a, 1b, 1c, 2a, 2b, 2c, and 2d, as well as all the conservation recommendations in the preceding biological opinion prepared for the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and North American green sturgeon ESUs, be adopted as EFH conservation recommendations.

Section 305(b)4(B) of the MSA requires the Corps to 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 Corps 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 Corps must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

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