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Staff Report:	April 1, 2005
Hearing Date:	April 15, 2005
Commission Action:	

STAFF REPORT: REGULAR CALENDAR

APPLICATION NO.: **1-04-005**

APPLICANTS: **County of Humboldt Department of Public Works**

PROJECT LOCATION: Within and along the levee banks of the lower 2½ River Miles of Redwood Creek, down stream of the Community of Orick, Humboldt County.

PROJECT DESCRIPTION: Vegetation and gravel removal during 2005-2009 as part of long-term, ongoing maintenance program within the Redwood Creek Flood Control Channel.

LAND USE PLAN DESIGNATION: Natural Resources (NR)

ZONING: Natural Resources (NR)

LOCAL APPROVALS RECEIVED: No local approvals necessary.

OTHER APPROVALS REQUIRED:

1) California Department of Fish and Game Fish and Game Code §1603 Streambed Alteration Agreement No. 04-0031;
2) (Pending) U.S. Army Corps of Engineers Clean Water Act §404 General Permit; and

3) (Pending) North Coast Regional Water Quality Control Board Clean Water Act §401 Water Quality Certification.

SUBSTANTIVE FILE DOCUMENTS:

1) U.S. Fish and Wildlife Service Endangered Species Act Consultation Biological Opinion; and
2) National Marine Fisheries Service Endangered Species Act Consultation Biological Opinion.

SUMMARY OF STAFF RECOMMENDATION:

Staff recommends that the Commission approve Coastal Development Permit No. 1-04-005 with conditions.

The County of Humboldt – Department of Public Works ("County" or "applicant") proposes to extract up to 90,000 cubic yards of gravel and clear an unspecified quantity of riparian vegetation annually over a five-year period from within and along the channelized lower reaches of Redwood Creek, downstream of the town of Orick, for flood control maintenance purposes.

The proposed project entails the resumption of the flood control facility management practices that have lapsed since 1988 when the County last excavated gravel and removed vegetation from the levee sides and bottom of the flood channel originally built by the U.S. Army Corps of Engineers in the late 1960s in response to major flood events along Redwood Creek that occurred in previous years. Although the County is contractually liable to the U.S. Army Corps of Engineers for maintaining the channel at a 250-year flood discharge capacity, acknowledging the environmental consequences such an endeavor would entail, the proposed development would result in restoring and maintaining the facility only to a 100-year flood capacity.

The proposed development, as conditioned, would allow the County to maintain its flood control facility infrastructure while supporting the natural integrity of the coastal riverine and estuarine habitat that lower Redwood Creek provides. The channel and levee maintenance would maintain water quality and habitat productivity, and protect natural resources and species of special concern.

Recommended Special Condition No. 1 requires the submittal for the review and approval of the Executive Director an annual gravel extraction and riparian vegetation removal plan that must conform to the extraction limits specified in Special Condition No. 2, which among other requirements, requires that the County use the extraction methods described in the NOAA Fisheries biological opinion and that the upstream ends of bars not be mined. Special Condition No. 1 also requires the annual submittal of stream cross-sections and other data prepared in conformance with the requirements of the Corps permit which will incorporate the recommendations of the biological opinion. Special Condition No. 4 restricts the use of seasonal crossings in a manner consistent with the NOAA Fisheries recommendations. The conditions also require that all extraction activities and reclamation activities occur within the June 15 to October 15 time period recommended by NOAA Fisheries. Special Condition No. 5 requires the submittal of a coastal development permit amendment for Commission adoption of a final detailed mitigation and monitoring program for mitigating the loss of the riparian vegetation that will be removed under the subject permit within one year of Commission action on this permit.

The staff believes that the proposed project, as conditioned, is consistent with Coastal Act policies and therefore recommends approval of the project.

STAFF NOTES:

1. Repair and Maintenance Activities with Substantial Risks of Adverse Impacts

The California Coastal Act (PRC §30000 *et seq.*) provides for certain exemptions to the requirements of the Act for obtaining coastal development permits for certain repair and maintenance activities. Generally, repair or maintenance activities that do not result in an addition to, or enlargement or expansion of, the object of those repair or maintenance activities are permit-exempted. However, if the Commission determines that certain extraordinary methods of repair and maintenance involve a risk of substantial adverse environmental impact, pursuant to the standards set forth within the Commission's administrative regulations (14 CCR §13000), the subject repair and/or maintenance activities shall, by regulation, require that a permit be obtained. As the proposed development entails maintenance to facilities or structures located in an environmentally sensitive habitat area comprising the removal, whether temporary or permanent, of rip-rap, rocks, sand or other beach materials or any other forms of solid materials for which the presence of mechanized equipment is involved, the project has the potential for significant adverse impacts to environmentally sensitive habitat areas and wetlands. Therefore, pursuant to Section 13252(a)(3) of the Commission's administrative regulations, a coastal development permit is required for the proposed development.

2. Jurisdiction and Standard of Review.

All portions of the proposed project along and within the Redwood Creek Flood Control Channel within the coastal zone are located in submerged and tidal waters subject to the Commission's area of original or retained coastal development permit jurisdiction.

The standard of review that the Commission must apply to the portions of the project within its permit jurisdiction is the Chapter 3 policies of the Coastal Act.

3. Commission Action Necessary

The Commission must act on the application at the April 15, 2005 meeting to meet the requirements of the Permit Streamlining Act.

I. STAFF RECOMMENDATION, MOTION AND RESOLUTION OF APPROVAL.

The staff recommends that the Commission adopt the following resolution:

Motion:

> I move that the Commission approve Coastal Development Permit No. 1-04-005 pursuant to the staff recommendation.

Staff Recommendation of Approval:

Staff recommends a **YES** vote. Passage of this motion will result in approval of the permit as conditioned and adoption of the following resolution and findings. The motion passes only by affirmative vote of a majority of the Commissioners present.

Resolution to Approve the Permit:

The Commission hereby approves a coastal development permit for the proposed development and adopts the findings set forth below on grounds that the development as conditioned will be in conformity with the policies of Chapter 3 of the Coastal Act. Approval of the permit complies with the California Environmental Quality Act because either (1) feasible mitigation measures and/or alternatives have been incorporated to substantially lessen any significant adverse effects of the development on the environment, or (2) there are no further feasible mitigation measures or alternatives that would substantially lessen any significant adverse impacts of the development on the environment.

II. STANDARD CONDITIONS: See attached.

III. SPECIAL CONDITIONS:

1. Annual Gravel Excavation and Riparian Vegetation Removal Maintenance Plan

A. **PRIOR TO THE START OF EACH YEAR'S FLOOD CONTROL CHANNEL MAINTENANCE OPERATIONS**, the applicant shall submit, for the review and written approval of the Executive Director, a final gravel extraction and riparian vegetation removal plan for that season consistent with the terms and conditions of this permit and that contains the following:

1. A gravel extraction plan of the annual gravel extraction operation containing cross-sections, maps, and associated calculations that accurately depict the proposed extraction area, demonstrates that the proposed extraction will be consistent with the extraction limits specified in Special Condition Nos. 3 and 4 below, and is prepared in conformance with the requirements of the individual permit granted for the project by the U.S. Army Corps of Engineers, San Francisco District;

2. A pre-extraction vertical rather than oblique aerial photo of the site taken during the spring of the year of mining at a scale of 1:6000 and upon which the proposed extraction activities have been diagrammed;

3. A copy of the flood channel and levee maintenance plan approved by the Interagency Review Team (IRT);

4. A post-extraction survey of the prior year's gravel extraction maintenance activities conducted following cessation of extraction and before alteration of the extraction area by flow following fall rains, that includes the amount and dimension of material extracted from each area excavated and is prepared in conformance with the requirements of the individual permit granted for the project by the U.S. Army Corps of Engineers, San Francisco District;

5. The results of biological monitoring report data required by the individual permit granted for the project by the U.S. Army Corps of Engineers, San Francisco District;

6. A plan for run-off control to avoid significant adverse impacts on coastal resources. The runoff control plan shall include, at a minimum, the following components;

   (a) The erosion control, run-off, spill prevention and response plan shall demonstrate that:

(1) Run-off from the gravel mining extraction and stockpiling sites shall not increase sedimentation in coastal waters;

(2) Run-off from the gravel mining extraction and stockpiling sites shall not result in pollutants entering coastal waters;

(3) Best Management Practices (BMPs) shall be used to prevent entry of polluted stormwater runoff into coastal waters during the transportation and storage of excavated materials, including but not limited to:

(4) A suite of the following temporary erosion and runoff control measures, as described in detail within in the "California Storm Water Best Management Commercial-Industrial and Construction Activity Handbooks, developed by Camp, Dresser & McKee, *et al.* for the Storm Water Quality Task Force, shall be used during mining: *Spill Prevention and Control* (CA12), *Vehicle and Equipment Fueling* (CA31), *Vehicle and Equipment Maintenance* (CA32), *Employee / Subcontractor Training* (CA40), and *Dust Control* (ESC21);

(b) A narrative report describing all temporary runoff control measures to be used during mining;

(c) A site plan showing the location of all temporary runoff control measures; and

(d) A schedule for installation and removal of the temporary runoff control measures.

B. The permittee shall undertake development in accordance with the approved final flood control facility maintenance plan. Any proposed changes to the approved final maintenance plan shall be reported to the Executive Director. No changes to the approved final flood control facility maintenance plan shall occur without a Commission amendment to this coastal development permit, unless the Executive Director determines that no amendment is legally required.

2. <u>Extraction Limitations</u>

Extraction of material shall be subject to the following limitations:

(a) Consistent with the proposed project description, the permittee shall extract no more than 90,000 cubic yards of gravel from the site per year;

(b) The permittee shall only extract material by secondary and mid-channel skims, narrow skims, dry trenching, horseshoe-shaped deep skims, or alcove extractions in the manner described in the NOAA Fisheries Biological Opinion. If dry trenching methods are used, a barrier such as silt fencing, or a gravel berm shall be constructed and maintained during trenching along the entire length of the excavated area to prevent turbid water from entering the flowing river. After completion of gravel extraction operations, the permittee shall remove the berm in several locations to prevent the creation of fish traps;

(c) Excavation shall not occur in the active channel (area where water is flowing unimpeded through the river channel);

(d) Extraction quantities shall not exceed: (1) the proposed cubic yards per year of gravel extraction; (2) any specific allocation limit required by the Army Corps of Engineers; and (3) the long term average sustained yield based on estimates of mean annual recruitment, as utilized by County of Humboldt Extraction Review Team (CHERT);

(e) Gravel extraction and vegetation removal operations shall not disturb or remove any of the riparian vegetation that is either: (1) located on gravel bars beyond the Interagency Review Team-approved gravel extraction or vegetation removal areas, access crossing, or stockpiling areas; or (2) within five feet of the base of the levee slopes, and less than four-inches-in-diameter at a four-inch height above ground;

(g) Horseshoe extractions shall occur on the part of the gravel bar that is downstream from the widest point of the bar and must be set back from the low flow channel with vertical offsets;

(h) Dry trench extractions shall be (1) limited to excavation on an exposed dry gravel bar; (2) either shallow and above the water table, or deep and extend below the water table, and (3) breached on the downstream end and connected to the river to prevent fish stranding after excavation when the sediment in the trench has settled;

(i) Alcove extractions shall be (1) located on the downstream end of gravel bars where naturally occurring alcoves form and provide refuge for salmonids; (2) regularly shaped or irregularly shaped to avoid riparian vegetation; (3) open to the low flow channel on the downstream end to prevent fish stranding; and (4) extracted to a depth either above or below the water table; and

(j) Any bar-skimming extractions that are consistent with subsection b above that are proposed adjacent to the low flow channel shall have a minimum skim floor elevation at the elevation of the 35% exceedence flow.

(k) The upstream end of the bar (head) shall not be mined or otherwise altered by gravel extraction operations. The minimum head of the bar shall be defined as that portion of the bar that extends from at least the upper third of the bar to the upstream end of the bar that is exposed at summer low flow.

3. Seasonal Site Closure

The seasonal development area must be reclaimed before October 15. The site must be reclaimed when extraction has been completed. Reclamation includes: (a) filling in depressions created by the mining that are not part of the approved extraction method; (b) grading the excavation site according to prescribed grade; and (c) removing all seasonal crossings and grading out the abutments to conform with surrounding topography and removing all temporary fills from the bar.

4. Seasonal Crossings

Any proposed crossing of the low flow channel or secondary channels that could be expected to maintain flow year-round shall be subject to the following criteria:

(a) The crossing shall be of the railroad flatcar or bridge variety, placed in a manner so as to span the channel with a minimum clearance of three (3) feet above the water surface;

(b) Stream channel crossing locations shall be determined on a site-specific basis. Special consideration shall be given to the proposed placement of the channel crossings at riffles and based on findings from CHERT that the location will minimize adverse effects to salmonids;

(c) No portion of the abutments or bridge supports shall extend into the wetted channel except in shallow flat water areas;

(d) The presence of heavy equipment in the wetted low-flow channel shall be minimized by limiting the number of heavy equipment crossings during each crossing installation or removal. A maximum of two crossing per installation or removal is allowed, although one crossing is preferred.

Heavy equipment shall not be used in the wetted low-flow channel except for channel crossing installation and removal;

(e) Channel crossings shall only be placed after June 30 of each year; and

(f) Channel crossing removal shall be completed by October 15 of each year.

5. **Final Riparian Vegetation Mitigation and Monitoring Plan**

WITHIN ONE YEAR OF THE COMMISSION'S ACTION ON COASTAL DEVELOPMENT PERMIT NO. 1-04-005, the applicant shall submit a coastal permit amendment application to the Commission for the adoption of a final detailed mitigation and monitoring program designed by a qualified wetland biologist for mitigating the loss of the riparian vegetation removed under the subject permit. The mitigation and monitoring program shall at a minimum provide either for (1) the in-kind replacement of riparian vegetation within the Redwood Creek watershed at a 1:1 ratio of riparian vegetation created to the maximum expected riparian habitat lost over the life of the project or (2) enhance stream channels within the watershed by removing barriers to fish passage and/or removing abandoned logging roads and similar facilities in and around streams within the watershed that enhances a total length of stream equivalent to the length of Redwood Creek affected by the project approved pursuant to this permit.

6. **Restricting Access to Maintenance Sites**

The permittees may restrict public access to all areas within 500 feet of the gravel extraction and vegetation removal sites during the period when maintenance activities are being performed. Public access on Redwood Creek to all boats and other watercraft may be similarly restricted within 300 yards of the maintenance sites. These restrictions needed to protect public safety shall only be enforced during maintenance operations. Any temporary signs and/or barriers used to close off the maintenance sites must be removed within 24 hours of cessation of gravel extraction or vegetation removal operations in the affected area.

7. **Permit Termination Date**

This permit only authorizes maintenance-related gravel extraction and major vegetation removal through October 15, 2009. All flood control channel maintenance operations after that date shall require a new coastal development permit.

8. **Army Corps of Engineers Approval**

PRIOR TO THE COMMENCEMENT OF BREACHING OPERATIONS, the permittee shall submit a copy of the permit issued by the U.S. Army Corps of Engineers granting approval for the project or evidence that no permit or permission is required. The permittees shall inform the Executive Director of any changes to the project required by the Army Corps of Engineers. Such changes shall not be incorporated into the project until the permittees obtain a Commission amendment to this coastal development permit, unless the Executive Director determines that no amendment is legally required.

IV. <u>FINDINGS AND DECLARATIONS</u>:

The Commission hereby finds and declares:

A. <u>Project Background</u>.

1. <u>History of Flood Control on Redwood Creek</u>

Following a series of floods through the mid-1950s and culminating with the 1964 "Christmas Flood" that devastated many coastal communities along California's Northcoast, including the town of Orick, the U.S. Army Corps of Engineers ("USACOE" or "Corps") constructed the Redwood Creek Flood Control Project. The facility comprises the channelization and levee berming of the lower 3.4 miles of the Redwood Creek drainage from more than a mile above Orick, just below its confluence with its major tributary, Prairie Creek, to a point approximately 1,000 feet upstream from the creek's mouth at the Pacific Ocean.

Although the flood events that had occurred through the 1950s and early 1960s were determined to represent 25-year recurrence flood events, with an average discharge of approximately 50,000 cubic-feet per second (cfs), the Corps designed the Redwood Creek facility to accommodate flow volumes of up to 77,000 cfs, approximately equivalent to a 250-year recurrence interval flood event. The channel was constructed with a width of approximately 250 feet and a 0.14% flow gradient throughout the project reach. The inner channel side slopes were excavated at a 1V:3H slope with riprap placed along the interior of the channelization varying in thickness from 12 to 24 inches. The 6.3 lineal miles of channel levees that line both banks of the creek extend to an approximately 25-foot height above the channel bottom and have a crest width of 12 feet with a one-lane unpaved maintenance road developed with several points of access from adjoining County roads. The inboard (landward) levee side slopes are graded to a 1V:2.5H slope. Construction commenced on the project in the spring of 1966 and the levees were completed and dedicated on September 22, 1968.

2. <u>Requisite Maintenance Responsibilities</u>

Upon completion of construction of the facility, ownership of the levees and channel bed was transferred to the County of Humboldt. Pursuant to applicable sections within the Navigation and Navigable Waters Title of the U.S. Code (33 USC §§ 208 *et seq.*), and as detailed in the "Redwood Creek Local Flood Protection Project – Humboldt County Operation and Maintenance Manual" (see Exhibit No. 9), upon receiving ownership of the flood control project improvements, the County also assumed the responsibility for maintaining the facility at its designed 77,000 cfs, 250-year flood through-flow capacity. Table 1 below, summarizes these maintenance responsibilities:

Table 1: **Requisite Maintenance Responsibilities for the Redwood Creek Flood Control Project**

Project Component	Maintenance Requirements
Channel and Floodway	• Keep channel or floodway clear of debris, weeds, and wild growth; • Assure the channel or floodway is not being restricted by the depositing of waste materials, the building of unauthorized structures, or other encroachments; • Prevent the capacity of the channel from being reduced by the formation of shoals; • Assure that the banks are not damaged by rain or wave wash, and associated sloughing; • Keep rip-rapped sections in good condition; and • Keep adjacent approach and egress channels clear of obstructions and debris that could interfere with their proper functioning.
Levees	• Promote soil development and the growth of sod on the flood control structure surfaces; • Exterminate burrowing animals; • Provide for the repair of erosion damage, unusual settlement, material sloughing, loss of grade or cross-sectional area; landsliding, seepage or sand boils; • Replace any dislodged or washed-out revetment work or riprap; • Maintain the levee crown to readily drain; and • Prohibit any encroachments onto the levee rights-of-way that might endanger the structure or hinder its operation.
Relief Wells	• Sound all relief wells prior to October 15 each year to determine the amount of sand deposition in pipes; • Flush any well with water and compressed air to clear any wells with greater than 12 inches of accumulated sand;

Project Component	Maintenance Requirements
	• Clear trash and other debris from collector pipe outlets; • Promptly make any necessary repairs and corrections to damaged relief wells and discharge systems; and • Cap with concrete any wells with chronic sand deposition problems and install replacement relief wells as needed.
Drainage Structures	• Maintain all through-levee drains, pipes, gates, operating mechanisms, headwalls, and riprap in good working condition; • Ensure that inlet and outlet channels are open; • Prevent the accumulation of trash and debris near drainage structures; • Assure that no fires are set near bituminous-coated pipes; and • Prevent erosion from occurring adjacent to structures that could endanger their water tightness or stability.
Miscellaneous Facilities	• Repair or replace all damaged, malfunctioning, or unserviceable parts without delay.

3. Previous Commission Flood Channel Maintenance Permit Actions

From 1968 through 1984, the County maintained vegetation growth along the Redwood Creek Flood Control Channel levees through the application of phenoxy- and glyphosate-based herbicides. Accumulated sediment was excavated by local gravel mining operators in exchange for the extracted aggregate materials. During this timeframe, these actions were viewed as forms of "repair or maintenance activities that do not result in an addition to, or enlargement or expansion of, the object of those repair or maintenance activities," no coastal development permit was required pursuant to Coastal Act Section 30610(d). The Coastal Commission became involved in the flood control channel maintenance in the mid-1980s when it received an application from the County requesting authorization to remove 250,000 cubic yards of gravel from the lower Redwood Creek streambed.

In 1985, and as extended for an additional year in 1997, the Commission approved Coastal Development Permit No. 1-85-078 for the initial extraction of 250,000 cubic yards of gravel to return the channel to its 250-year flood, 77,000 cfs conveyance design capacity, with provisions for subsequent removal of up to 110,000 cubic yards of accumulated sediments annually to maintain the facility's capacity. These extracted materials were vended to the contractor for the construction of the Highway 101 bypass of the Redwood State and National Parks between the towns of Orick and Klamath.

Beginning in the late 1980s and continuing throughout much of the 1990s, the County deferred further maintenance on the Redwood Creek flood control due, in large part, to budgetary constraints. During this period, the wave of sediment from the heavily harvested forested area upstream mobilized by the floods of the 1950's and 60s continued to move down and through the Redwood Creek watershed to deposit in the creek's lower reaches. In addition, riparian vegetation composed primarily of slough willow and red alder that had been removed under the previous permitted maintenance activities began to be reestablished, growing at rates of up to 12 feet in height each year.

Concurrent with this period of lapsed maintenance, several regulatory actions took place which have complicated the County ability to pursue a regular maintenance program of the Redwood Creek flood control facility. Beginning in the late 1960s, several fish and wildlife species, and rare plants that either inhabit the lower Redwood Creek vicinity, or for whom the lower watercourse provides suitable habitats, were afforded enhanced protection as listed or candidate species under the federal and state endangered species acts. These species listings include the California Brown Pelican (Pelecanus occidentalis californicus) on October 13, 1970, beach layia (Layia carnosa) on June 22, 1992, the tidewater goby (Eucyclogobius newberryi) on February 4, 1994, the willow flycatcher (Empidonax traillii) on February 27, 1995, the Southern Oregon / Northern California Evolutionarily Significant Unit (ESU) coho salmon on May 6, 1997, the California Coastal ESU Chinook salmon (Oncorhynchus tshawyscha) on September 16, 1999, and the Northern California ESU steelhead (Oncorynchus mykiss irideus) on June 7, 2000. Several other rare plant species endemic to the project vicinity appear in the California Native Plants Society's *Inventory of Rare and Endangered Plants of California* list as "1B" species, which qualify the plants as candidate species under the California Endangered Species Act. These include sand pea (Lathyrus japonicus), pink sand-verbena (Abronia umbellata ssp. brevifolia), Oregon coast Indian paintbrush (Castilleja affinis ssp. litoralis), and Howell's montia (Montia howellii). Moreover, to prevent impacts to aquatic habitats, especially those of anadromous fish and other endangered species, commencing in the late 1990s the Department of Pesticide Regulation in conjunction with the State Water Quality Control Board initiated programs to further restrict the application of herbicides near watercourses. The listing or candidacy of these species places the responsibility on the County to prepare biological assessments of the presence or potential presence of these organisms and to analyze the potential adverse impacts the proposed development would have on their viability and continuance as part of the environmental review processes for obtaining authorizations from the U.S. Army Corps of Engineers and the California Department of Fish and Game.

3. Other Project-related Programs

Redwood State and National Parks Management Plan – Redwood Creek Estuary Restoration Program

On April 18, 2000, a Record of Decision was published within the Federal Register announcing the National Park Service (NPS) adoption of "Alternative 1" of the *Final General Management Plan/General Plan/Environmental Impact Report* for the Redwood National and State Parks. Among the actions identified within the adopted plan were specified watershed management and restoration work to be undertaken at the Redwood Creek estuary. The plan states that NPS would play a leadership role in organizing a multi-disciplinary approach to addressing the restoration of the estuary chiefly through developing a plan for restoring the estuary and related fish and wildlife habitats in conjunction with private landowners, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the California Department of Fish and Game, the U.S. Army Corps of Engineers, the County of Humboldt, the residents of the community of Orick, the Yurok Tribe, and other interested parties. Among the methods identified for inclusion in such a plan were the following:

- Land acquisition from willing sellers;
- Conservation easements;
- Controlled breaching and channel manipulation;
- Partial levee removal; and
- Restructuring affected roads and drainage structures.

Partial Restoration of the Lower Redwood Creek Floodplain

In 2001, the Coastal Conservancy provided a $75,000 grant to fund a hydraulic and a feasibility study by the U.S. Army Corps of Engineers to assess various designs for setback levees and alternatives primarily for the end goal of restoration of the estuary, and secondarily to assess floodwater conveyance techniques that would require less habitat disrupting maintenance. A hydraulic analysis was completed for six different levee configurations downstream of the Highway 101 bridge. At a series of public meetings held in the fall of 2003 in Orick, the results of the hydraulic analysis were discussed. No clear consensus was reached as to an acceptable levee re-configuration. Since the 2003 community meetings, no further actions have been initiated toward pursuing restoration on the lower Redwood Creek floodplain through construction of setback levees.

B. Project Location and Description.

1. Project Location and Setting

The project site includes the channelized portions of the Redwood Creek Hydrologic Unit, along the lower 2.1 river-miles of Redwood Creek within the coastal zone. The project reach begins approximately 1,000 feet westerly from the Highway 101 bridge over Redwood Creek within the unincorporated town of Orick, in northwestern Humboldt County (see Exhibit Nos. 1-3).

Redwood Creek, a sixth-order river in north coastal California is approximately 60 miles in length and drains a 280-square-mile basin. The main stem together with an additional 60 miles of fifth-order tributary channels, support anadromous fish stocks. The downstream one-third of the watershed as well as the intertidal sloughs and estuary at the creek's mouth lie within the borders of Redwood National Park. The upstream two-thirds of the watershed and the lands in the vicinity of the Town of Orick adjacent to the flood control facility between Prairie Creek and the estuary are privately owned.

As tidal and/or submerged lands at the time of entry into the Union, the State of California has a fee interest at the flood control project site. The site is located on sovereign state lands held by the California State Lands Commission. Access to the levees and channel is via a series of gated access roads at the termini of several County roads within the Town of Orick. The area surrounding the flood control facility consists of a generally flat coastal plain devoted primarily to agriculture but also developed with a variety of residential, commercial, and public facility uses.

Redwood National Park – Redwood Creek Estuary Unit

On October 2, 1968, the National Park Service acquired the northern and southern intertidal sloughs at the mouth of Redwood Creek, adjoining coastline, and former grazing and lumber mill site as part of the establishment of Redwood National Park. These acquired parklands lie immediately downstream of the project reach and contain an estuary complex that provides habitat to a diverse set of ecological communities.

2. Project Description

The applicants are requesting a five-year permit to conduct annual maintenance on the Redwood Creek Flood Control Project floodway channel and levees. Maintenance activities would include vegetation removal and gravel extraction designed to improve the hydraulic capacity of the floodway channel between the levees. The objective of the proposed five-year maintenance program is to maintain the flood control channel to standards acceptable to the U.S. Army Corps of Engineers, such that the County of Humboldt does not incur liability due to an increased risk of overtopping the Redwood Creek flood control levees.

Due to the numerous-variables involved in maintaining the floodway capacity while simultaneously protecting various natural resources and minimizing potential impacts to critical salmonid habitat, the County proposes to use a collaborative adaptive management approach to identify specific sites and quantities of sediment and vegetation to be removed to minimize the project's potentially significant adverse impacts on coastal resources. An Interagency Review Team (IRT) composed of staff members of Redwood National & State Park (RNSP), National Marine Fisheries Service (NOAA Fisheries), U.S. Fish & Wildlife Service (USFWS), California Department of Fish & Game (CDFG), the U.S. Army Corps of Engineers (USACOE), and the County of Humboldt would review and make recommendations on specific maintenance activities to be undertaken each year during the late spring to early autumn low-flow seasons. The County would provide members of the interagency review team with a gravel and/or vegetation management proposal during each year of the five-year permit period. Each proposal would identify discreet "hydraulic hot spots" within the channel portions lying downstream of the Highway 101 bridge from which specific amounts of gravel and/or vegetation would be removed. These areas would be rated in order of which would provide the greatest hydraulic benefit in terms of improvement to floodwater capacity and conveyance. The County would provide a ten-day notice to the team members so that they can review proposed maintenance actions and attend a field review.

The Interagency Review Team would review and approve the annual maintenance plan by consensus based upon a "decision matrix" developed by the reviewing agencies in 2002-2003. A field review would be conducted by NOAA Fisheries, in collaboration with RNSP and CDFG, would rank the fish habitat adjacent to each of the identified hydraulic hot spots as "high," "medium," and "low" with regards to importance for listed salmonids. Both hydraulic and habitat variables would then be used to develop a decision matrix, whereby areas ranked as high hydraulic hot spots with low to moderate ranked adjacent habitat would be prioritized for gravel and/or vegetation management. Areas within the flood control reach that could potentially benefit from sediment removal for improvement of salmonid habitat would also be given priority consideration. The decision matrix would not rule out treating other areas of the channel, especially through the use of sediment removal, but would be used as a tool for prioritizing sediment and vegetation removal in a manner that would reduce potential impacts on listed salmonids and their habitat (see Exhibit No. 7).

Gravel Extraction

The County has requested authorization for the excavation of up to 90,000 cubic yards of sand and gravel materials from the point bars and shoals that have formed within the floodway channel. This maximum volume was selected using data from the hydraulic analysis for six different levee configurations downstream of the Highway 101 Bridge. Removal of the full 90,000 cubic yards in any one year would represent an atypical situation, (e.g. following an extreme high flow event which had resulted in substantial deposition of sediment within the project reach). It is expected that during average years the volume removed would be significantly lower, estimated to be in the 30,000 to 50,000 cubic yard range.

Sediment would be removed through a variety of methods, including the use of traditional bar skimming, utilizing a minimum two foot vertical offset from the water surface elevation of the summer low flow. An upstream portion of the gravel bar would be left undisturbed to assure retention of the meander pattern and single narrow creek channel. Upon completion of skimming activities each year, the bar would be graded in the downstream direction, towards the thalweg to provide a free-draining surface and remove depressions where fish could become trapped when the creek's water levels drop. In addition, another potential alternative sediment removal design would be to excavate fish passage channels through the portions of the flood control reach that tend to flow intermittently (subsurface) during dry summers to aid salmonid migration by enhancing stream connectivity. Other alternative sediment removal designs include the construction of connected refugia alcoves at the downstream end of gravel bars where appropriate.

Access to the gravel extraction sites would be through the existing levee road system. The use of temporary bridges across open water stretches to access the gravel bars would be minimized, and temporary abutments would be constructed outside of the live channel to the maximum extent practical. Where the flatcar used as the bridge is not long enough to span the live channel, brow logs or concrete blocks could be used to reduce the amount of abutment material in contact with the live stream. To the maximum extent practical heavy equipment channel crossings would be limited to two passes per temporary bridge construction/removal. Use of abutment material would be minimized, and abutment material and approach ramps would be removed following removal of temporary bridges.

Sediment removal would not occur prior to June 15, or after October 15 of any year without prior written approval from CDFG in consultation with NOAA Fisheries. Provisions for extending the gravel extraction season to the end of October are to be based on the consideration of weather forecasts, rising flows and salmonid migration timing.

Vegetation Removal

Maintenance of the flood control facility would also involve the removal of vegetation from within the channel and along the levee side slopes. All ruderal vegetation along the rip-rapped slope of the levees down to within five feet of the "toe of the slope," defined as the intersection between the riprap and the current bed of Redwood Creek, would be removed. Vegetation removal from within the channel would be prioritized using the decision matrix for gravel extraction maintenance described above, focusing primarily on the high ranked hydraulic hot spots with low to moderate ranked adjacent salmonid habitat.

Within the five-foot zone above the toes of the levees, trees with a basal diameter greater than four inches as measured at four inches above ground level would be removed, but all other vegetation would be retained. The selection of various treatments to be implemented in any given year of the proposed five-year maintenance program will be accomplished through use of the decision matrix coupled with on-site visits and discussion with the interagency team. Other vegetation removal designs could include, but are not limited to, the following:

- Remove trees from the dry side of the islands to within ten feet of the live waters of the creek.
- Trees within ten feet of the creek on an island that are greater than four inches in diameter at a height of four inches above ground level would be removed and cut into four-foot lengths and left in place.

- To increase scour potential, remove all vegetation from the tip of a bar 30 feet downstream of the head of the bar.
- To provide potential velocity refugia for salmonids and to prevent excessive numbers of large trees on extensive dry stretches of bars, trees with a diameter of 4 inches and greater would be removed.
- To create a mosaic of vegetated and non-vegetated areas on the extensive dry stretches of bars, remove all vegetation from small areas on the bar while leaving other areas completely vegetated.

C. Development within Coastal Rivers and Streams.

Section 30236 of the Coastal Act provides that:

> *Channelizations, dams, or other substantial alterations of rivers and streams shall incorporate the best mitigation measures feasible, and be limited to (l) necessary water supply projects, (2) flood control projects where no other method for protecting existing structures in the floodplain is feasible and where such protection is necessary for public safety or to protect existing development, or (3) developments where the primary function is the improvement of fish and wildlife habitat.* [Emphases added.]

Section 30236 sets forth a number of different limitations on what development may be allowed that causes substantial alteration of rivers and streams. For analysis purposes, a particular development proposal must be shown to be for one of three purposes: (1) for a necessary water supply project; (2) flood control projects where there is no other feasible methods for protection of existing structures within the floodplain and the project is necessary for public safety and the protection of existing development; or (3) primarily for fish and wildlife habitat improvement. In addition, the development must incorporate the best mitigation measures feasible.

1. Permissible Uses for Channelization and Substantial Alteration of Streams

The first test set forth above is that any proposed channelization or other substantial alteration of a river or stream may only be allowed only for three purposes enumerated in Section 30236, including "flood control projects where no other method for protecting existing structures in the floodplain is feasible and where such protection is necessary for public safety or to protect existing development." The proposed development entails maintenance of an existing flood control project. The primary objective of the development is to increase the hydraulic competence and capacity of the Redwood Creek Flood Control Project for providing flood protection to the lower Redwood Creek watershed area. Thus, the substantial streambed alteration associated with the proposed flood channel maintenance program is allowable pursuant to Section 30235(2) of the

Coastal Act provided: (a) there is no other feasible method for protecting existing structures in the floodplain; and (b) such protection is necessary for public safety or to protect existing development.

a. Availability of Other Feasible Methods for Protecting Floodplain Structures

Flooding hazards in the lower Redwood Creek drainage could hypothetically be managed through other methods than the existing engineered channel and containment levees. For example, a flood control dam could be constructed upstream of Orick where the creek enters the mountain canyon to the east of town, impounding flood waters into a reservoir and allowing their release over time at flow rates that would not result in inundation of lands within the lower watershed. Another option would be to route Redwood Creek around flood-prone areas in the lower drainage through a bypass canal that would convey and discharge floodwaters safely into the Pacific Ocean. However, the County of Humboldt does not possess either the land base or the capital necessary to develop such large public works facilities. Notwithstanding these financial limitations, damming or diversions would result in far greater and wide-reaching significant adverse environmental impacts than would the proposed maintenance program. Thus, the Commission finds no other feasible measures exist for protecting structures within the lower Redwood Creek floodplain.

b. Necessity of Project for Public Safety and to Protect Existing Structures

As evidenced by the property damages that resulted during the various floods that occurred on Redwood Creek during the 1950s and in 1964 prior to construction of the Redwood Creek Flood Control Project, maintenance of the facility is necessary to prevent future flooding of the coastal plain areas in the lower watershed. At the present time, approximately 20% of the design capacity of the flood control facility has been lost due to accumulated sediment and vegetation within the channelized reach. Based upon hydraulic analysis performed in 2003, the encroachment of these materials in the channel and along the levees sides has effectively reduced the conveyance capacity of the facility from the original 77,000 cfs, 250-year recurrence interval flood event to approximately 50,770 to 65,200 cfs, roughly that corresponding to 50- to 100-year flood events. Without the proposed maintenance to selective remove accumulated sediment and vegetation from the channel and levee sides, the facility will continue to aggrade with sand and gravel deposits transported from the creek's upper reaches and become progressively more densely vegetated, further reducing the hydraulic competence and capacity of the channel. Overtime, this situation could eventually cause the flood control levees to be over-topped by creek flows generated from moderate high flow events, resulting in localized flooding of property in proximity to the area being over-topped. Should the structural integrity of the levees be compromised by saturation and erosion from such over-topping flows or by the seepage of stream flows through the levee along the rooting of vegetation growing in and on the channel slopes, a catastrophic breach of the facility could occur resulting in wide-spread flooding throughout the lower Redwood

Creek watershed. Such a failure would seriously jeopardize the public safety of the Orick area and would involve extensive damage to existing structures at low elevations within the lower creek drainage. Accordingly, the Commission finds that the protection to the Redwood Creek Flood Control Project as would be provided by the proposed project is necessary for public safety and the protection of existing development.

2. Feasible Mitigation Measures

The second test set forth by the stream alteration policy of the Coastal Act is whether best feasible mitigation measures have been provided to minimize the adverse environmental impacts of the subject channelization, damming, and/or substantial alteration of rivers or streams.

The proposed flood control facility maintenance activities would be conducted in riverine and riparian wetlands could have potentially significant adverse effects on a number of threatened, endangered and special status species and/or their habitat that depend on the aquatic environment of lower Redwood Creek.

Vulnerable Fish and Wildlife Species and Their Habitats

A total of seven plant and animal species that depend on the wetland environment of lower Redwood Creek and its environs are formally listed or have candidacy as either "endangered," or "threatened" under the Federal (FESA) and California (CESA) Environmental Species Acts, or have been identified as "species of special concern" by CDFG's Habitat Conservation Planning Branch. Table 2 below, summarizes the status of these species:

Table 2: Environmentally Sensitive Animal and Plant Species That Depend on the Aquatic and Riparian Vegetation Environments in the Lower Redwood Creek Area for Their Habitat

Taxonomic Group/Name	Common Name	Federal / State ESA Status
Fishes		
Oncorhynchus kisutch	Coho (Silver) salmon	FT/CCT
Eucyclogobius newberryi	Tidewater Goby	FE/CSC
Oncorhynchus clarki clarki	Coastal Cutthroat Trout	CSC
Oncorhynchus tshawytscha	Chinook (King) Salmon	CSC
Oncorhynchus mykiss	Steelhead	CSC
Birds		
Pelecanus occidentalis califomicus	California Brown Pelican	FE/CE
Vascular Plants		
Layia carnosa	Beach Layia	FE

Legend:
FE – FESA "Endangered"
FT – FESA "Threatened"
CE – CESA "Endangered"
CCT – CESA "Candidate Threatened"
CSC – California "Species of Special Concern"

The potential impacts to these species and habitat and their mitigation are discussed in the following sub-sections:

Coho Salmon – Federally Listed as Threatened

Coho salmon (*Oncorhynchus kisutch*) are found in many of the short coastal drainage basins between the Oregon border and Monterey Bay. In larger coastal drainages this species is usually found primarily in the lower-gradient reaches closer to the coast. Coho salmon distribution in the Redwood Creek basin is limited to the main stem and the larger low gradient tributaries, primarily in Prairie Creek and its tributaries, possibly owing to the lower gradient and more pristine nature of that watershed. Based on data collected by RNSP, it is estimated that coho can be found occupying 26 miles of stream within the Lower Redwood Creek Basin. Although coho salmon migrate, hold and rear in the 2.1 miles of lower Redwood Creek that is within the project area, there are no reports of spawning within this reach.

In commenting on the project EIR, the National Marine Fisheries Service (NOAA Fisheries) concluded that the extraction of gravel and the placement and removal of temporary channel crossings associated the proposed action may have adverse direct effects on salmonids and their habitat through: (1) injury or death from equipment contact; (2) increases in turbidity and sedimentation from pushing up bridge approaches and abutments and bridge use, including the reduction of invertebrate production at temporary channel crossing locations; (3) attraction of spawning adults and redd building by changes to local channel form; (4) noise and vibration disturbance from heavy equipment use; and, (5) introduction of petroleum products.

However, as further detailed in the biological opinion, NOAA Fisheries finds that only incidental take of coho would result from the project provided:

- Annual monitoring cross-sections of all identified bars within the project area developed subject to the protocols set forth in the most current U.S. Army Corps of Engineers Letter of Permission for Gravel Mining in Humboldt County (LOP 96-1C) are provided to NOAA Fisheries prior to the annual inter-agency review. Aerial photos of the project reach are similarly provided to NOAA Fisheries if a flood event equivalent to the 10-year recurrence interval occurs. In addition NOAA Fisheries must be provided the opportunity to review and the County's annual maintenance plan.

- The upstream end of the bar (head of the bar) is not mined or otherwise altered by gravel removal activities. The minimum head of the bar buffer is defined as the upstream one-third portion of the bar.

- The amount of time that heavy equipment is in the wetted low-flow channel is minimized by limiting the number of heavy equipment crossings per each temporary channel crossing installation and removal. A maximum of two equipment passes across the channel per installation or removal shall be allowed.
- All temporary channel crossings and associated fills are identified and approximately located in the annual pre-extraction information. If the flatcar used to construct the temporary bridge is not long enough to span the live channel, then brow logs, or concrete blocks are to be used to prevent native gravel material used for abutment construction from entering the live channel.

- All temporary channel crossings are constructed after June 30 each year.

- Woody debris must be provided to function as cover within the excavated alcove or fish passage channel (e.g., cut branches, trunks or root wads), and the annual pre-extraction mining plan describes the cover that will be associated with the alcove or fish passage channel be subject to NOAA Fisheries review and approval.

- The highest priority for annual vegetation removal shall be the removal of vegetation from the levee faces above the five-foot buffer found at the toe of the levees. The overall maintenance plan shall focus on gravel removal and vegetation removal from the levee faces above the five-foot buffer, such that annual vegetation removal from the channel bed (not including vegetation removal from the levee faces above the five-foot buffer found at the toe of the levees) shall be limited to a maximum of 25% of the entire annual maintenance plan.

- To reduce the cutting of deposited large woody debris within the action area and to reduce the effects to salmonids from reductions in large woody debris, all access roads owned or controlled by the County, and roads owned or controlled by the contractors used to implement the proposed action are to be gated and locked.

- Stream and riparian areas shall not be used as equipment staging or refueling areas. Equipment, both hand tools and heavy equipment, must be stored, serviced, and fueled away from riparian areas (i.e., equipment must not be stored, serviced or fueled within the channel bed or channel banks, nor on the levee faces themselves; equipment maintenance, re-fueling of equipment and storage of fuel shall be done within a fueling containment area with an impervious layer to provide containment of any spills). Machinery (e.g., chainsaws, bulldozers) will be inspected for leaks prior to use in riparian areas. Heavy equipment will be cleaned (e.g., power washed, steam) prior to use below the ordinary high water mark. The County has the materials necessary to implement spill cleanup plans, and that these materials are available to all work crews using heavy machinery, providing multiple sets of cleanup materials to each crew if sharing would prevent timely implementation of cleanup plans.

- All ground disturbing actions associated with the Redwood Creek Levee Maintenance Program must occur between June 15 and October 15 annually during the five-year permit period. If periods of dry weather are predicted after October 15, additional work may be done with NOAA Fisheries' approval, if the work can be completed within the window of predicted dry weather.

These provisions are incorporated into the attached special conditions. Special Condition No. 1 requires the submittal for the review and approval of the Executive Director an annual gravel extraction and riparian vegetation removal plan that must conform to the extraction limits specified in Special Condition No. 2, which among other requirements, requires that the County use the extraction methods described in the NOAA Fisheries biological opinion and that the upstream ends of bars not be mined. Special Condition No. 1 also requires the annual submittal of stream cross-sections and other data prepared in conformance with the requirements of the Corps permit which will incorporate the recommendations of the biological opinion. Special Condition No. 4 restricts the use of seasonal crossings in a manner consistent with the NOAA Fisheries recommendations. The conditions also require that all extraction activities and reclamation activities occur within the June 15 to October 15 time period recommended by NOAA Fisheries.

Therefore, the Commission finds that as conditioned as described above to incorporate the above-listed reasonable and prudent measures as identified in the NOAA Fisheries biological opinion, the maintenance program incorporates the best mitigation measures feasible to reduce potentially significant adverse environmental effects on coho salmon to less than significant levels consistent with the requirements of Section 30236 of the Coastal Act.

Tidewater Goby – Federally Listed as Endangered: The endangered tidewater goby has been found in Redwood Creek in varying numbers throughout the years. Tidewater gobies occur in near-estuarine tidal stream-bottoms with salinities close to that of fresh water, although this species is very tolerant of elevated salinities that may even approach those of full seawater (35 parts per thousand). Tidewater gobies are bottom-dwelling fish that prefer gravelly bottom areas with submerged plants.

Locally, Tidewater Gobies are known to occur in Stone Lagoon State Park just south of the Redwood National and State Parks (RNSP) boundary. The status and distribution of the species throughout all of RNSP are currently unknown. However, surveys are conducted annually in the Redwood Creek estuary, and presence/absence sampling was conducted in 1998 in Espa Lagoon near Gold Beach in Prairie Creek State Park. There are historic records of gobies at Freshwater Lagoon from the early 1950s prior to highway construction over the sand bar, and five gobies were collected from the Redwood Creek estuary in 1980. The Redwood Creek specimens are the last known captures of this species in the parks. It is unlikely that the species will return to the Redwood Creek estuary without reintroduction and restoration of the estuary to its historical configuration.

Based upon information initially gathered from surveys conducted in the estuary portions of Redwood Creek, and as reflected in their informal consultation (see Exhibit No. 8), the USFWS have determined that the proposed project will have no effect on the tidewater goby for the following reasons:

- In 1980, gobies were captured in the north slough of Redwood Creek. Since 1996, annual goby surveys have been conducted in the Redwood Creek estuary. No gobies have been detected during these annual surveys; and
- Based on the degraded conditions of the estuary and past survey results, it is reasonable to assume that gobies are no longer present in the Redwood Creek estuary.

Therefore, the Commission finds that no mitigation is required pursuant to Section 30236 of the Coastal Act to offset potential significant adverse environmental effects on the Tidewater goby as the proposed project has been determined to have no effect on the tidewater goby.

Coastal Cutthroat Trout, Chinook Salmon, and Steelhead, – State Listed as Species of Special Concern: Coastal cutthroat trout is a resident salmonid in coastal streams in northern California and southern Oregon, and is the most abundant salmonid in Redwood Creek. All of the life requisites for this species are provided by the conditions in the streams in Redwood Creek.

Chinook salmon generally spawn in upstream reaches of large streams and rivers along the Pacific Coast, but young fish spend several months during their first year "rearing" in suitable habitat in coastal estuaries and lagoons.

Steelhead are seagoing trout. Steelhead have a life history similar to that of *coho* salmon, although the steelhead (which is closely related to non-seagoing rainbow trout) find appropriate habitat conditions in smaller streams, and in more upstream reaches, than do the larger salmonids. CDFG data indicate that steelhead are common in Redwood Creek.
Although these species are "species of special concern" under the California Endangered Species Act, the California Department of Fish and Game has concluded that the proposed maintenance program would not significantly adversely impact populations of Coastal cutthroat trout, Chinook salmon, or steelhead, or the viability of their habitat within the Redwood Creek basin, its estuary, or feeder streams provided the protections for coho salmon are implemented. The proposed project would not significantly modify stream characteristics unique to Coastal cutthroat trout, Chinook salmon, or steelhead

from current conditions to a point where the extent or viability of these species would be adversely affected.

Therefore, the Commission finds that as conditioned as described above to incorporate the above-listed reasonable and prudent measures as identified in the NOAA Fisheries biological opinion for the protection of Coho salmon, the maintenance program incorporates the best mitigation measures feasible to reduce potentially significant adverse environmental effects on Coastal cutthroat trout, Chinook salmon, and steelhead to less than significant levels consistent with the requirements of Section 30236 of the Coastal Act.

Brown Pelican – State and Federally Listed as Endangered: California Brown Pelicans are found in estuarine, marine subtidal, and marine pelagic waters along the west coast from Mexico to Washington. They breed on offshore islands from southern California to the Pacific coast of southern Mexico and in the Gulf of California. The largest breeding colony in the United States is found on West Anacapa Island in southern California. This is currently the northern-most breeding colony along the west coast. Since the mid-1970s Brown Pelicans have expanded their range dramatically. By 1985 thousands of Brown Pelicans were migrating as far as the Washington coast. The range expansion from southern areas into the north has occurred along with the combination of greater reproductive success since 1985, *El Niño* events, and generally warmer water in the North Pacific Ocean. The increase in numbers in areas north of California rose from approximately 4,200 pelicans in 1987 to more than 10,000 in 1991. During that same time, fall counts of Brown Pelicans in northern California decreased. The coastline between Trinidad and the Klamath River has been identified as having the largest numbers of brown pelicans north of Point Arena during the summer. In fall, this area of use expanded to the Oregon border. Now in summer and fall brown pelicans are commonly observed along the entire RNSP coastline. Brown Pelicans can be seen in the area from April until January, however, the peak season of use is late June through October.

Offshore rocks, estuaries, and open beaches are used by Brown Pelicans for resting during the day ("loafing"); off shore rocks and estuaries are the most often preferred loafing sites. Groups of 100 or more individuals have been observed with some regularity at the Klamath and Smith River estuaries and the mouth of Redwood Creek. The largest number of pelicans recorded in one group by RNSP surveyors, estimated at 1,000 individuals occurred on the Klamath River spit.

Coastal water bird aerial surveys conducted by the California Department of Fish and Game indicate a relatively low amount of beach use by pelicans along the northern California coast. Aerial surveys in 2001 showed that pelicans observed on mainland beaches or sand spits constituted less than 10% of all pelicans observed loafing during those surveys. However, despite the observed preference for off shore rocks and estuaries pelicans are known to loaf on open beaches in RNSP with some regularity. Data collected by RNSP staff and others indicate that pelicans repeatedly use the same approximate locations on beaches. In RNSP these loafing sites include the beach near the mouth of Redwood Creek, the beach in the vicinity of Home and Boat Creeks near Fern Canyon, and open stretches of beach in the vicinity of Ossagon and Squashan Creeks to the north of the project site.

In reviewing the proposed development, the USFWS has determined that the proposed flood maintenance project may affect, but is not likely to adversely affect, the California brown pelican based upon the following factors:

- Although the levee maintenance activities may temporarily disturb loafing or foraging pelicans in the Redwood Creek estuary, because of the temporary nature of the disturbance and the availability of other loafing and foraging areas, this disturbance is not expected to significantly alter essential behaviors such as feeding and loafing. In addition, no known pelican breeding colonies exist along the Humboldt County coastline;

- No suitable pelican habitat that exists within, along or in proximity to the flood control channel would be removed or degraded by the project.

Therefore, the Commission finds that based upon the determination of the USFWS, no mitigation is needed pursuant to Coastal Act Section 30236 to offset potentially significant adverse impacts to brown pelicans from the proposed maintenance program on Redwood Creek as the proposed project is not likely to adversely affect the California brown pelican.

Beach Layia – Federally Listed as Endangered: The Beach Layia is a succulent annual herb, less than 15 cm (6 inches) tall, belonging to the sunflower family (Asteraceae). It is a winter annual that germinates during the rainy season from fall to mid-winter, blooms in the spring, and sets seed before the dry season. It tends to grow in patches, and population numbers vary annually, both spatially and temporally. The species occupies sparsely vegetated open areas in semi-stabilized fore dune and coastal scrub communities. The habitat where it is located experiences some drifting sand and has low-growing herbaceous, perennial native species. Associated plant species, such as beach silver top (Glehnia leiocarpa), beach pea (Lathyrus japonicus and L. littoralis), dunegrass (Leymus mollis), pink sand-verbena (Abronia latifolia), beach strawberry (Fragaria chiloensis) and beach-bur (Ambrosia chamissonis) provide protection from sand movement and erosion. Beach Layia was State listed as endangered in 1991, and Federally listed as endangered in 1992.

Historically, Beach Layia was restricted to widely scattered, isolated populations within eight dune systems in California, from the mouth of the Little River in Humboldt County to the San Francisco peninsula. More recently it is known to occur in seven dune systems from Humboldt County to Santa Barbara County. The species occurs in 19 extant populations with 300,000 individuals; the largest populations are known from Humboldt

County. Extirpated populations at the mouth of the Little River were thought to represent the northernmost occurrence of the species until a population was discovered on southern end of Freshwater Spit in RNSP in July of 1999.

After the Freshwater population was discovered additional surveys for Beach Layia were conducted in all potentially suitable habitat in RNSP. No additional populations to date have been detected. Projects proposed in suitable Beach Layia habitat are surveyed entirely prior to project implementation.

Potential adverse effects to Beach Layia could occur if it were present within the area disturbed by gravel excavation activities. As previously stated, after the original discovery of the populations on Freshwater Spit surveys of all suitable habitat within the RNSP were surveyed with negative results. Given this fact it is unlikely that Beach Layia would be adversely affected by the excavation activities within the flood control channel.

Therefore, the Commission finds that based upon the determination of the USFWS, no mitigation is needed pursuant to Coastal Act Section 30236 to offset potentially significant adverse impacts to Beach Layia from the proposed maintenance program on Redwood Creek as the proposed project is not likely to adversely affect Beach Layia.

Emergent Riparian Vegetation- related Common Species

Late seral condition stands of riparian vegetation in good to excellent condition generally consist of four layers: grass/forb, low shrub, tall shrub, and a moderate to full tree canopy closure. Early seral stands generally lack tall shrub and have little or no tree cover and hence low canopy closure. Vertical structural diversity is generally lowest in early seral condition and highest in late seral condition. Horizontal patchiness is greater in early and intermediate seral condition and lower in late seral condition. Some types of disturbance may increase vertical and horizontal patchiness, including fire, grazing, and firewood cutting.

Notwithstanding the superiority of more established riparian corridors, emergent cover and riparian vegetation along perennial watercourses such as found along Redwood Creek can provide food and cover for a variety of common bird species. Suitable nesting and perching habitat for a variety of avian species has been found in and among the trees of early seral riparian vegetation surrounding wetlands or along rivers and streams on the northern California coast in settings similar to the riparian corridor along lower Redwood Creek. In addition, suitable conditions exist in and near the project site for the potential establishment of several rare plant species. Table 3 below, summarizes the environmentally sensitive plant and animal species for which riparian vegetation along the lower Redwood Creek drainage might provide habitat:

Table 3: Environmentally Sensitive Plant and Animal Species That May Utilize the Early Seral Riparian Vegetation Along Lower Redwood Creek for Habitat

Taxonomic Name	Common Name	Federal / State ESA Status
Birds		
Empidonax traillii	Willow Flycatcher	CE
Phalacrocorax auritus	Double-crested Cormorant	CSC
Pandion haliaetus	Osprey	CSC
Aix sponsa	Wood Duck	CCSC
Ardea herodias	Great Blue Heron	Protected
Egretta thula	Snowy Egret	CSC
Ardea alba	Great Egret	Protected
Nycticorax nycticorax	Black-crowned Night Heron	FSC
Vermivora celata	Orange-crowned Warbler	N/A
Vascular Plants		
Lathyrus japonicus	Sand pea	CNPS "1B"
Abronia umbellata ssp. brevifolia	Pink sand-verbena	CNPS "1B"
Castilleja affinis ssp. litoralis	Oregon Coast Indian paintbrush	CNPS "1B"
Montia howellii	Howell's montia	CNPS "1B"

Legend:
FE – FESA "Endangered"
FT – FESA "Threatened"
FSC – FESA "Species of Concern"
CE – CESA "Endangered"
CT – CESA "Threatened"
CCT – CESA "Candidate Threatened"
CCSC – Candidate California "Species of Special Concern"
CSC – California "Species of Special Concern"
CNPS "1B" – California Native Plants Society "1B" Listing[1]

Thus given the potential habitat value afforded by the riparian vegetation with the project reach of Redwood Creek to the above-listed species, mitigation to replace and offset the temporal losses of such habitat is indicated.

1 Pursuant to the Native Plant Protection Act and the California Endangered Species Act, plants appearing on the California Native Plant Society's "List 1B" meet the definition as species eligible for state listing as a rare, threatened, or endangered plant. List 1B plants are defined as "rare plant species vulnerable under present circumstances or to have a high potential for becoming so because of its limited or vulnerable habitat, its low numbers of individuals per population (even though they may be wide ranging), or its limited number of populations."

Therefore, the Commission finds that with the requirements of Special Condition No. __ that the applicant submit a coastal development permit amendment application to the Commission for the adoption of a final mitigation and monitoring program for mitigating the loss of the riparian vegetation to be removed by the proposed project, the project as conditioned incorporates the best mitigation measures feasible to reduce significant adverse environmental effects on riparian vegetation habitat to less than significant levels consistent with the requirements of Section 30236 of the Coastal Act.

Conclusion

As (1) the primary objective of the development is to manage the hydraulic competence and capacity of the Redwood Creek Channel for providing flood protection for the lower Redwood Creek watershed area, (2) no other feasible measures exist for protecting structures within the lower Redwood Creek floodplain, and (3) the project is necessary for the public safety and to protect existing development, the proposed substantial streambed alteration of the river is for an allowable purpose under Coastal Act Section 30236.

The proposed project is for five years of channel maintenance. The five-year authorization period will allow regulated sediment and vegetation removal to be undertaken while additional environmental monitoring studies are completed to further define and validate the maintenance strategy and ensure the long-term protection of sensitive species and habitats. The applicants have consulted with the USFWS, NOAA Fisheries, and other federal, state and local agencies about the implementation of management actions, including monitoring programs to study each listed species to confirm that there are no adverse environmental effects to any of the listed species from loss of habitat (see Exhibit Nos. 7, 8, and 9). Any results derived from the studies that document environmental impacts that are not addressed under the current protocols will be taken into consideration when the applicants apply for additional authorizations for maintenance in future years.

The proposed project as conditioned incorporates reasonable and prudent mitigation measures recommended by federal, state, and local agency consultations. The Commission imposes Special Condition Nos. 1 through 5 which reiterate in summary the provisions imposed by the various fish and wildlife trustee agencies who have reviewed the proposed development and additional mitigation to reduce impacts on coastal resources to levels that are less than significant. Therefore, the Commission finds, as conditioned herein, the proposed breaching program is consistent with the requirements of Section 30236 of the Coastal Act, in that the best feasible mitigation measures have been provided to minimize or avoid adverse environmental effects.

D. Hazards.

Coastal Act Section 30253 states in relevant part:

> *New development shall: (1) Minimize risks to life and property in areas of high geologic, flood; and fire hazard. (2) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.*

The primary purpose of the proposed project is to minimize the risk of flooding developed areas surrounding the channelized portions of lower Redwood Creek through: (a) restoring and maintaining the flood control facility to a capacity to convey flows associated with a 100-year recurrence interval flooding event; and (b) preventing the growth of riparian vegetation to a size that could compromise the structural integrity of the facilities levees.

As shown on the Federal Emergency Management Agency's Flood Insurance Rate Map for the Orick area (see Exhibit No. 4), the extent of "Flood Zone A," the 100-year floodplain, in the project area is limited to the area between the flood control facility's levees. Under present conditions, adjoining lands within the lower Redwood Creek drainage would be subject to flooding only if a flood event of greater magnitude than that of what the flood control channel could currently convey (55,000 cfs, roughly equivalent to the 100-year flood flow) were to occur, or if a physical breach of the levees developed allowing for the release of the creek's flows onto adjoining properties. Depending upon the magnitude of the greater than 100-year recurrence interval flood event, the severity of the breach and the water elevation within the creek at the time of the breach, surrounding areas within the lower watershed would become inundated, potentially resulting in damages to a variety of agricultural, residential, commercial, and public facility developed lands.

The applicants propose to selectively remove gravel and riparian vegetation from within the channel and along the levee sides of the Redwood Creek Flood Control Project. Although the proposed development would not result in the flood control channel being fully restored to its original 250-year flood capacity, the channel would be returned and maintained a condition that would accommodate flows that would result from a 100-year flood event. This action would afford flood protection at a level commensurate to the flood protection required by the Federal Emergency Management Agency's National Flood Insurance Program for development within flood prone areas such that flood insurance coverage could be secured for such development from underwriters of this federal program. Moreover, by maintaining the flood control facility to a 100-year flood capacity standard rather than returning the channel to its full designed capacity, aquatic and riparian fish and wildlife habitat that are provided by the facility would be protected.

A major objective of the proposed development is to restore maintain the hydraulic capacity of the Redwood Creek Flood Control Project such that accumulated gravel would not the cross-section volume of the facility to a point where over-topping of the levees would occur, or riparian vegetation which has become established within the channel and on the levee banks does not grow to a point where root growth would penetrate deep into the sides of the levees. If such overtopping and/or rooting were allowed to occur, the geologic stability of the flood control structure could be compromised from rill erosion over the top and inboard sides of the levee and from the "piping" of the creek's waters along the root channels. Either of these erosional forces could adversely impact the structural integrity of the levees, potentially leading to a catastrophic breach and release of floodwater. Thus, the inherent object of the development is to promote geologic stability by preventing such erosional impacts from occurring.

The proposed project effectively protects the important habitat values of the lower Redwood Creek riparian system while minimizing the risk to life and property from flood and geologic hazards. The Commission therefore finds that the proposed project is consistent with Coastal Act Section 30253.

E. **<u>Public Access and Coastal Recreation</u>**.

Coastal Act section 30210 states:

> *In carrying out the requirement of Section 4 of Article X of the California Constitution, maximum access, which shall be conspicuously posted, and recreational opportunities shall be provided for all the people consistent with public safety needs and the need to protect public rights, rights of private property owners, and natural resource areas from overuse.*

Coastal Act section 30211 states:

> *Development shall not interfere with the public's right of access to the sea where acquired through use or legislative authorization, including, but not limited to, the use of dry sand and rocky coastal beaches to the first line of terrestrial vegetation.*

Section 30212 (a) in part states:

> *Public access from the nearest public roadway to the shoreline and along the coast shall be provided in new development projects ...*

Coastal Act section 30214(a) states:

(a) *The public access policies of this article shall be implemented in a manner that takes into account the need to regulate the time, place, and manner of*

> *public access depending on the facts and circumstances in each case including, but not limited to, the following:*
>
> *(1) Topographic and geologic site characteristics.*
>
> *(2) The capacity of the site to sustain use and at what level of intensity.*
>
> *(3) The appropriateness of limiting public access to the right to pass and repass depending on such factors as the fragility of the natural resources in the area and the proximity of the access area to adjacent residential uses.*
>
> *(4) The need to provide for the management of access areas so as to protect the privacy of adjacent property owners and to protect the aesthetic values of the area by providing for the collection of litter.*

Section 30210 of the Coastal Act requires that maximum public access shall be provided consistent with public safety needs and the need to protect natural resource areas from overuse. Section 30212 of the Coastal Act requires that access from the nearest public roadway to the shoreline be provided in new development projects except where it is inconsistent with public safety, military security, or protection of fragile coastal resources, or adequate access exists nearby. Section 30211 requires that development not interfere with the public's right to access gained by use or legislative authorization. Section 30214 of the Coastal Act provides that the public access policies of the Coastal Act shall be implemented in a manner that takes into account the capacity of the site and the fragility of natural resources in the area. In applying Sections 30210, 30211, 30212, and 30214, the Commission is also limited by the need to show that any denial of a permit application based on these sections, or any decision to grant a permit subject to special conditions requiring public access, is necessary to avoid or offset a project's adverse impact on existing or potential access.

The maintenance site is located between the first public road and the sea. Therefore, the Commission must consider whether requiring public access is appropriate in this case. The proposed maintenance breaching activities do not require the provision of any new public access under Section 30212(a)(2) as adequate public access exists nearby, to and along adjacent beaches, and to the waters of Redwood Creek. Moreover, Sections 30210-30214 require that the public access policies be implemented in a manner that takes into account public safety and the protection of fragile coastal resources. The project will cause some interference with public access along the levees and boating access near the various extraction sites when the accumulations of sediment are periodically removed from the flood control channel. The gravel extraction and riparian vegetation activities create a hazard for those who venture too near the excavation and clearing sites as these maintenance entail the use of motorized heavy excavation and transport equipment and/or the felling of relatively large major vegetation. Therefore, the Commission attaches

Special Condition No. 6, which allows the applicant to restrict public access to all areas within 500 feet of the gravel excavation and vegetation removal sites during the maintenance operations. The condition also allows restrictions on boating access within 300 yards of the maintenance sites within the channel during the same period. However, the condition requires that the restrictions on access only be enforced during maintenance operations, and that any temporary signs or banners used to close off the maintenance sites must be removed within 24 hours of cessation of gravel extraction or vegetation removal operations in the affected areas.

As conditioned, the temporary restrictions on public access in the immediate proximity of active maintenance operations will pose no significant or lasting adverse impacts on public access or water-related recreational uses. The Commission therefore finds that the project, as conditioned, is consistent with the public access and recreational policies of the Coastal Act.

F. Visual Resources.

Section 30251 of the Coastal Act states:

> *The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas. New development in highly scenic areas such as those designated in the California Coastline Preservation and Recreation Plan prepared by the Department of Parks and Recreation and by local government shall be subordinate to the character of its setting.* [Emphasis added.]

In addition, Section 30240(b) of the Coastal Act states that:

> *Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas.* [Emphases added.]

The proposed project will affect public views within the coastal zone, including views from within some portions of Redwood National Park in two ways. First, the excavation of gravel and the removal of riparian from within the flood control channel bottom and/or from the outboard sides of the channel levees would alter the visual characteristics of the river channel. Second extraction and vegetation removal activities, the stockpiling of excavated gravel and/or vegetation cuttings, and the placement of temporary stream crossings could partially obstruct views for a temporary period of time during construction. However, none of these impacts would result in a significant impairment of scenic resources. The alteration of the channel would only occur in discrete, discontinuous localities along the overall project reach of Redwood Creek and would approximate the scouring the bars and riparian vegetation would be subjected to during naturally-occurring high-flows down Redwood Creek. Stockpiled materials would only be present for short periods of time until removed from the bar. The temporary stream crossings would only be in place seasonally between June 15 to October 15 and would be placed below the tops of the levees where they would be less noticeable.

The excavated and cleared areas within the flood control channel and along its levee sides would appear as open areas of exposed gravel and cobble substrate. Although the differences in bar elevation and the exposure of bare levee sides may be noticeable to hikers along the levees and to other users of the parklands and recreational facilities in and around the lower creek, the change in appearance will not be out of character with the surroundings, as the exposed gravel and levee would blend in with adjacent in-stream and levee areas.

Therefore, given that the visual impacts of the development are temporary and transient in nature, and the fact that the proposed maintenance activities would not significantly alter scenic public views within the lower Redwood Creek area, the Commission finds that this project is consistent with Sections 30251 and 30240(b) of the Coastal Act.

G. U.S. Army Corps of Engineers Review.

The project is within and adjacent to a navigable waterway and involves "waters of the United States," and is therefore subject to review by the U.S. Army Corps of Engineers (USACE) pursuant to the Federal Clean Water Act (33 USC §1341). Pursuant to the Federal Coastal Management Zone Act (16 USC 1451 *et seq.*), any permit issued by a federal agency for activities that affect the coastal zone must be consistent with the coastal zone management program for that state. Under agreements between the Coastal Commission and the USACE, the Corps will not issue a permit until the Coastal Commission approves a federal consistency certification for the project or approves a permit. To ensure that the project ultimately approved by the Corps is the same as the project authorized herein, the Commission attaches Special Condition No. 8 that requires the permittees, prior to commencing breaching operations, to: (1) demonstrate that all necessary approvals from the USACE for the proposed dredging and filling have been obtained; and (2) incorporate any changes required by the Army Corps only after the permittees obtain any necessary Commission-approved amendment to this permit.

H. California Environmental Quality Act (CEQA)

Section 13906 of the Commission's administrative regulation requires Coastal Commission approval of Coastal Development Permit applications to be supported by a finding showing the application, as modified by any conditions of approval, is consistent with any applicable requirements of the California Environmental Quality Act (CEQA). Section 21080.5(d)(2)(A) of CEQA prohibits a proposed development from being approved if there are any feasible alternatives or feasible mitigation measures available, which would substantially lessen any significant adverse effect the proposed development may have on the environment.

The Commission incorporates its findings on Coastal Act consistency at this point as if set forth in full, including all associated environmental review documentation and related technical evaluations incorporated-by-reference into this staff report. Those findings address and respond to all public comments regarding potential significant adverse environmental effects of the project that were received prior to preparation of the staff report. As discussed above, the proposed project has been conditioned to be consistent with the policies of the Coastal Act. As specifically discussed in these above findings, which are hereby incorporated by reference, mitigation measures that will minimize or avoid all significant adverse environmental impacts have been required. As conditioned, there are no other feasible alternatives or feasible mitigation measures available which would substantially lessen any significant adverse impacts, which the activity may have on the environment. Therefore, the Commission finds that the proposed project, as conditioned to mitigate the identified impacts, can be found consistent with the requirements of the Coastal Act and to conform to CEQA.

V. **EXHIBITS**:

1. Regional Location Map
2. Project Location Map
3. Project Site Map
4. FEMA-FIRM Community Panel No. 060060 0150B
5. Project Site Aerial Photographs (1948, 1988, 2002)
6. Project Description Narrative
7. NOAA Fisheries FESA Section 7 Consultation Biological Opinion
8. USFWS FESA Section 7 Informal Consultation Letter
9. Excerpt, *Redwood Creek Local Flood Protection Project Operation and Maintenance Manual*

APPENDIX A

STANDARD CONDITIONS

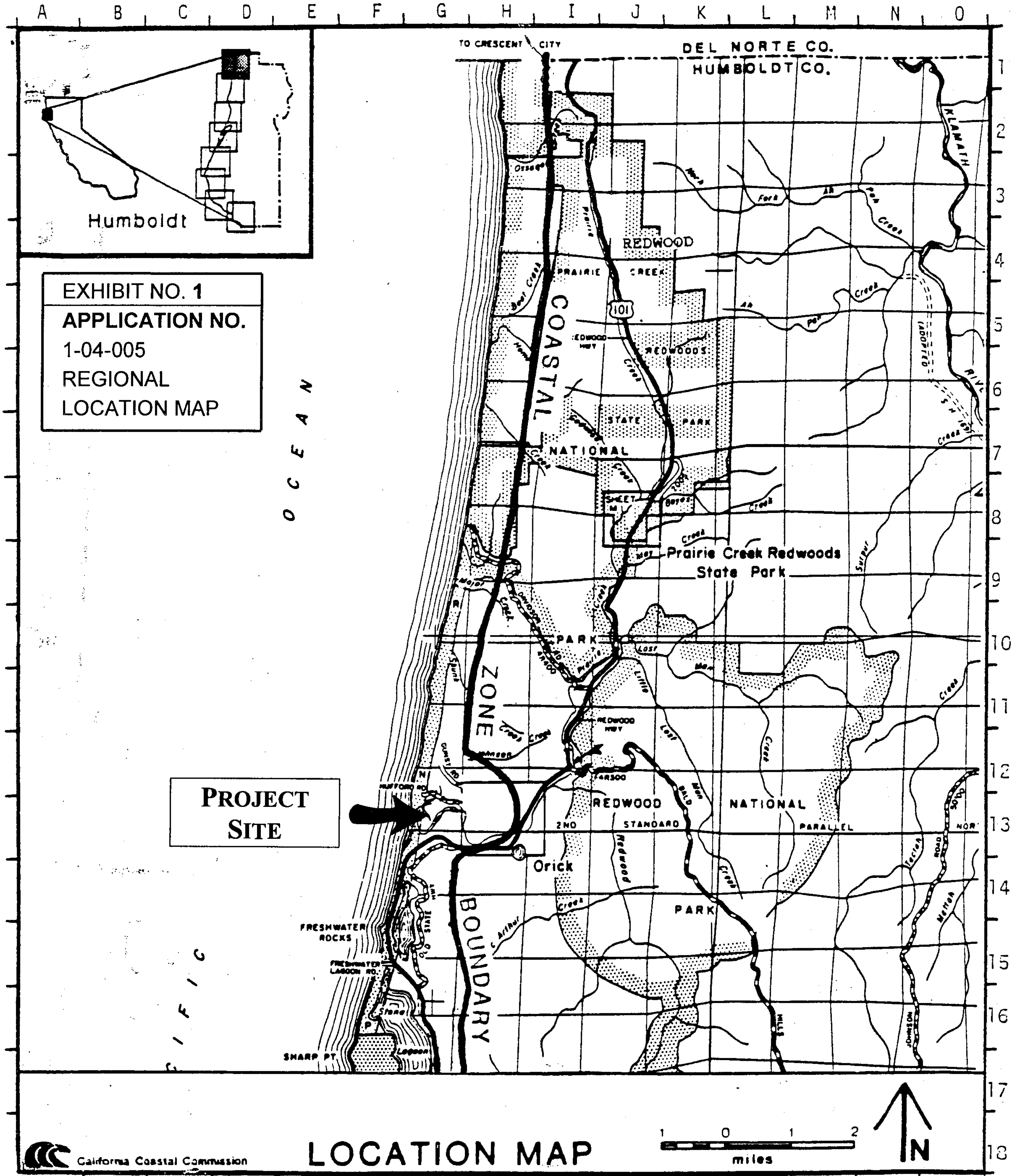
1. Notice of Receipt and Acknowledgement. The permit is not valid and development shall not commence until a copy of the permit, signed by the permittee or authorized agent, acknowledging receipt of the permit and acceptance of the terms and conditions, is returned to the Commission office.

2. Expiration. If development has not commenced, the permit will expire two years from the date on which the Commission voted on the application. Development shall be pursued in a diligent manner and completed in a reasonable amount of time. Application for extension of the permit must be made prior to the expiration date.

3. Interpretation. Any questions of intent of interpretation of any condition will be resolved by the Executive Director of the Commission.

4. Assignment. The permit may be assigned to any qualified person, provided assignee files with the Commission an affidavit accepting all terms and conditions of the permit.

5. Terms and Conditions Run with the Land. These terms and conditions shall be perpetual, and it is the intention of the Commission and the permittee to bind all future owners and possessors of the subject property to the terms and conditions.



County of Humboldt

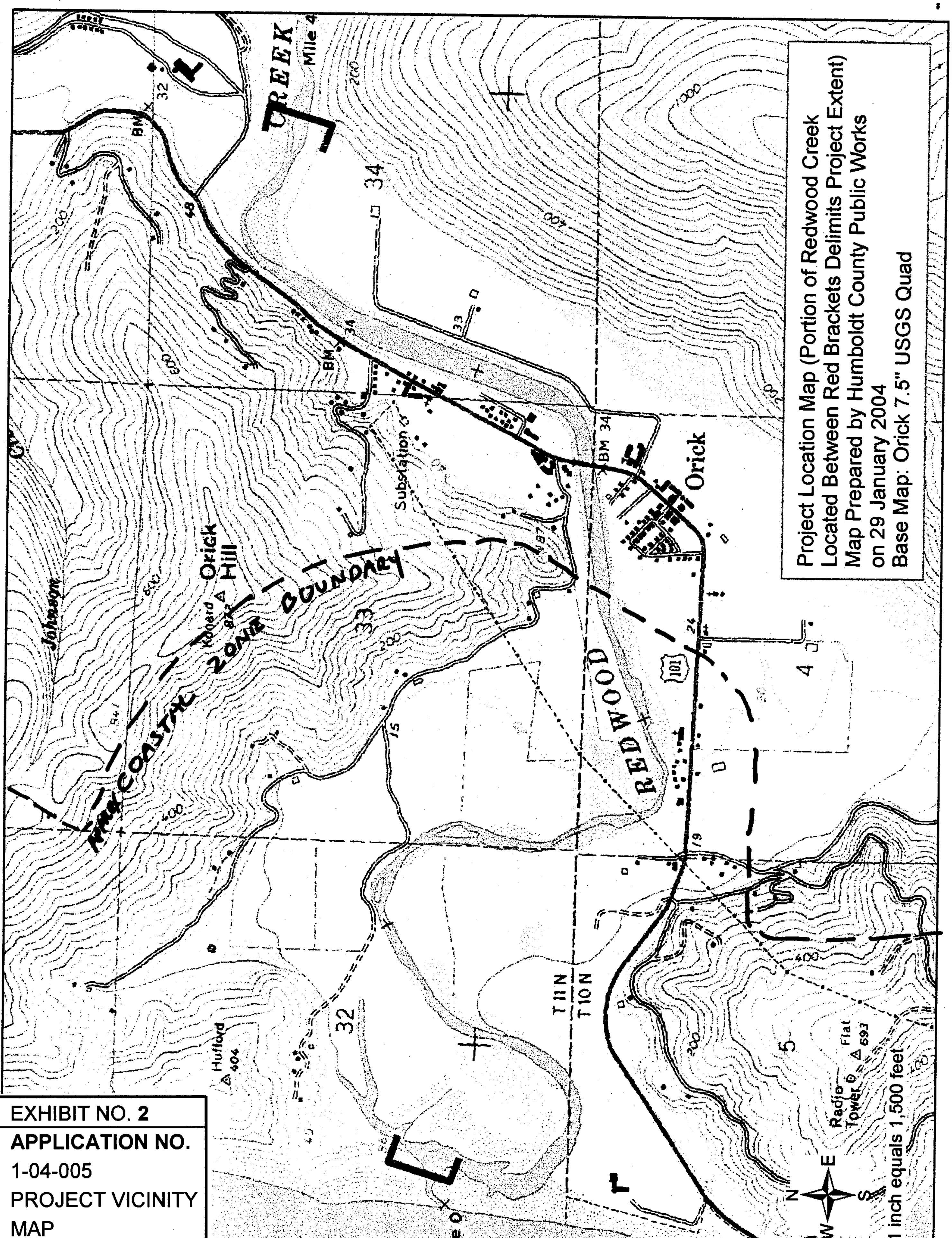


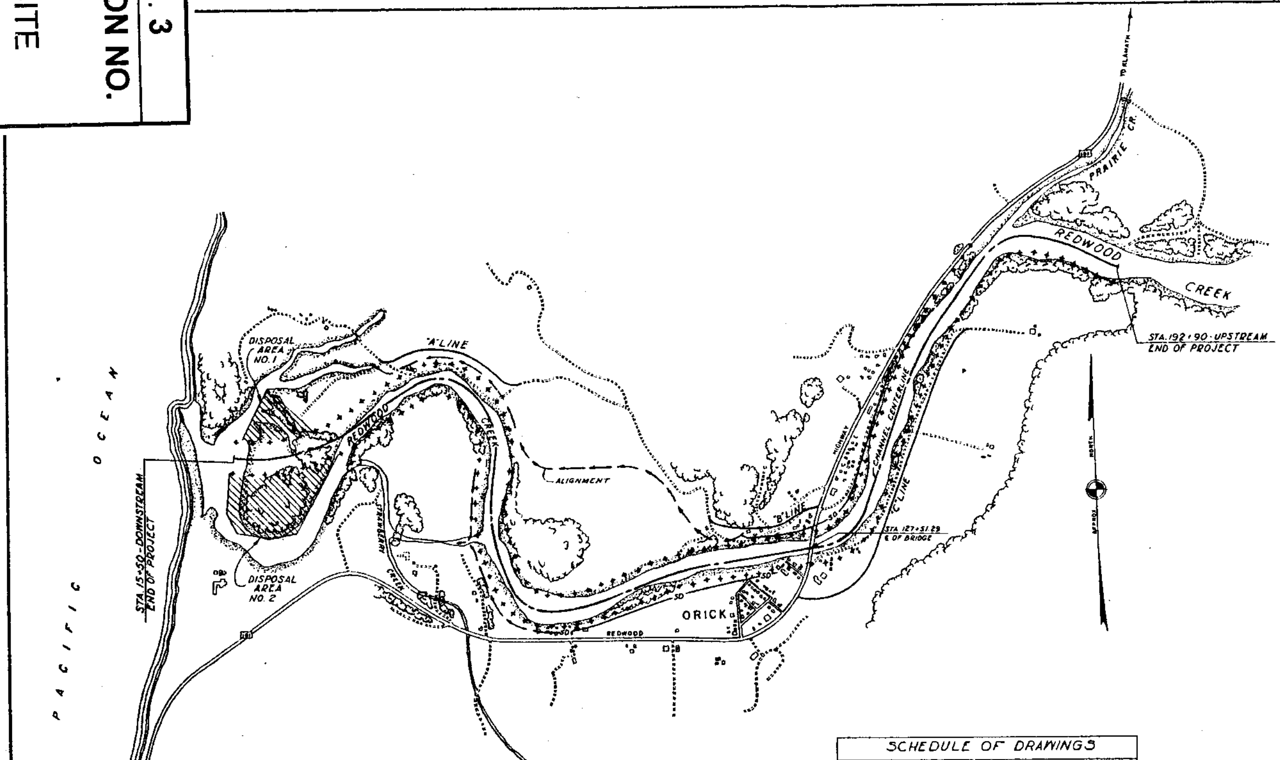
EXHIBIT NO. **2**

APPLICATION NO.

1-04-005

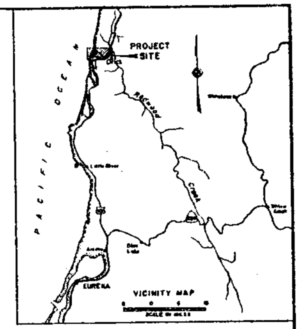
PROJECT VICINITY MAP

EXHIBIT NO. 3
APPLICATION NO.
1-04-005
PROJECT SITE
MAP



SITE PLAN

GRAPHIC SCALE: 1" = 600'



LEGEND

- CONSTRUCTION RIGHT OF WAY
- PAVED ROAD
- RELOCATED ROAD
- UNIMPROVED ROAD
- TELEPHONE LINE & POLES
- POWER LINE & POLES
- FENCE
- EDGE OF WATER
- BUILDING
- DEPRESSED AREA
- CULVERT - NEW
- CULVERT - EXISTING
- VEGETATION
- SD — STORM DRAIN - NEW
- SEPTIC TANK
- RELIEF WELL - NEW
- INTERIOR DRAINAGE DITCH - NEW
- LEVEE
- DISPOSAL AREA OR FILL AREA
- 2F-6 EXPLORATION HOLE (AUGER)
- 7F-6 EXPLORATION HOLE (UNDISTURBED SAMPLE)
- TH-1 AUGER BORING, COURTESY OF DIVISION OF HIGHWAYS, STATE OF CALIFORNIA
- R.C.P. REINFORCED CONCRETE PIPE
- BUILDINGS TO BE REMOVED BY OTHERS
- CORPS OF ENGINEERS DISK SET IN CONCRETE
- POST

NOTES:

1. ELEVATIONS ARE BASED ON THE DATUM OF MEAN SEA LEVEL.
2. DISTANCES, BEARINGS AND COORDINATES ARE BASED ON THE STATE OF CALIFORNIA COORDINATE SYSTEM (LAMBERT CONFORMAL PROJECTION), ZONE 1, CALIFORNIA, AS DESCRIBED IN SPECIAL PUBLICATION NO. 253 PUBLISHED BY THE U.S. COAST AND GEODETIC SURVEY.
3. ELEVATIONS ARE BASED ON U.S.C. & G.S. B.M. J-74 A STANDARD BRASS DISK SET IN WEST CURB AT SOUTH END OF HIGHWAY 101 BRIDGE OVER REDWOOD CREEK. ELEV 34.360 M.S.L.
4. FOR PROFILE OF INTERIOR DRAINAGE DITCHES SEE SHEETS 19 & 20.
5. ALL POWER LINES AND TELEPHONE LINES WILL BE RELOCATED BY OTHERS PRIOR TO CONSTRUCTION.
6. LOCATIONS OF SEPTIC TANKS AND WATER SUPPLY WELLS ARE APPROXIMATE ONLY. EXACT LOCATIONS WILL BE DETERMINED IN THE FIELD BY THE CONTRACTOR.

PROJECT CENTERLINE

LOCATION	BEARING	DISTANCE	COORDINATES X	COORDINATES Y
STA. 6+99.13			1,425,500.00	720,510.00
	S 82°38'24"E	1,935.35		
P.I. 1			1,427,420.00	720,262.00
	N 56°37'35"E	1,305.24		
P.I. 2			1,428,510.00	720,980.00
	N 61°11'21"E	1,027.15'		
P.I. 3			1,429,410.00	721,475.00
	S 41°26'27"E	740.35'		
P.I. 4			1,429,900.00	720,920.00
	S 32°16'32"E	[illegible]		
P.I. 5			1,430,140.00	720,540.00
	S 5°54'06"W	1312.97'		
P.I. 6			1,430,005.00	719,234.00
	S 18°34'27"E	1,208.86'		
P.I. 7			1,430,410.00	718,095.00
	N 89°46'32"E	785.02'		
P.I. 8			1,431,195.00	718,098.00
	N 69°23'35"E	1,543.38'		
P.I. 9			1,432,639.02	718,641.27
	N 81°43'36"E	2,597.21'		
P.I. 10			1,435,210.00	719,015.00
	N 20°00'37"E	2,703.19'		
P.I. 11			1,436,135.00	721,555.00
	N 34°41'34"E	1,584.74'		
P.I. 12			1,437,037.00	722,858.00
	S 84°59'30"E	836.19'		
P.I. 13			1,437,870.00	722,785.00
	S 63°55'28"E	772.17'		
P.I. 14			1,438,575.00	722,470.00
	S 87°02'44"E			

SCHEDULE OF DRAWINGS

DRAWING NO.	SHT. NO.	TITLE OF DRAWINGS
85-45-6	1	VICINITY MAP, SITE PLAN & SCHEDULE OF DRAWINGS
	2	PLAN AND PROFILE - STA. 11+00 TO STA. 46+00
	3	PLAN AND PROFILE - STA. 46+00 TO STA. 73+56.44
	4	PLAN AND PROFILE - STA. 73+56.44 TO STA. 113+00
	5	PLAN AND PROFILE - STA. 113+00 TO STA. 126+00
	6	PLAN AND PROFILE - STA. 126+00 TO STA. 142+00
	7	PLAN AND PROFILE - STA. 142+00 TO STA. 160+00
	8	PLAN AND PROFILE - STA. 160+00 TO STA. 177+25
	9	PLAN AND PROFILE - STA. 177+25 TO STA. 192+90
85-45-6	10	TYPICAL CROSS SECTIONS AND PROFILES
85-45-6	11	CROSS SECTIONS - STA. 17+00 TO STA. 49+00
85-45-6	12	CROSS SECTIONS - STA. 54+00 TO STA. 85+00
85-45-6	13	CROSS SECTIONS - STA. 89+00 TO STA. 118+00
	14	CROSS SECTIONS - STA. 119+50 TO STA. 150+00
	15	CROSS SECTIONS - STA. 155+00 TO STA. 175+50
85-45-6	16	CROSS SECTIONS - STA. 179+00 TO STA. 191+50
85-45-6	17	LEVEE CONSTRUCTION AT HIGHWAY 101 BRIDGE
85-45-6	18	PLAN AND PROFILE ACCESS RAMPS AND TURNAROUND

SCHEDULE OF DRAWINGS

DRAWING NO.	SHT. NO.	TITLE OF DRAWINGS
85-45-6	19	CENTERLINE PROFILE RIGHT INTERIOR DRAINAGE SYSTEM
85-45-6	20	CENTERLINE PROFILE LEFT INTERIOR DRAINAGE SYSTEM
85-45-6	21	BRIDGE PIER EXTENSION AND CONTROL SILL
85-45-6	22	RELIEF WELL AND CABLE GATE
85-45-6	23	DRAINAGE STRUCTURES
85-45-6	24	REINFORCED CONCRETE ENDWALL AND BOX CULVERT
85-45-6	25	REINFORCED CONCRETE MANHOLE AND INLET
85-45-6	26	DISPOSAL AREAS
85-45-6	27	LOCATION OF EXPLORATION HOLES
85-45-6	28-36	LOGS OF EXPLORATION HOLES
85-45-6	37-39	COUNTY ROAD RELOCATION
85-45-6	40	COUNTY ROAD RELOCATION
85-45-6	41-45	COUNTY ROAD RELOCATION
85-45-6	46	COUNTY ROAD RELOCATION
85-45-6	47-50	COUNTY ROAD RELOCATION
	51	ALTERNATE ALIGNMENT-INTERIOR DRAINAGE DITCHES STA. 59+50 TO STA. 112+86.61
	52	PROFILES AND TYPICAL SECTIONS BERMS AND ALTERNATE DRAINAGE DITCHES
85-45-6	53	REINFORCED CONCRETE BOX CULVERTS

SCHEDULE OF DRAWINGS

DRAWING NO.	SHT. NO.	TITLE OF DRAWINGS
85-45-6	54	EXTENSION OF SLOPE PROTECTION WORKS AT PRAIRIE CREEK PLAN & TYPICAL CROSS SECTIONS
85-45-6	55	EXTENSION OF SLOPE PROTECTION WORKS AT UPSTREAM LIMIT OF LEFT BANK - PLAN & TYPICAL CROSS SECTIONS

REVISIONS

SYMBOL	DESCRIPTION	DATE	APPROVAL
2	AS CONSTRUCTED - CHANGES MADE JWR	18 JAN 69	GW
1	ADDED NOTE, ALTERNATE ALIGNMENT AND SHEETS NO. 51, 52 & 53. REVISED END OF FIRST CONSTRUCTION PHASE. EM	4 MAR 66	

U. S. ARMY ENGINEER DISTRICT, SAN FRANCISCO
CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA

HUMBOLDT COUNTY — CALIFORNIA

REDWOOD CREEK
CHANNEL IMPROVEMENTS
VICINITY MAP, SITE PLAN AND
SCHEDULE OF DRAWINGS

DRAWN BY: G.P.E. R.R.
TRACED BY:
CHECKED BY: KJH
SUBMITTED: CHIEF, CIVIL SECTION
APPROVAL RECOMMENDED:
APPROVED:
DATE: 10 FEB. 1966
SCALE: AS SHOWN
SPEC. No. 66-36
PREPARED UNDER THE DIRECTION OF
ROBERT H. ALLAN
LT. COLONEL, C.E., DISTRICT ENGINEER
SHEET 1 — DRAWING NUMBER 85 45 6

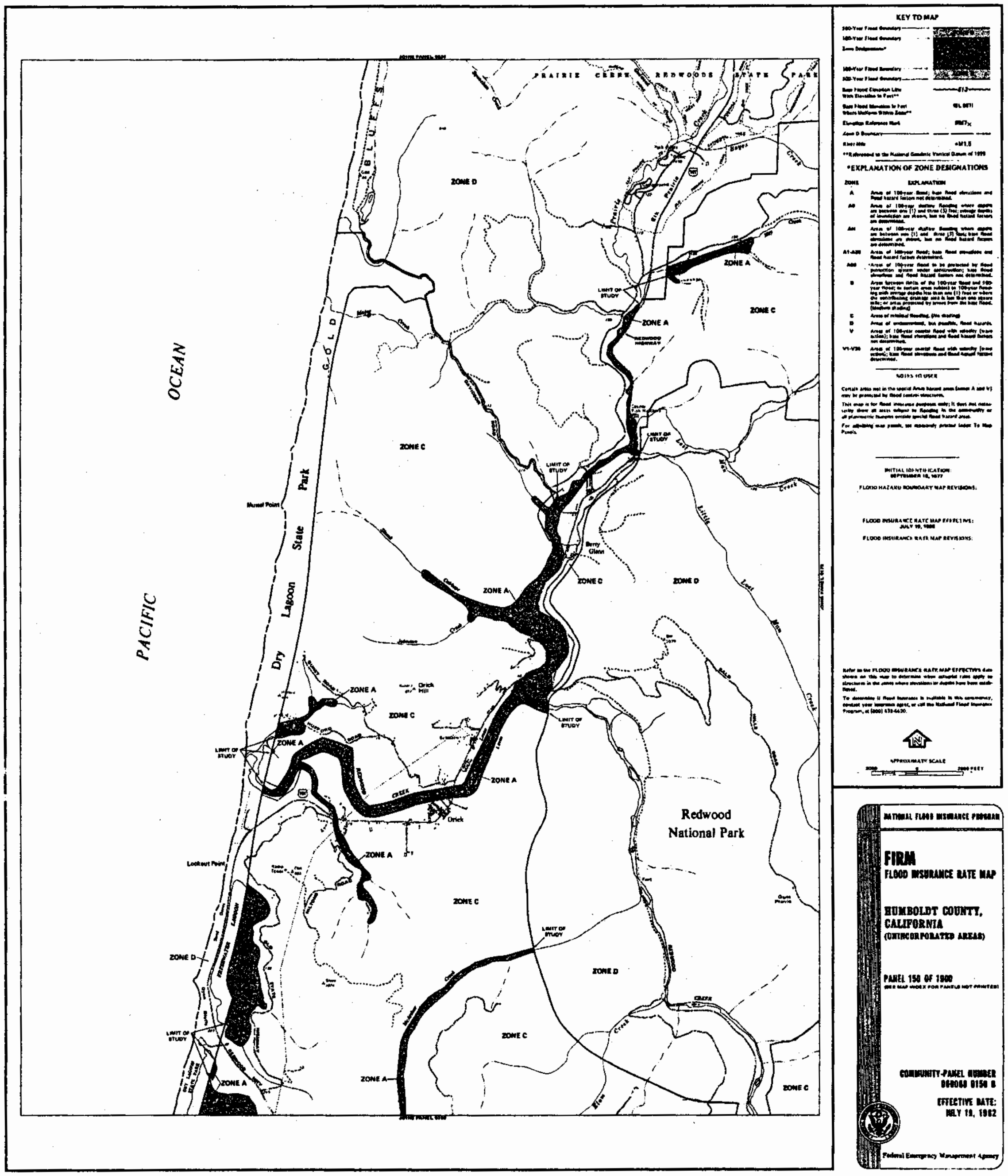


EXHIBIT NO. **4**

APPLICATION NO.

1-04-005

FEMA – FIRM MAP

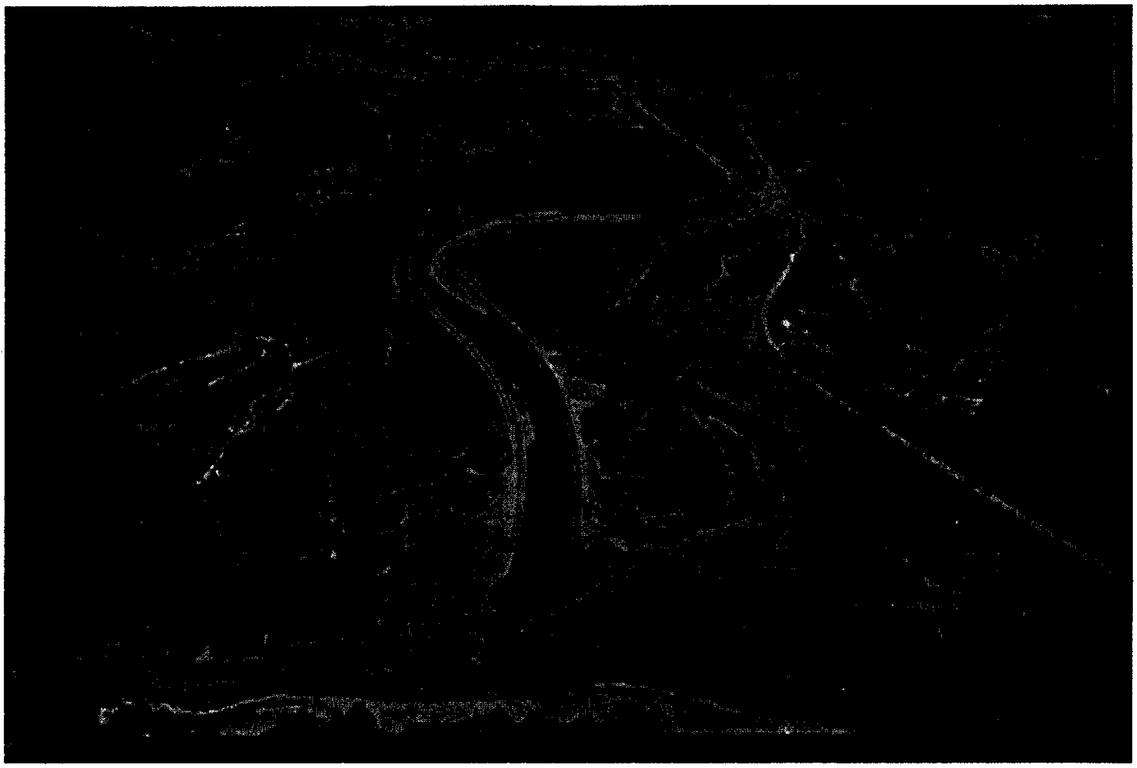
Photo No. 1: **Lower Redwood Creek, Orick California – 1948**

The Redwood Creek estuary in 1948 is shown above in its historic channel before aggradation associated with the 1950, 1953, 1955, and 1964 floods. Note the clear-cut in upstream areas above the town of Orick. The snags of old conifers in fields adjacent to the estuary suggest clearing of the forest in the prior 50 years. Lack of bank vegetation makes the creek susceptible to flood damage and erosion.

Source: Klamath Resource Information System – Redwood Creek Project, 2003, http://www/krisweb.com

EXHIBIT NO. **5**
APPLICATION NO.
1-04-005
PROJECT SITE AERIAL PHOTOGRAPHS (1948, 1988, 2002) (Page 1 of 4)

Photo No. 2: **Lower Redwood Creek, Orick California – 1988**



Following the 1964 flood, the lower Redwood Creek channel was graded and confined between armored levees from a point over a mile above the town of Orick to approximately 1,000 feet above its entry into the Pacific Ocean. Overtime, accumulated sediment cut off the sloughs, blocking fish access and preventing connection to once productive holding and rearing areas of the estuary.

Source: Klamath Resource Information System – Redwood Creek Project, 2003, http://www/krisweb.com

3 of 4

Photo Nos. 3A & 3B: <u>Lower Redwood Creek, Orick California – 2002</u>


Match-Line Sheet 1
Sheet 2
For Illustrative Purposes Only
1 inch equals 300 feet
Aerial Image from 2002

PROJECT DESCRIPTION
REDWOOD CREEK FLOOD CONTROL PROJECT
Humboldt County Public Works Department
(January 2004)

Background

The Redwood Creek Flood Control Project was constructed in 1968 by the U.S. Army Corps of Engineers. After construction, the Corps turned over responsibility for operation and maintenance of the project to the County of Humboldt. The County would be liable for damages incurred if the flood control levees are overtopped. A recent decision by the Sixth Appellate District of California in the case of James Arreola *v.* Monterey County (i.e. the Pajaro River Case) has created the legal climate under which flood control projects must be maintained.

A review team has been established to review and make recommendations on maintenance activities proposed by the County over a five-year permit period. The members of the team are Redwood National & State Park (RNSP), National Marine Fisheries Service (NOAA Fisheries), U.S. Fish & Wildlife Service (USFWS), California Department of Fish & Game (DFG), Corps of Engineers (COE), and the County of Humboldt.

Gravel and Vegetation Management

In an attempt to determine the feasibility of restoring the estuary of Redwood Creek the County, working with funds provided by the California Coastal Conservancy, is in the process of completing a hydraulic analysis for six different levee configurations downstream of the Highway 101 bridge. As part of the study, cross-sections were run during November 2002 at various points along the three mile flood control reach to aid in the identification of areas that have severe aggregation of gravel and vegetation thereby significantly reducing the floodway capacity of this flood control project. In cooperation with state and federal agencies the County intends on ranking these areas so that those with the least hydraulic capacity are addressed first. The goal of both County and the resource agencies is for the County to focus on these hydraulic hot spots thereby minimizing the amount of streambed disturbed along the entire three-mile stretch of levees.

Due to the numerous variables involved in maintaining the floodway capacity of Redwood Creek (flood control reach) while simultaneously protecting various natural resources and minimizing potential impacts to critical salmonid habitat, the agencies thought a collaborative management approach of both vegetation and gravel was prudent. The County will provide members of the interagency review team with a gravel and or vegetation management proposal each year of the 5-year permit period. Each proposal will identify "hydraulic hot spots" within the channel from which specific amounts of gravel and or vegetation will be removed. The County would provide a ten-day notice to the team members so that they could review proposed maintenance actions and attend a field review. In turn, representatives of the agencies would be given five days to provide written recommendations to the County. Over time it is anticipated that this process will result in an efficient adaptive management maintenance program for this flood control project.

Decision Matrix

On November 13, 2002, during a field review, representatives of NOAA Fisheries, CDFG, COE and the County agreed on a process whereby areas of the channel would be ranked as high, medium and low with regards to impact on the hydraulic capacity of the channel between the levees (hydraulic "hot spots"). During a follow-up field review on March 5, 2003, NOAA Fisheries suggested that the habitat adjacent to each of the identified hot spots should also be ranked as high, medium and low with regards to importance for listed salmonids. Both variables would then be used to develop a decision matrix, whereby areas ranked as high hydraulic hot spots with low to moderate ranked adjacent habitat would be prioritized for gravel and or vegetation management. Areas within the flood control reach that could potentially benefit from sediment removal for improvement of salmonid habitat would also be given priority consideration. The decision matrix would not rule out treating other areas of the channel, especially through the use of sediment removal, but would be used as a tool for prioritizing vegetation removal in a manner that would reduce potential impacts on listed salmonids and their habitat. NOAA Fisheries (with input from RNSP and/or CDFG) will rank the salmonid habitat adjacent to the hot spots. To provide additional analytical data to aid in the identification of "hydraulic hot spots" the County is attempting to secure funding for yearly aerial photographs and cross section data for use in HEC analysis. Given the current and foreseeable state and local budgetary concerns it is unknown at this time if these future funds will be available. In the event that these tools are not available the County and interagency team will identify potential gravel and vegetation removal areas on the August 27, 2002 1"=100' blue line aerial photos using professional judgment. The interagency team will then assemble the decision matrix for use prior to annual implementation.

Gravel Management

In order maintain an acceptable floodway capacity and to maximize potential benefits to listed salmonids, both skimming and alternative sediment removal activities would be implemented. A potential alternative sediment removal design would be to excavate a fish passage channel in the upstream section of the flood control project (i.e. in the ± 900-ft section north of and adjacent to the upstream end of the north levee). This portion of the flood control reach tends to flow intermittently during dry summers. A fish passage channel could be constructed through this reach to aid in connectivity and salmonid migration, while also meeting the objective of increased floodway capacity. The RNSP has agreed to provide geomorphic design for this type of sediment removal. Alternative sediment removal designs, such as the channel described above, or the construction of connected alcoves at the downstream end of gravel bars, could also be utilized where appropriate. Sediment would also be removed through the use of traditional bar skimming, utilizing a minimum two foot vertical offset from the water surface elevation of the summer low flow. An upstream portion of the gravel bar would be left undisturbed to assure retention of the meander pattern and single narrow creek channel. Upon completion of skimming activities each year the bar would be graded in the downstream direction/towards the thalweg to provide a free-draining surface.

The use of temporary bridges would be minimized, and temporary abutments would be constructed outside of the live channel to the maximum extent practical. Where the flatcar used as the bridge is not long enough to span the live channel, brow logs or concrete blocks could be used to reduce the amount of abutment material in contact with the live stream. To the maximum extent practical heavy equipment channel crossings will be limited to two passes per temporary bridge construction/removal. Use of abutment material will be minimized, and abutment material and approach ramps will be removed following removal of temporary bridges.

Sediment removal would not occur prior to June 15, or after October 15 of any year without prior written approval from the DFG who in turn would consult with the NOAA Fisheries. There is the opportunity for fall extensions until the end of October, based on weather forecasts, rising flows and salmonid migration timing.

The County would not remove more that 90,000 yds^3 of gravel per year. This volume was selected using data from the hydraulic analysis for six different levee configurations downstream of the Highway 101 Bridge. Removal of 90,000 yds^3 in any one year would represent an extreme situation, e.g. extreme flow event. It is expected that during average years the volume removed would be significantly lower. As previously stated the County is attempting to secure funding for yearly aerial photographs and spring cross section data collection. Ultimately the County would also like to obtain funding to obtain fall cross-section data in order to monitor yearly sediment management activities. Unfortunately the current and foreseeable state and local budgetary situation may not allow for this data collection. In lieu of conducting fall cross-sections the County and interagency team would conduct a field visit in the fall to evaluate that years sediment management activities.

Vegetation Management

Vegetation removal would be prioritized using the decision matrix described above, and would focus primarily on the high ranked hydraulic hot spots with low to moderate ranked adjacent salmonid habitat. All vegetation would be removed from the riprapped slope of the levees down to within 5 feet of the toe of the slope, which is defined as the intersection between the riprap and the current bed of Redwood Creek. Within the 5-foot zone upslope of the toe trees with a basal diameter greater than 4 inches at 4 inches above ground level would be removed, all other vegetation would be retained. The selection of various treatments to be implemented in any one-year of the five year permit will be accomplished through use of the decision matrix coupled with on-site visits and discussion with the interagency team. Other vegetation removal designs could include but are not limited to the following:

1. Remove trees from the dry side of the islands to within 10 feet of the creek.
2. Trees within 10 feet of the creek on an island that are greater than 4 inches in diameter at a height of 4 inches above ground level would be removed and cut into 4 foot lengths and left in place.
3. In an attempt to increase scour potential remove all vegetation from the tip of an island 30 feet downstream of the head of the island.
4. In an effort to provide potential velocity refugia for salmonid and to prevent excessive numbers of large trees on extensive dry stretches of bars, trees with a diameter of 4 inches and greater would be removed.
5. Another technique that could be implemented to achieve the goals stated in item four above would be to create a mosaic of vegetated and non-vegetated areas on the extensive dry stretches of bars. This could be accomplished by removing all vegetation from small areas on the bar and leaving other areas completely vegetated.

6. Along the portions of the levee where a 10-foot strip of trees occurs at the toe and is bordered by the creek, all trees growing in and on the riprap with a diameter greater than 4 inches would be removed.

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

MAR 2 2004

In Response Refer to:
151422SWR02AR6457LBW

Mr. Calvin C. Fong
Department of the Army
San Francisco District, Corps of Engineers
333 Market Street
San Francisco, California 94105-2197

Dear Mr. Fong:

This letter transmits the National Marine Fisheries Service's (NOAA Fisheries) biological opinion (Opinion) based on our review of the U.S. Army Corps of Engineers' (Corps) proposed permitting of the Redwood Creek Flood Protection Project (herein referenced as "Project") (Corps File Number 25094N). The Opinion (Enclosure 1) analyzes the effects of the Project on Northern California (NC) steelhead (*Oncorhynchus mykiss*), California Coastal (CC) Chinook salmon (*O. tshawytscha*), Southern Oregon/Northern California Coast (SONCC) coho salmon (*O. kisutch*), and designated SONCC coho salmon critical habitat (CH), in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). In addition, NOAA Fisheries evaluated the Project for potential adverse effects to Essential Fish Habitat (EFH), pursuant to section 305 (b) (2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA).

Endangered Species Act Consultation

After reviewing the best available scientific and commercial information, current status of NC steelhead, CC Chinook salmon, SONCC coho salmon and designated SONCC coho CH, environmental baseline for the action area, effects of the Project, and cumulative effects, NOAA Fisheries' concludes in the Opinion that the Project, as proposed, is not likely to jeopardize the continued existence of NC steelhead, CC Chinook salmon or SONCC coho salmon, and is not likely to result in the destruction or adverse modification of SONCC coho salmon CH. In the Opinion, NOAA Fisheries also concludes that the Project may result in incidental take of CC Chinook salmon SONCC coho salmon, and NC steelhead; therefore, an Incidental Take Statement is included with the Opinion. The Incidental Take Statement identifies Reasonable and Prudent Measures, and Terms and Conditions to implement those measures that NOAA Fisheries believes are necessary and appropriate to minimize this incidental take.

EXHIBIT NO. 7
APPLICATION NO.
1-04-005
EXCERPTS OF NOAA FISHERIES' BIOLOGICAL OPINION (Page 1 of 82)

Magnuson-Stevens Fishery Conservation and Management Act Consultation

The Project action area includes areas identified as EFH for various life stages of salmon species Federally managed under the Pacific Coast Salmon Fishery Management Plan, specifically, CC Chinook salmon and SONCC coho salmon. In addition, the Project action area also includes areas identified as EFH for Pacific groundfish. Based on the best available information, NOAA Fisheries has determined that the proposed action may adversely affect EFH for CC Chinook salmon, SONCC coho salmon and Pacific groundfish. An EFH Conservation Recommendation is provided in Enclosure 2. Section 305(b)(4)(B) of the MSA requires the action agency to provide NOAA Fisheries with a detailed written response within 30 days to the EFH Conservation Recommendation, including a description of measures adopted by the action agency for avoiding, minimizing, or mitigating the effects of the Project on EFH [50 CFR 600.920(j)]. In the case of a response that is inconsistent with the EFH Conservation Recommendation, the action agency must explain the reason for not following the recommendation, including a scientific justification for any disagreement with NOAA Fisheries over the anticipated effects of the Project and the measures needed to avoid, minimize, or mitigate such effects. For more information on EFH, see our website at http://swr.nmfs.noaa.gov

If you have any questions concerning these consultations, please contact Ms. Leslie Wolff at (707) 825-5172.

Sincerely,

Rodney R. McInnis

Rodney R. McInnis
Acting Regional Administrator

Enclosures (2)

cc: Kelley Reid – Army Corps of Engineers, P.O. Box 4863, Eureka, CA 95502
Adam Forbes – Humboldt County Department of Public Works, P.O. Box 4863, Eureka, CA 95502-4863
David Anderson - Redwood National and State Parks, P.O. Box 7, Orick, CA 95555
Carl Harral - California Department of Fish and Game, 601 Locust St., Redding, CA 96001
Randy Brown - U.S. Fish and Wildlife Service, 1655 Heindon Rd., Arcata, CA 95521
Peter LaCivita - Department of the Army, San Francisco District, Corps of Engineers, 333 Market Street, San Francisco, California 94105-2197

Enclosure 1

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

ACTION AGENCY: U.S. Army Corps of Engineers

ACTIVITY: Humboldt County, Maintenance of the Redwood Creek Flood Control Project

CONSULTATION CONDUCTED BY: Southwest Region, National Marine Fisheries Service

DATE ISSUED: MAR 2 2004

FILE NUMBER: 151422SWR02AR6457

I. BACKGROUND AND CONSULTATION HISTORY

On March 1, 2002, the Army Corps of Engineers (Corps) issued a Public Notice for a five-year Department of the Army permit application from the County of Humboldt, Department of Public Works (County) to remove vegetation and gravel from the Redwood Creek Flood Control Project. Although the permit application from the County is dated November 3, 2000, and the Public Notice was not issued until March 1, 2002, technical assistance from the National Marine Fisheries Service (NOAA Fisheries) was not requested prior to the County submitting the permit application to the Corps, or prior to publication of the Public Notice. NOAA Fisheries formally commented on the Public Notice (March 28, 2002, letter from I. Lagomarsino, NOAA Fisheries, to K. Reid, Corps); however, the Corps did not incorporate these comments in a subsequent draft of the Public Notice.

The permit application package submitted by the County to the Corps contained a description of the proposed action, and a flow capacity analysis of the Redwood Creek Flood Control Project (Humboldt County 2000). The County's flow capacity analysis updated the Corps' analysis entitled "Letter Report on Flow Capacity for Redwood Creek Federal Flood Control Project" (Corps 1998). According to the analyses performed in 1998 and 2000, the flood control project could convey flows near to, or greater than, their estimation of the 100-year flood.

The Letter Report on Flow Capacity for Redwood Creek Federal Flood Control Project (Letter Report), prepared by the Corps in April of 1998, analyzed the channel flood capacity with the 1997 channel configuration, using the U.S. Army Corps of Engineers Hydrologic Engineering Center River Analysis System (HEC-RAS) model. The Letter Report showed that the conveyance capacity of the 1997 channel condition was 65,200 cubic feet per second (cfs), which is approximately equivalent to the 100-year flood. The project was originally designed in1966 to carry 77,000 cfs, approximately equivalent to the 250-year flood, according to information contained in the Letter Report.

The largest flood of record for Redwood Creek occurred in 1964 at 50,500 cfs. All other large floods on record (1955, 1972, and 1975) were also approximately 50,000 cfs. The County's modeling, which analyzes channel cross sections taken in 2000, shows that the ultimate original capacity of the flood control channel was 97,000 cfs to the top of the flood control levees, and that the original design capacity of 77,000 cfs provided 3 to 6 feet of freeboard. The permit application states that under current conditions, the flood control project will overtop in some locations at 77,000 cfs, and that the minimum available freeboard has been decreased from 3 feet to 0.5 feet. Even though there has been gravel aggradation within the flood control reach, the County's modeling results show that the flood control project is still providing flood protection for a flow which is significantly larger than the flood of record.

The County concluded that there has been a 20-percent reduction in the channel capacity from its original design (77,000 cfs, with 3 to 6 feet of freeboard), and reported that modeling results suggest increasing available freeboard by extracting gravel in the project area. The modeling results displayed in the permit application represent a "snapshot in time" of conditions applicable only at the time the model was run, and for the channel cross sections used in the modeling. When cross sections change through natural gravel recruitment or scour, or from gravel extraction, the modeling results also change. In addition, if the cross sections are spaced too far apart, as may be the case with the approximate 1000-foot spacing interval that was used, HEC-RAS cannot model the actual channel configuration. Moreover, information on gravel recruitment rates were not included in the permit application.

On June 10, 2002, NOAA Fisheries received an initial request for Endangered Species Act (ESA) section 7 consultation from the Corps on the maintenance of the Redwood Creek Flood Control Project (June 5, 2002, letter from C. Fong, Corps, to R. McInnis, NOAA Fisheries). The request for consultation concerned the effects of maintenance of flood conveyance capacity in Redwood Creek on threatened Southern Oregon/Northern California Coast (SONCC) coho salmon *(Oncorhynchus kisutch)* and its designated critical habitat, and on California Coastal (CC) Chinook salmon *(O. tshawytscha)* and Northern California (NC) steelhead *(O. mykiss)*. The initial request for consultation included:(1) the permit application from the County, (2) the Public Notice, and (3) the Corps' Operations and Maintenance Manual (O&M Manual) for the Redwood Creek Flood Protection Project.

However, from the June 5, 2002, letter it was not clear on what proposed action the Corps was requesting section 7 consultation. In its June 5, 2002, letter the Corps states that they were in receipt of an application from the County for a five-year maintenance plan for the Redwood Creek Flood Protection Project and NOAA Fisheries comments' dated March 28, 2002. The Corps goes on to state that the County is obligated by the Corps' Operations and Maintenance (O&M) Manual to maintain the project as designed, and that in recent years the County has accepted mitigating measures to lessen the impact to resources; however, the mitigating measures conflict with the obligation to maintain the project. Although the Corps requests section 7 consultation in the June 5, 2002, letter in regards to potential impacts to listed salmonid species by the proposed maintenance, it is not clear if the "proposed maintenance" is the County's permit application, or the Corps' O&M Manual.

Additionally, on June 5, 2002, NOAA Fisheries received a letter from the County (June 4, 2002, letter from R. Stein, County, to Lt. Col. T. O'Rourke, Corps). In their letter the County requests that the Corps conduct a reevaluation of the maintenance baseline for the Redwood Creek Flood Protection Project, per the request by NOAA Fisheries contained in the March 28, 2002, comments to the March 1, 2002, Public Notice.

On June 21, 2002, NOAA Fisheries responded to the Corps' initial request for consultation (June 21, 2002, letter from I. Lagomarsino, NOAA Fisheries, to C. Fong, Corps) with a request for additional information. To complete the consultation initiation package NOAA Fisheries requested: (1) a final proposed action, or a draft proposed action that closely resembles what the final proposed action will be; (2) a final biological assessment (BA) or project information package (PIP), since NOAA Fisheries had not yet received a draft BA or PIP; and (3) a determination from the Corps regarding the County's request for a reevaluation of the maintenance baseline.

On August 29, 2002, NOAA Fisheries received a letter from the Corps (August 26, 2002, letter from C. Fong, Corps, to R. McInnis, NOAA Fisheries) again stating that the County is obligated by the Corps' O&M Manual to maintain the project as designed. In this letter the Corps also stated that a copy of the permit application, the Public Notice, and the O&M Manual had been provided to NOAA Fisheries, and that the Corps' believed that this information, in total, satisfied the requirements to initiate formal consultation. The August 29, 2002, letter also included four paragraphs on potential effects of maintenance activities on listed salmonids, and an explanation from the Corps that reevaluation of the maintenance baseline had not been initiated and that reevaluation could possibly last for years. At such time that the O&M Manual may be modified the Corps states that they would initiate consultation regarding subsequent maintenance activities.

On October 3, 2002, NOAA Fisheries responded to the Corps' August 26, 2002, letter (October 3, 2002, letter from I. Lagomarsino, NOAA Fisheries, to Lt. Col. M. McCormick, Corps). In our letter we stated that the permit application, the Public Notice, and the O&M Manual all describe the proposed action differently, with corresponding different levels of impact to listed salmonids. We requested clarification on which description of the proposed action the Corps was requesting consultation. In our October 3, 2002, letter we state that if we did not hear back from the Corps within 30 days we would initiate consultation on the worst case scenario (i.e., description of the proposed action found in the O&M Manual). The O&M Manual represented the worst case scenario as it requires that the project be maintained without including measures designed to reduce effects to listed salmonids.

On October 9, 2002, NOAA Fisheries received a letter from the Environmental Branch of the Corps (September 30, 2002, letter from R. Chishom, Corps, to I. Lagomarsino, NOAA Fisheries) responding to our March 28, 2002, comment letter on the Public Notice. In their October 9, 2002, letter the Corps recognizes that NOAA Fisheries has concerns over impacts resulting from the proposed maintenance project on listed salmonids in Redwood Creek. In their letter the Corps requests our technical assistance to reduce or eliminate adverse impacts to listed salmonids. Previous to receipt of this letter from the Environmental Branch of the Corps, NOAA Fisheries had been working with the Regulatory Branch of the Corps.

Subsequently, on October 10, 2002, NOAA Fisheries met with representatives of the County, and the California Coastal Conservancy in person, and with the Environmental Branch of the Corps via conference call. At this meeting the Environmental Branch of the Corps explained that there is flexibility in how the requirements for flood conveyance capacity that are outlined in the O&M Manual are met, and that there is also flexibility in how to interpret the O&M Manual. More specifically, there is flexibility in the way in which gravel and vegetation removal is accomplished, and that this flexibility can be used to reduce adverse effects of project maintenance. Furthermore, the Environmental Branch of the Corps explained the O&M Manual can be revised to reflect up to a 20 percent reduction in flood conveyance capacity, that a 20-percent reduction requires a National Environmental Policy Act (NEPA) analysis and can be approved by the Colonel of the San Francisco District of the Corps. Based on this new information provided by the Environmental Branch of the Corps, the County requested NOAA Fisheries' technical assistance and agreed to an interagency field review of the project area with the objective of modifying their proposed action to reduce the impacts to listed salmonids, while still accomplishing the objective of increasing channel conveyance capacity.

On October 29, 2002, NOAA Fisheries participated in a field review of the flood control project with representatives from the County, the Corps, Redwood National and State Parks (RNSP), and the California Department of Fish and Game (CDFG). During this field review the various involved agencies discussed the following modifications to the proposed action that would reduce the impacts associated with maintenance of channel conveyance capacity: (1) the establishment of an interagency team to review and approve the County's annual proposal for gravel and vegetation removal under the proposed five-year term of the permit from the Corps; (2) measures to reduce the impacts of gravel and vegetation removal such as increased vertical offsets for traditional bar skimming, and seasonal timing restrictions; (3) measures to reduce the impacts associated with temporary channel crossings used to haul gravel; and (4) the development of a rating system for prioritizing hydraulic "hot spots" for gravel and vegetation removal based on recent cross sections and hydraulic analysis of channel conveyance capacity in order to focus disturbance within the channel, and to avoid impacting higher quality habitat.

Between November 2002 and March 2003, multiple meetings, phone calls, and an additional field visit occurred between NOAA Fisheries, the County, the Corps, CDFG and RNSP regarding modifying the proposed action with the objective of reducing the impacts to listed salmonids. On December 19, 2002, and February 27, 2003, NOAA Fisheries received copies of letters from the

County to the Corps (December 19, 2002, letter from D. Tuttle, County, to K. Reid, Corps, and February 27, 2003, letter from A. Forbes, County, to K. Reid, Corps). Both of these letters describe some of the modifications to the proposed action discussed at the various meetings. On March 21, 2003, NOAA Fisheries provided the County an electronic memo detailing the various suggestions that were discussed in order to assist the County in describing potential modifications to the proposed action.

On April 1, 2003, NOAA Fisheries was copied on a letter from the County to the Corps (March 31, 2002 (sic), letter from A. Forbes, County, to K. Reid, Corps). The letter received on April 1, 2003, requests that the original permit application submitted to the Corps in November 2000 be modified, and that this latest letter is intended to replace the December 19, 2002, and February 27, 2003, letters. The letter received on April 1, 2003, describes the excavation of sediment in Redwood Creek and in the North and South Sloughs, and the removal of portions of vegetation within the flood control reach of Redwood Creek and from the levee faces themselves, as well as measures designed to reduce or minimize effects of the proposed action on listed salmonids. The modified proposed action is fully described in the *Description of the Proposed Action* section of this Biological Opinion (Opinion).

On April 28, 2003, NOAA Fisheries received a request for ESA section 7 consultation from the Corps on the modified County application for a five-year maintenance plan for the Redwood Creek Flood Control Project (April 24, 2003, letter from C. Fong, Corps, to R. McInnis, NOAA Fisheries). The Corps requested consultation on the proposed action as amended by the March 31, 2002 (sic), letter from the County. The request for consultation concerns the effects of the amended five-year maintenance plan on threatened SONCC coho salmon and its designated critical habitat, and on CC Chinook salmon and NC steelhead.

On July 22, 2003, during the formal consultation process, NOAA Fisheries contacted the County to discuss and clarify the proposed action (July 22, 2003, phone conversation between M. Kelly, NOAA Fisheries and A. Forbes, Humboldt County). The County clarified that the interagency review team will not only provide the County with recommendations for annual maintenance, but will approve the annual maintenance plans by consensus.

Related to the levee maintenance proposal is the additional hydraulic analysis that the County is completing with funds provided by the California Coastal Conservancy. On May 2, 2003, NOAA Fisheries received a copy of a hydraulic analysis for existing conditions, and for six different levee set-back configurations downstream of the Highway 101 Bridge (Moffatt and Nichol 2003). Although not part of this proposed action, this new analysis on levee set-back configurations may aid in long-term planning for restoration of estuary and lower river function in Redwood Creek. Additionally, the cross sections measured for this hydraulic analysis, together with the flow capacity analysis of the 2002 channel configuration found in Moffatt and Nichol (2003) has been used by the County in development of this proposed action, and will also be utilized to inform annual maintenance proposals under a five-year maintenance permit. Similar to the flow analyses completed in 1998 and 2000, Moffatt and Nichol (2003) also found that the current channel and levee configuration could convey flows near to, or greater than, their estimation of the 100-year flood.

NOAA Fisheries also received a copy of a memorandum from Kamman Hydrology and Engineering regarding a progress report on recent HEC-RAS modeling of the current configuration of lower Redwood Creek (September 17, 2003, memorandum from G. Kamman, to D. Tuttle, County, and M. Bowen, California Coastal Conservancy). The Coastal Conservancy has contracted with Kamman Hydrology and Engineering to continue hydraulic analysis for lower Redwood Creek, and to include the portion of channel above the Highway 101 Bridge. In the September 17, 2003, memorandum Kamman (2003) describes his progress on modeling current flow conveyance capacity for lower Redwood Creek using a higher Manning roughness coefficient (n) than the n value that was used by the Corps (1998), Humboldt County (2002), or by Moffatt and Nichol (2003) in their analyses. An increase in the n value will decrease estimated flow conveyance capacity of the channel. Kamman (2003) states that he decided on a higher n value based on a Pajaro River study and review of land-based and aerial photographs of lower Redwood Creek. Kamman also states that although this n value may not be representative of actual Redwood Creek channel conditions, it provides important information regarding the possible existing and/or future frequency/probability and location of flooding under conditions representative of such a value. Kamman's modeling results indicated that lower Redwood Creek may overtop the levees during a 50-year flood.

In addition to the flow capacity analyses for lower Redwood Creek (Corps 1998, Humboldt County 2000, Moffatt and Nichol 2003, and Kamman 2003), and information on lower Redwood Creek provided by RNSP (2000), NOAA Fisheries considered or used documents that pertain to gravel removal in Humboldt County in this Opinion, which include: the analysis of a flow-based minimum skim floor elevation for in-channel gravel mining in Humboldt County (NMFS 2002a); all of the fisheries and vegetation monitoring reports completed as a condition of the Letter of Permission procedure (LOP 96-1) that has been used to permit commercial gravel mining by the Corps in Humboldt County (Halligan 1997b, 1998, 1999, and 2003; Jensen 2000; Theiss 1997; County of Humboldt 1998; Palco 2003); all County of Humboldt Extraction Review Committee (CHERT) reports (Klein *et al.* 1998, 1999, 2000, 2001, and 2003; Jager *et al.* 2003); and the Corps' assessment of changes in channel morphology and bed elevation in the Mad River, 1971-2000 (Knuuti 2003). In addition to these documents specific to Humboldt County rivers, NOAA Fisheries also used a large body of peer-reviewed and gray literature on the subjects of gravel mining and vegetation removal.

Additionally, NOAA Fisheries utilized the synthesis of scientific literature regarding the effects of gravel extraction on salmonids and their habitat provided in the NOAA Fisheries, Southwest Region 2003 draft document entitled "Sediment Removal from Freshwater Salmonid Habitat: Guidelines to NOAA Fisheries staff for the Evaluation of Sediment Removal Actions from California Streams." A complete administrative record is on file at the NOAA Fisheries Arcata Area Office.

I. DESCRIPTION OF THE PROPOSED ACTION

A. Action Area

The action area includes "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR § 402.02). The action area for the proposed action includes approximately 3.4 miles of Redwood Creek, from the mouth of Redwood Creek to the upstream extent of the levees, including the confluence with Prairie Creek, and the Redwood Creek estuary including the North and South sloughs.

B. Proposed Action

The Corps proposes to issue a five-year permit to the County for activities intended to maintain the conveyance capacity of the flood control channel on the lower 3.4 miles of Redwood Creek. These activities include vegetation removal and gravel extraction designed to improve the hydraulic capacity of the floodway channel between the levees. The objective of the proposed five-year maintenance permit is to maintain the flood control channel to standards acceptable to the Corps, so that the County does not incur liability due to an increased risk of overtopping the Redwood Creek flood control levees. The project was originally designed in 1966 to carry 77,000 cfs, approximately equivalent to the 250-year flood, according to information contained in the Letter Report (Corps 1998). Estimates by the Corps (1998) showed that the conveyance capacity of the 1997 channel condition was 65,200 cubic feet per second (cfs), which is approximately equivalent to the 100-year flood. The permit application from the County in 2000 concluded that there has been a 20-percent reduction in the channel capacity from its original design (77,000 cfs, with 3 to 6 feet of freeboard), and reported that modeling results suggest increasing available freeboard by extracting gravel in the project area. The most recent estimates of flow conveyance capacity (Moffatt and Nichol 2003 and Kamman 2003) suggest that the levees will currently contain the approximate 50- to100-year flood event.

In order to minimize the amount of streambed alteration within the floodway, the County will focus work in areas with the least hydraulic capacity. These areas, or "hydraulic hot spots," are typically associated with high aggradation of gravel and/or high density of vegetation, but may also include areas where the levees have subsided.

Due to the numerous variables involved in maintaining the floodway capacity while simultaneously protecting various natural resources and minimizing potential impacts to critical salmonid habitat, the County proposes a collaborative management approach with the various interested agencies. The County will provide members of this interagency review team with a gravel and/or vegetation management proposal during each year of the five-year permit period. Each proposal will identify discreet hydraulic hot spots (e.g., the area directly downstream of Highway 101 Bridge) within the channel from which specific amounts of gravel and or vegetation would be removed. The County would provide a ten-day notice to the team members so that they can review proposed maintenance actions and attend a field review. The interagency review team will approve the annual maintenance plan by consensus (A. Forbes, County of Humboldt, pers. comm. 2003).

During the field review, NOAA Fisheries, in collaboration with RNSP and CDFG, would rank the fish habitat adjacent to each of the identified hot spots as high, medium and low with regards to importance for listed salmonids. Both variables would then be used to develop a decision matrix, whereby areas ranked as high hydraulic hot spots with low to moderate ranked adjacent habitat would be prioritized for gravel and/or vegetation management. Areas within the flood control reach that could potentially benefit from sediment removal for improvement of salmonid habitat would also be given priority consideration. The decision matrix would not rule out treating other areas of the channel, especially through the use of sediment removal, but would be used as a tool for prioritizing sediment and vegetation removal in a manner that would reduce potential impacts on listed salmonids and their habitat. The County would then prepare a draft plan, which would be provided to the agency representatives, who would be given five days to provide written recommendations to the County. NOAA Fisheries would then review the final plan to determine whether the plan is consistent with the expected effects of the proposed action as analyzed in this Opinion, and so that NOAA Fisheries could provide approval of the final annual maintenance plan.

To provide additional data to aid in the identification of hydraulic hot spots, the County is attempting to secure funding for yearly aerial photographs and cross section data and funding HEC analyses. In the event that these tools are not available, the County and interagency team will identify potential gravel and vegetation removal areas on the August 27, 2002, 1"=100' blue line aerial photos using professional judgment. The interagency team will then assemble the decision matrix for use prior to annual review, approval and implementation.

1. Gravel Removal

In order to maintain a floodway capacity close to the project design standards, both bar skimming and alternative sediment removal activities would be implemented. A potential alternative sediment removal design would be to excavate a fish passage channel in the upstream section of the flood control project (i.e., in the approximately 900-foot section of channel upstream of the north levee; also upstream of the mouth of Prairie Creek). This portion of the flood control reach tends to flow intermittently during dry summers. A fish passage channel could be constructed through this reach to aid in connectivity and salmonid migration, while also meeting the objective of increased floodway capacity. The RNSP has agreed to provide geomorphic design for a fish passage channel. Alternative sediment removal designs, such as the channel described above, or the construction of alcoves connected to the low flow channel at the downstream end of gravel bars, could also be utilized where appropriate. Sediment would also be removed through the use of traditional bar skimming, utilizing a minimum two foot vertical offset from the water surface elevation of the summer low flow. An upstream portion of the gravel bar would be left undisturbed to help provide hydraulic control of the channel. Upon completion of skimming activities each year, the bar would be graded in the downstream direction, or towards the thalweg, to provide a free-draining surface. Sediment removal and associated activities, such as installation and removal of temporary stream crossings, would not occur prior to June 15, or after October 15 of any year without prior written approval from CDFG and NOAA Fisheries.

Installation of a maximum of eight temporary flatcar bridges will be required to provide access to gravel extraction sites by heavy equipment. The use of temporary bridges would be minimized, and temporary abutments would be constructed outside of the live channel to the maximum extent practical. Where the flatcar is not long enough to span the live channel, brow logs or concrete blocks would be used to reduce the amount of abutment material in contact with the live stream. To the maximum extent practical, in-water crossings by heavy equipment will be limited to two passes during installation and two passes during removal of each temporary bridge. Use of abutment material will be minimized, and abutment material and approach ramps will be removed following removal of temporary bridges.

The County would not remove more than 90,000 cubic yards of gravel per year. The County states that this volume was selected using data from hydraulic analysis. The County also states that removal of 90,000 cubic yards in any one year would represent an extreme situation. The County expects that during average years the volume of sediment removed would be significantly lower. As previously stated, the County is attempting to secure funding for yearly aerial photographs and spring cross section data collection. Ultimately, the County would also like to obtain funding to obtain fall cross section data in order to monitor yearly sediment management activities. In lieu of conducting fall cross sections, the County is proposing that the interagency team would conduct a field visit in the fall to evaluate that year's sediment management activities.

2. Vegetation Removal

Vegetation removal would be prioritized using the decision matrix described above, and would focus primarily on the high ranked hydraulic hot spots with low to moderate ranked adjacent salmonid habitat. All vegetation would be removed from the rip-rap slope of the levees down to within five feet of the toe of the slope, which is defined as the intersection between the rip-rap and the current bed of Redwood Creek. Within the five-foot zone, upslope of the toe, trees with a basal diameter greater than four inches at four inches above ground level would be removed, and all other vegetation would be retained. The selection of various treatments to be implemented in any one year of the five-year permit will be accomplished through use of the decision matrix coupled with on-site visits and discussion with the interagency team. Proposed vegetation removal designs include, but are not limited to the following:

- Remove trees from the dry side of islands to within 10 feet of the creek. The County did not specify at what river flow the 10-foot offset would be measured.
- Trees within 10 feet of the creek on an island, that are greater than four inches in diameter at a height of four inches above ground level, would be removed and cut into four-foot lengths and left in place.

- In an attempt to increase scour potential, remove all vegetation from the lower end of an island to 30 feet downstream of the head of the island.
- In an effort to increase floodway capacity by preventing expanses of large trees on extensive dry stretches of bars, while maintaining some velocity refugia for salmonids, only trees with a diameter of four inches and greater would be removed from these bars.
- Another technique that could be implemented to achieve the goals stated in item four above would be to create a mosaic of vegetated and non-vegetated areas on the extensive dry stretches of bars. This could be accomplished by removing all vegetation from small areas on the bar and leaving other areas completely vegetated.
- Along portions of the levee where a 10-foot strip of trees occurs at the toe and is bordered by the creek, all trees growing in and on the rip-rap with a diameter greater than 4 inches would be removed.

3. <u>Excavation of the North and South Slough Outlet Channels</u>

As a part of the five-year Redwood Creek levee maintenance permit, the County proposes to excavate the channels between the North Slough and Redwood Creek embayment, and between the South Slough and the embayment. RNSP personnel and equipment will do the work

The proposed excavated channels are likely to be temporary, as large winter storms can fill up the excavated channels in one event or over the course of several events in one or multiple years. Conditions may not change from year to year, or the excavated channel may remain open under its own erosive power. Over the five-year span of the permit, the work may occur once or yearly, depending on sedimentation conditions. The activity would occur when the mouth of Redwood Creek is open and subject to tidal fluctuation so any anoxic water or suspended sediment would be diluted and transported out to sea. To minimize any impact on listed fish, the operating window of the activity is described as: (1) after winter storms were over, (2) salmonid spawning runs completed, and (3) when the numbers of salmonid juveniles in the estuary is low prior to summer rearing.

a. North Slough

A trapezoidal channel, approximately 900 feet long, connecting the North Slough to the embayment of the Redwood Creek estuary would be excavated using a bulldozer and excavator. The channel would be four feet deep, seven feet wide at the base, and 15 feet wide on top. Approximately 1,500 cubic yards of sand would be excavated. The spoils would be placed along side the channel and "feathered" (i.e., smoothed and sloped) to blend into the existing sand deposits. During excavation, existing driftwood would be moved from the channel footprint to allow excavation and heavy equipment access. Where the channel would be excavated through the area vegetated by the exotic reed canary grass and willows, the sand spoils would be placed on the unvegetated sand channel area. Woody debris in remnants of the historical channel (not classified as fill by the Corps) may be removed by an excavator or dragged with a chain and winch.

b. South Slough

A trapezoidal channel, approximately 1,100 feet long, connecting the South Slough to the embayment of the Redwood Creek estuary would be excavated using the same type of heavy equipment. The channel would be up to four feet deep, a maximum of 14 feet wide at the base, and 22 feet wide on top. Up to approximately 3,000 cubic yards of sand would be excavated. The spoils would be placed on the sand area next to the excavated channel, and smoothed and sloped to blend into the landscape.

In summary, the specifics of the proposed action depend on the annual interagency review process that will develop an annual maintenance plan each year of the five-year permit period. NOAA Fisheries expects that the annual maintenance plan will propose gravel and vegetation removal consistent with the measures described in the proposed action. Based on the information contained in the Corps' Letter Report (1998), we expect that approximately 75% of the annual maintenance will be accomplished by gravel removal using traditional skimming and the excavation of a fish passage channel, and that unless a very large storm event occurs, annual gravel removal will total significantly less than 90,000 cubic yards. We also expect that approximately 25% of the annual maintenance will be accomplished by vegetation removal, and that vegetation removal will be concentrated in areas where loss of hydraulic capacity intersects areas of low to moderate salmonid habitat value. Additionally, we expect that maintenance activities will occur every year of the five-year permit period.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

This Opinion considers the effects of the proposed action on three salmonid ESUs listed as threatened under the ESA: SONCC coho salmon, CC Chinook salmon and NC steelhead. Table 1 presents a summary of the Federal Register Notice (FR) dates and citations, and geographic distributions. This section describes the status of critical habitat, species life history, and population trends at the ESU scale. Within the action area, more specific abundance and distribution information is provided in the *Environmental Baseline* discussion.

A. Critical Habitat

This Opinion describes the effects of the proposed action on designated critical habitat for SONCC coho salmon. The critical habitat for SONCC coho salmon includes all accessible waterways, substrate, and adjacent riparian zones. Excluded are: (1) areas above specific dams identified in the FR notices, (2) areas above longstanding natural impassible barriers (i.e., natural waterfalls), and (3) tribal lands.

In designating critical habitat, NOAA Fisheries considers the following requirements of the species: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter;

(4) sites for breeding, reproduction, or rearing offspring; and, generally, (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of this species (see 50 CFR 424.12(b)). In addition to these factors, NOAA Fisheries also focuses on the known physical and biological features (primary constituent elements) within the designated area that are essential to the conservation of the species and that may require special management considerations or protection. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation.

Current condition of critical habitat for the SONCC coho salmon ESU is discussed in the factors affecting the species section below. The *Environmental Baseline* section describes habitat conditions within the action area. Furthermore, the *Effects of the Action* section is largely organized around anticipated effects on fish habitat.

Table 1. The scientific name, listing status under the Endangered Species Act, Federal Register Notice citation, and geographic distribution of the Evolutionarily Significant Units (ESU) covered by the proposed Incidental Take Permit.

	SONCC coho salmon	NC Steelhead	CC Chinook Salmon
Scientific Name	*Oncorhynchus kisutch*	*O. mykiss*	*O. tshawytscha*
Listing Status	threatened	threatened	threatened
Federal Register Notice	May 6, 1997, 62 FR 24588	June 7, 2000, 65 FR 36074	September 16, 1999, 64 FR 50393
Geographic Distribution	from Cape Blanco, Oregon, to Punta Gorda, California	from Redwood Creek (Humboldt County), south to the Gualala River, inclusive	from Redwood Creek (Humboldt County) south through the Russian River
Critical Habitat Designation	May 5, 1999, 64 FR 24049	N/A	N/A (vacated by consent decree April 30, 2002)

B. Species Life History and Population Trends

1. <u>Coho Salmon</u>

a. General Life History

In contrast to the life history patterns of other Pacific salmonids, coho salmon generally exhibit a relatively simple three-year life cycle. Most coho salmon enter rivers between September and

February. Coho salmon river entry timing is influenced by many factors, one of which appears to be river flow. In addition, many small California stream systems have their mouths blocked by sandbars for most of the year except winter. In these systems, coho salmon and other Pacific salmonid species are unable to enter the rivers until sufficiently strong freshets open passages through the bars (Weitkamp *et al.* 1995). Coho salmon spawn from November to January (Hassler 1987), and occasionally into February and March (Weitkamp *et al.* 1995).

Although each native stock appears to have a unique time and temperature for spawning that theoretically maximizes offspring survival, coho salmon generally spawn at water temperatures within the range of 10-12.8°C (Bell 1991). Bjornn and Reiser (1991) found that spawning occurs in a few third-order streams, but most spawning activity was found in fourth- and fifth-order streams. Nickelson *et al.* (1992) found that spawning occurs in tributary streams with a gradient of 3% or less. Spawning occurs in clean gravel ranging in size from that of a pea to that of an orange (Nickelson *et al.* 1992). Spawning is concentrated in riffles or in gravel deposits at the downstream end of pools featuring suitable water depth and velocity (Weitkamp *et al.* 1995).

The favorable range for coho salmon egg incubation is 10-12.8°C (Bell 1991). Coho salmon eggs incubate for approximately 35 to 50 days, and start emerging from the gravel two to three weeks after hatching (Hassler 1987; Nickelson *et al.* 1992). Following emergence, fry move into shallow areas near the stream banks. As coho salmon fry grow, they disperse upstream and downstream to establish and defend territories (Hassler 1987).

Juvenile rearing usually occurs in tributary streams with a gradient of 3% or less, although they may move up to streams of 4% or 5% gradient. Juveniles have been found in streams as small as one to two meters wide. At a length of 38-45 mm, the fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Godfrey 1965; Nickelson *et al.* 1992). Rearing requires temperatures of 20°C or less, preferably 11.7-14.4°C (Bell 1991; Reeves *et al.* 1987, Reiser and Bjornn 1979). Coho salmon fry are most abundant in backwater pools during spring. During the summer, coho salmon fry prefer pools featuring adequate cover such as large woody debris, undercut banks, and overhanging vegetation. Juvenile coho salmon prefer to over-winter in large mainstem pools, backwater areas and secondary pools with large woody debris, and undercut bank areas (Heifetz *et al.* 1986; Hassler 1987). Coho salmon rear in fresh water for up to 15 months, then migrate to the sea as smolts between March and June (Weitkamp *et al.* 1995).

The ideal food channel for maximum coho smolt production would have shallow depth (7-60 cm), fairly swift mid-stream flows (60 cm/sec), numerous marginal back-eddies, narrow width (3-6 cm), copious overhanging mixed vegetation (to lower water temperatures, provide leaf-fall, and contribute terrestrial insects), and banks permitting hiding places (Boussu 1954). The early diets of emerging fry include chironomid larvae and pupae (Mundie 1969). Juvenile coho salmon are carnivorous opportunists that primarily eat aquatic and terrestrial insects. They do not appear to pick stationary items off the substratum (Mundie 1969; Sandercock 1991).

Little is known about residence time or habitat use in estuaries during seaward migration, although it is usually assumed that coho salmon spend only a short time in the estuary before entering the ocean (Nickelson *et al.* 1992). Growth is very rapid once the smolts reach the estuary (Fisher *et al.* 1984). While living in the ocean, coho salmon remain closer to their river of origin than do Chinook salmon (Weitkamp *et al.* 1995). Nevertheless, coho salmon have been captured several hundred to several thousand kilometers away from their natal stream (Hassler 1987). After about 12 months at sea, coho salmon gradually migrate south and along the coast, but some appear to follow a counter-clockwise circuit in the Gulf of Alaska (Sandercock 1991). Coho salmon typically spend two growing seasons in the ocean before returning to their natal streams to spawn as three year-olds. Some precocious males, called "jacks," return to spawn after only six months at sea.

b. Range-wide (ESU) Status and Trends of SONCC Coho Salmon

Available historical and most recent published coho salmon abundance information are summarized in the NOAA Fisheries coast-wide status review (Weitkamp *et al.* 1995). The following are excerpts from this document:

> Gold Ray Dam adult coho passage counts provide a long-term view of coho salmon abundance in the upper Rogue River. During the 1940s, counts averaged ca. 2,000 adult coho salmon per year. Between the late 1960s and early 1970s, adult counts averaged fewer than 200. During the late 1970s, dam counts increased, corresponding with returning coho salmon produced at Cole Rivers Hatchery. Coho salmon run size estimates derived from seine surveys at Huntley Park near the mouth of the Rogue River have ranged from ca. 450 to 19,200 naturally-produced adults between 1979 and 1991. In Oregon south of Cape Blanco, Nehlsen *et al.* (1991) considered all but one coho salmon population to be at "high risk of extinction." South of Cape Blanco, Nickelson *et al.* (1992) rated all Oregon coho salmon populations as "depressed."
>
> Brown and Moyle (1991) estimated that naturally-spawned adult coho salmon returning to California streams were less than one percent of their abundance at mid-century, and indigenous, wild coho salmon populations in California did not exceed 100 to 1,300 individuals. Further, they stated that 46% of California streams which historically supported coho salmon populations, and for which recent data were available, no longer supported runs.
>
> No regular spawning escapement estimates exist for natural coho salmon in California streams. California Department of Fish and Game (CDFG; 1994) summarized most information for the northern California region of this ESU. They concluded that "coho salmon in California, including hatchery populations, could be less than six percent of their abundance during the 1940's, and have experienced at least a 70% decline in the 1960's." Further, they reported that coho salmon populations have been virtually eliminated in many streams, and that adults are observed only every third year in some

streams, suggesting that two of three brood cycles may already have been eliminated.

> The rivers and tributaries in the California portion of this ESU were estimated to have average recent runs of 7,080 natural spawners and 17,156 hatchery returns, with 4,480 identified as "native" fish occurring in tributaries having little history of supplementation with non-native fish. Combining recent run-size estimates for the California portion of this ESU with Rogue River estimates provides a rough minimum run-size estimate for the entire ESU of about 10,000 natural fish and 20,000 hatchery fish.

Schiewe (1997a) summarizes updated and new data on trends in abundance for coho salmon from the Northern California and Oregon Coasts. The following are excerpts from this document regarding the status and trends of the SONNC coho salmon ESU:

> Information on presence/absence of coho salmon in northern California streams has been updated since the study by Brown *et al.* (1994) cited in the status review. More recent data (Table 2) indicates that the proportion of streams with coho salmon present is lower than in the earlier study (52% vs. 63%). In addition, the BRT received updated estimates of escapement at the Shasta and Willow Creek weirs in the Klamath River Basin, but these represent primarily hatchery production and are not useful in assessing the status of natural populations.

> New data on presence/absence in northern California streams that historically supported coho salmon are even more disturbing than earlier results, indicating that a smaller percentage of streams in this ESU contain coho salmon compared to the percentage presence in an earlier study. However, it is unclear whether these new data represent actual trends in local extinctions, or are biased by sampling effort.

NOAA Fisheries (2001a) updated the status review for coho salmon from the Central California Coast ESU (CCC) and the California portion of the SONCC ESU. The following is a summary of the updated status review:

> In the California portion of the SONCC coho salmon ESU, there appears to be a general decline in abundance, but trend data are more limited in this area and there is variability among streams and years. In the California portion of the SONCC coho salmon ESU, Trinity River Hatchery maintains large production and is thought to create significant straying to natural populations. In the California portion of the SONCC coho salmon ESU, the percent of streams with coho present in at least one brood year has shown a decline from 1989-1991 to the present. In 1989-1991 and 1992-1995, coho were found in over 80 percent of the streams surveyed. Since then, the percentage has declined to 69 percent in the most recent three-year interval.

> Both the presence-absence and trend data presented in this report suggest that many coho salmon populations in this ESU continue to decline. Presence-absence information from

the past 12 years indicates fish have been extirpated or at least reduced in numbers sufficiently to reduce the probability of detection in conventional surveys. Unlike the CCC ESU, the percentage of streams in which coho were documented did not experience a strong increase in the 1995-1997 period. Population trend data were less available in this ESU, nevertheless, for those sites that did have trend information, evidence suggests declines in abundance.

After considering this information, we conclude that the Southern Oregon/Northern California Coast ESU is presently not at risk of extinction, but it is likely to become endangered in the foreseeable future. The conclusion is tempered by the fact that population trend data was limited, and further analysis may reveal declines sufficient to conclude that the California portion of this ESU is in danger of extinction.

Table 2. Summary statistics of historical and current presence-absence data for coho salmon from the California portion of the SONCC ESU (from Schiewe 1997a).

Area	Streams historically inhabited by coho salmon	Streams recently surveyed	Number of streams with coho salmon present	Percent of streams with coho salmon present	
				New data	Brown *et al.* (1994)
Del Norte County	130	46	21	46	55
Humboldt County	234	130	71	55	69
Total	364	176	92	52	63

Based on the very depressed status of current coho populations discussed above as well as insufficient regulatory mechanisms and conservation efforts over the ESU as a whole, NOAA Fisheries concluded that the ESU is likely to become endangered in the foreseeable future (62 FR 24588).

c. Factors Responsible for the SONCC Coho Salmon Population Decline

The SONCC coho salmon ESU was listed as threatened due to numerous factors including several long-standing, human-induced factors (e.g., habitat degradation, harvest, water diversions, and artificial propagation) that exacerbate the adverse effects of natural environmental variability (e.g., floods, drought, poor ocean conditions). Habitat factors that contributed to the decline of coho salmon in the SONCC ESU included changes in channel morphology, substrate changes, loss of instream roughness and complexity, loss of estuarine habitat, loss of wetlands, loss and/or degradation of riparian areas, declines in water quality, altered stream flows, impediments to fish passage, and elimination of habitat. The major activities identified as responsible for the decline of coho salmon in Oregon and California included logging, road building, grazing, mining, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals, and unscreened diversions for irrigation (May 6, 1997; 62 FR 24588).

Forest management activities that influence the quantity, quality, or timing of stream flows affect fish habitat primarily through changes in the normal levels of peak flows or low flows (Sullivan *et al.* 1987; Chamberlin *et al.* 1991). Water outflow from hillsides to streams are affected through changes in evapotranspiration, soil water content, and soil structure. In general, timber management activities allow more water to reach the ground, and may alter water infiltration into forest soils such that less water is absorbed or the soil may become saturated faster thereby increasing surface flow. Road systems, skid trails, and landings where the soils become compacted may also accelerate runoff. Ditches concentrate surface runoff and intercept subsurface flow bringing it to the surface (Chamberlin *et al.* 1991; Furniss *et al.* 1991). Significant increases in the magnitude of peak flows or the frequency of channel forming flows can increase channel scouring or accelerate bank erosion. Changes in peak flow and sediment yield directly related to the removal of vegetation will typically persist for only a few years and tend to decrease over time as the watershed recovers and new vegetation grows. Changes associated with roads persist indefinitely as roads are maintained or abandoned without treatment. Stream channel responses may take decades or centuries to recover (Chamberlin *et al.* 1991; Furniss *et al.* 1991).

Since the adoption of the Northwest Forest Plan in 1994, there has been a significant decrease in the miles of new road constructed on public lands in the range of the northern spotted owl, which includes the SONCC coho salmon ESU. Although there are few miles of new roads constructed in any given year, the existing road system has the potential to significantly further degrade SONCC coho salmon habitat. There are thousands of miles of legacy roads and skid roads, and thousands of culverts on public lands within the SONCC coho salmon ESU. These roads are not only chronic sources of fine sediment, but during floods they can deliver immense quantities of fine and coarse sediments to SONCC coho salmon spawning and rearing areas. Fine sediments can impair coho habitat by filling pools and reducing habitat complexity.

Improperly placed culverts can create barriers to migrating fish. Culverts with inadequate hydraulic capacity can restrict stream flows, often resulting in major contributions of sediment to streams when the culverts become plugged or overflow. When water overtops the road fill, the water may divert out of the stream channel and flow down the road or road-ditch and discharge onto hillslopes unaccustomed to heavy, overland flow and produce erosional consequences far removed from the crossing (Flanagan *et al.* 1998).

Tribal harvest (fishing) was not considered a major factor in the decline of coho salmon in the SONCC ESU. In contrast, over-fishing in non-tribal fisheries is believed to have been a significant factor (May 6, 1997; 62 FR 24588). Disease and predation were not believed to have been major causes in the species decline; however, they may have had substantial impacts in local areas. For example, Higgins *et al.* (1992) and CDFG (1994) reported that Sacramento River pikeminnow have been found in the Eel River basin and are considered to be a major threat to native coho salmon. Furthermore, California sea lions and Pacific harbor seals, which occur in most estuaries and rivers where salmonid runs occur on the West Coast, are known predators of salmonids. Harbor seals are present year-round near Cape Mendocino. California sea lions are present near Cape Mendocino in the fall and spring. At the mouth of the Eel River, harbor seals haul-out in large numbers (600-1,050 seals). More than 1,200 harbor seals have been counted in the vicinity of Trinidad Head. Coho salmon may be vulnerable to impacts from pinniped predation. In the final rule listing the SONCC coho salmon ESU, NOAA Fisheries indicated that it was unlikely that pinniped predation was a significant factor in the decline of coho salmon on the West Coast, although they may be a threat to existing depressed local populations. NOAA Fisheries (1997) determined that although pinniped predation did not cause the decline of salmonid populations, in localized areas where they co-occur with salmonids (especially where salmonids concentrate or passage may be constricted), predation may preclude recovery of these populations. Specific areas where predation may preclude recovery cannot be determined without extensive studies.

Artificial propagation was also a factor in the decline of coho salmon due to the genetic impacts on indigenous, naturally-reproducing populations, disease transmission, predation of wild fish, depletion of wild stock to enhance brood stock, and replacement rather than supplementation of wild stocks through competition and the continued annual introduction of hatchery fish.

Existing regulatory mechanisms, including land management plans (e.g., National Forest Land Management Plans, State Forest Practice Rules), Clean Water Act section 404 activities, urban growth management, and harvest and hatchery management all contributed to varying degrees to the decline of coho salmon due to lack of protective measures, the inadequacy of existing measures to protect coho salmon and/or its habitat, or the failure to carry out established protective measures. Since the listing of the SONCC coho salmon ESU, no new threats have been identified.

2. Steelhead

a. General Life History

Biologically, steelhead can be divided into two basic run-types, based on the state of sexual maturity at the time of river entry and duration of spawning migration (Burgner *et al.* 1992). The stream-maturing type, or summer steelhead, enters fresh water in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type, or winter steelhead, enters fresh water with well-developed gonads and spawns shortly after river entry (August 9, 1996, 61 FR 41542; Barnhart 1986). Variations in migration timing exist between populations. Some river basins have both summer and winter steelhead, while others only have one run-type. South of Cape Blanco, Oregon, summer steelhead are known to occur in the Rogue, Smith, Klamath, Trinity, Mad, and Eel Rivers, and in Redwood Creek (Busby *et al.* 1996).

Summer steelhead enter fresh water between May and October in the Pacific Northwest (Busby *et al.* 1996, Nickelson *et al.* 1992). They require cool, deep holding pools during summer and fall, prior to spawning (Nickelson *et al.* 1992). They migrate inland toward spawning areas, overwinter in the larger rivers, resume migration in early spring to natal streams, and then spawn (Meehan and Bjornn 1991, Nickelson *et al.* 1992) in January and February (Barnhart 1986).

Winter steelhead enter fresh water between November and April in the Pacific Northwest (Busby *et al.* 1996, Nickelson *et al.* 1992), migrate to spawning areas, and then spawn, generally in April and May (Barnhart 1986). Some adults, however, do not enter some coastal streams until spring, just before spawning (Meehan and Bjornn 1991).

There is a high degree of overlap in spawn timing between populations within an ESU regardless of run type (Busby *et al.* 1996). Difficult field conditions at that time of year and the remoteness of spawning grounds contribute to the relative lack of specific information on steelhead spawning. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (August 9, 1996, 61 FR 41542, Nickelson *et al.* 1992). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996).

Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Barnhart 1986, Everest 1973). Steelhead enter streams and arrive at spawning grounds weeks or even months before they spawn and are vulnerable to disturbance and predation. Cover, in the form of overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water, turbulence, and turbidity (Giger 1973) are required to reduce disturbance and predation of spawning steelhead. It appears that summer steelhead occur where habitat is not fully utilized by winter steelhead; summer steelhead usually spawn further upstream than winter steelhead (Withler 1966, Behnke 1992).

Steelhead require a minimum depth of 0.18 m and a maximum velocity of 2.44 m/s for active upstream migration (Smith 1973). Spawning and initial rearing of juvenile steelhead generally take place in small, moderate-gradient (generally 3-5%) tributary streams (Nickelson *et al.* 1992). A minimum depth of 0.18 m, water velocity of 0.30-0.91 m/s (Smith 1973, Thompson 1972), and clean substrate 0.6-10.2 cm (Hunter 1973, Nickelson *et al.* 1992) are required for spawning. Steelhead spawn in 3.9-9.4°C water (Bell 1991).

Depending on water temperature, steelhead eggs may incubate for 1.5 to 4 months before hatching, generally between February and June (Bell 1991). Bjornn and Reiser (1991) noted that steelhead eggs incubate about 85 days at 4°C and 26 days at 12°C to reach 50% hatch.

Nickelson *et al.* (1992) stated that eggs hatch in 35-50 days, depending upon water temperature.

After two to three weeks in late spring, and following yolk sac absorption, alevins emerge from the gravel and begin actively feeding. After emerging from the gravel, fry usually inhabit shallow water along banks of perennial streams. Fry occupy stream margins (Nickelson *et al.* 1992). Older fry establish and defend territories.

Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson *et al.* 1992).

Juvenile steelhead migrate little during their first summer and occupy a range of habitats featuring moderate to high water velocity and variable depths (Bisson *et al.* 1988). Rearing juveniles prefer water temperatures ranging from 12-15°C (Reeves *et al.* 1987). Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects (Chapman and Bjornn 1969), and older juveniles sometimes prey on emerging fry. Steelhead hold territories close to the substratum where flows are lower and sometimes counter to the main stream; from these, they can make forays up into surface currents to take drifting food (Kalleberg 1958). Juveniles rear in freshwater from one to four years (usually two years in the California ESUs), then smolt and migrate to the ocean in March and April (Barnhart 1986). Winter steelhead populations generally smolt after two years in fresh water (Busby *et al.* 1996). Steelhead smolts are usually 15-20 cm total length and migrate to the ocean in the spring (Meehan and Bjornn 1991). Based on purse seine catch, juvenile steelhead tend to migrate directly offshore during their first summer from whatever point they enter the ocean rather than migrating along the coastal belt as salmon do. During the fall and winter, juveniles move southward and eastward (Hartt and Dell 1986).

Steelhead typically reside in marine waters for two or three years prior to returning to their natal stream to spawn as four or five-year olds (August 9, 1996, 61 FR 41542). Populations in Oregon and California have higher frequencies of age-1 ocean steelhead than populations to the north, but age-2 ocean steelhead generally remain dominant (Busby *et al.* 1996). Age structure appears to be similar to other west coast steelhead, dominated by four-year-old spawners (Busby *et al.* 1996). Some steelhead return to fresh water after only two to four months in the ocean and are termed "half-pounders" (Snyder 1925). Half-pounders generally spend the winter in fresh water and then out migrate again the following spring for several months before returning to fresh water to spawn. Half-pounders occur over a relatively small geographic range in southern Oregon and northern California, and are only reported in the Rogue, Klamath, Mad, and Eel Rivers (Snyder 1925, Barnhart 1986, Kesner and Barnhart 1972, and Everest 1973).

b. Range-wide (ESU) Status and Trends of NC steelhead

Available historical and most recent published steelhead abundance are summarized in the NOAA Fisheries west coast steelhead status review (Busby *et al.* 1996). The following are excerpts from this document:

> Prior to 1960, estimates of abundance specific to this ESU were available from dam counts in the upper Eel River (Cape Horn Dam–annual average of 4,400 adult steelhead in the 1930s), the South Fork Eel River (Benbow Dam–annual average of 19,000 adult steelhead in the 1940s), and the Mad River (Sweasey Dam–annual average of 3,800 adult steelhead in the 1940s).
>
> In the mid-1960s, estimates of steelhead spawning populations for many rivers in this ESU totaled 198,000. The only current run-size estimates for this area are counts at Cape Horn Dam on the Eel River where an average of 115 total and 30 wild adults were reported.
>
> Adequate adult escapement information was available to compute trends for seven stocks within this ESU. Of these, five data series exhibit declines and two exhibit increases during the available data series, with a range from 5.8% annual decline to 3.5% annual increase. Three of the declining trends were significantly different from zero. We have little information on the actual contribution of hatchery fish to natural spawning, and little information on present total run sizes for this ESU. However, given the preponderance of significant negative trends in the available data, there is concern that steelhead populations in this ESU may not be self-sustaining.

Schiewe (1997b) summarized more recent data on trends in abundance for summer and winter steelhead in the Northern California ESU. The following are excerpts from this document:

> Updated spawner surveys of summer steelhead in Redwood Creek, the south for of the Van Duzen River (Eel River Basin), and the Mad River suggest mixed trends in abundance: the Van Duzen fish decreased by -7.1% from 1980-96 and the Mad River summer steelhead have increased by 10.3% over the same time period. The contribution of hatchery fish to these trends in abundance is not known.
>
> New weir counts of winter steelhead in Prairie Creek (Redwood Creek Basin, Humboldt county) show a dramatic increase (over 36%) in abundance during the period 1985-1992. This increase is difficult to interpret because a major highway construction project during this time period resulted in intensive monitoring of salmonids in the basin and Prairie Creek Hatchery was funded to mitigate lost salmonid production. Therefore, it is unclear whether the increase in steelhead reflects increased monitoring effort and mitigation efforts or an actual recovery of Prairie Creek steelhead.

In 2000, NOAA Fisheries concluded that the status of the population had changed little since the 1997 evaluation. Based on this and a lack of implementation of State conservation measures, NOAA Fisheries concluded that the Northern California steelhead ESU warrants listing as a threatened species (65 FR 36074).

c. Factors Responsible for Steelhead Population Decline

NOAA Fisheries identified numerous factors contributing to the decline of NC Steelhead (64 FR36074). First, NOAA Fisheries noted various sources of both riparian and instream habitat degradation. Increased sedimentation due to the combined effects of land management activities such as timber harvest, agriculture and mining, and the residual effects of the floods of 1955 and 1964 have degraded and continue to degrade habitat conditions for NC Steelhead. These floods also resulted in major channel restructuring and minor passage blockages that continue to impact this ESU. Water diversions also degrade and limit the habitat available to NC steelhead.

Second, NOAA Fisheries expressed concern about the influence of past and present steelhead hatcheries--both in terms of genetic introgression and ecological interactions between hatchery and wild stocks. NOAA Fisheries specifically identified the past practices of the Mad River Hatchery as potentially damaging to NC Steelhead. CDFG out-planted non-indigenous hatchery Mad River Hatchery brood stocks to other streams within the ESU. They also attempted to cultivate a run of non-indigenous summer steelhead within the Mad River. CDFG ended these practices in 1996.

Third, NOAA Fisheries concluded that introduction of nonnative species and habitat modifications have resulted in increased impacts to NC steelhead from increased predator populations. In particular, NOAA Fisheries believes that predation by artificially introduced Sacramento pikeminnows in the Eel River as a major problem.

Finally, NOAA Fisheries also noted that under some circumstances, the impacts of recreational fishing might become a concern--particularly during years of decreased availability of refugia such as drought years.

See also the *Factors Affecting SONCC Coho Salmon* and *Factors Affecting CC Chinook Salmon* sections of this biological opinion for further information on factors affecting steelhead trout.

3. <u>Chinook Salmon</u>

a. General Life History

The coastal drainages south of Cape Blanco, Oregon, are dominated by the Rogue, Klamath, and Eel Rivers. The Chetco, Smith, Mad, Mattole, and Russian Rivers and Redwood Creek are smaller systems that contain sizable populations of fall-run Chinook salmon (Campbell and Moyle 1990, ODFW 1995). Presently, spring runs are found in the Rogue, Klamath, and Trinity

Rivers; additionally, a vestigial spring run may still exist on the Smith River (Campbell and Moyle 1990, USFS 1995). Historically, fall-run Chinook salmon were predominant in most coastal river systems south to the Ventura River; however, their current distribution only extends to the Russian River (Healey 1991). There have also been spawning fall-run Chinook salmon reported in small rivers draining into San Francisco Bay (Nielson *et al.* 1994).

Of the Pacific salmon, Chinook salmon arguably exhibit the most diverse and complex life history strategies. Healey (1986) described 16 age categories for Chinook salmon, 7 total ages with 3 possible freshwater ages. Two generalized freshwater life-history types were described by Healey (1991): "stream-type" Chinook salmon reside in freshwater for a year or more following emergence, whereas "ocean-type" Chinook salmon migrate to the ocean within their first year.

Chinook salmon mature between 2 and 6+ years of age (Myers *et al.* 1998). Freshwater entry and spawning timing are generally thought to be related to local water temperature and flow regimes (Miller and Brannon 1982). Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and actual time of spawning (Myers *et al.* 1998).

Run timing for spring-run Chinook salmon in this area typically begins in March and continues through July, with peak migration occurring in May and June. Spawning begins in late August and can continue through October, with a peak in September. Historically, spring-run spawning areas were located in the river headwaters (generally above 400 m). Run timing for fall-run Chinook salmon varies depending on the size of the river. Adult Rogue, Upper Klamath, and Eel River fall Chinook salmon return to freshwater in August and September and spawn in late October and early November (Stone 1897, Snyder 1931, Nicholas and Hankin 1988, Barnhart 1995). In other coastal rivers and the lower reaches of the Klamath River, fall-run freshwater entry begins later in October, with peak spawning in late November and December--often extending into January (Leidy and Leidy 1984, Nicholas and Hankin 1988, Barnhart 1995). Late-fall or "snow" Chinook salmon from Blue Creek, on the lower Klamath River, were described as resembling the fall-run fish from the Smith River in run and spawning timing, as well as the degree of sexual maturation at the time of river entry (Snyder 1931).

When they enter freshwater, spring-run Chinook salmon are immature and they must stage for several months before spawning. Their gonads mature during their summer holding period in freshwater. Over-summering adults require cold-water refuges such as deep pools to conserve energy for gamete production, redd construction, spawning, and redd guarding. The upper limit of the optimal temperature range for adults holding while eggs are maturing is 59° F to 60° F (Hinz 1959). The upper preferred water temperature for spawning adult Chinook salmon is 55° F to 57° F (Reiser and Bjornn 1979). Unusual stream temperatures during spawning migration and adult holding periods can alter or delay migration timing, accelerate or retard mutations, and increase fish susceptibility to diseases. Sustained water temperatures above 80.6° F are lethal to adults (Cramer and Hammack1952, CDFG 1998).

Spring-run Chinook salmon eggs generally incubate between October to January, and fall-run Chinook salmon eggs incubate between October and December (Bell 1991). Length of time required for eggs to develop and hatch is dependant on water temperature and is quite variable, typically ranging from three to five months. The optimum temperature range for Chinook salmon egg incubation is 44° F to 54° F (Rich 1997). Incubating eggs show reduced egg viability and increased mortality at temperatures greater than 58° F and show 100% mortality for temperatures greater than 63° F (Velson 1987). Velson (1987) and Beacham and Murray (1990) found that developing Chinook salmon embryos exposed to water temperatures of 35° F or less before the eyed stage experienced 100% mortality (CDFG 1998). Emergence of spring- and fall-run Chinook salmon fry begins in December and continues into mid-April (Leidy and Leidy 1984; Bell 1991). Fry use woody debris, interstitial spaces in cobble substrates, and undercut banks as cover (Everest and Chapman 1972). As the fry grow, habitat preferences change. Juveniles move away from stream margins and begin to use deeper water areas with slightly higher water velocities.

Chinook salmon populations south of Cape Blanco all exhibit an ocean-type life history. The majority of fish emigrate to the ocean as subyearlings, although yearling smolts can constitute up to approximately a fifth of outmigrants from the Klamath River Basin, and to a lesser proportion in the Rogue River Basin; however, the proportion of fish which smolted as subyearling vs. yearling varies from year to year (Snyder 1931, Schluchter and Lichatowich 1977, Nicholas and Hankin 1988, Barnhart 1995). This fluctuation in age at smoltification is more characteristic of an ocean-type life history. Furthermore, the low flows, high temperatures, and barrier bars that develop in smaller coastal rivers during the summer months would favor an ocean-type (subyearling smolt) life history (Kostow 1995).

Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure. The optimum temperature range for rearing Chinook salmon fry is 50° F to 55° F (Rich 1997, Seymour 1956) and for fingerlings is 55° F to 60° F (Rich 1997).

Ocean-type juveniles enter saltwater during one of three distinct phases. "Immediate" fry migrate to the ocean soon after yolk resorption at 30-45 mm in length (Lister *et al.* 1971, Healey 1991). In most river systems, however, fry migrants, which migrate at 50-150 days post-hatching, and fingerling migrants, which migrate in the late summer or autumn of their first year, represent the majority of ocean-type emigrants. Stream-type Chinook salmon migrate during their second or, more rarely, their third spring. Under natural conditions stream-type Chinook salmon appear to be unable to smolt as subyearlings.

The diet of out migrating ocean-type Chinook salmon varies geographically and seasonally, and feeding appears to be opportunistic (Healey 1991). Aquatic insect larvae and adults, *Daphnia*, amphipods (*Eogammarus* and *Corophium spp.*), and *Neomysis* have been identified as important food items (Kjelson *et al.* 1982, Healey 1991).

Juvenile stream- and ocean-type Chinook salmon have adapted to different ecological niches. Ocean-type Chinook salmon tend to utilize estuaries and coastal areas more extensively for juvenile rearing. In general, the younger (smaller) juveniles are at the time of emigration to the estuary, the longer they reside there (Kjelson *et al.* 1982, Levy and Northcote 1982, Healey 1991). Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to those watersheds, or parts of watersheds, that are more consistently productive and less susceptible to dramatic changes in water flow, or which have environmental conditions that would severely limit the success of subyearling smolts (Miller and Brannon 1982, Healey 1991).

In preparation for their entry into a saline environment, juvenile salmon undergo physiological transformations known as smoltification that adapt them for their transition to salt water (Hoar 1976). These transformations include different swimming behavior and proficiency, lower swimming stamina, and increased buoyancy that also make the fish more likely to be passively transported by currents (Saunders 1965, Folmar and Dickhoff 1980, Smith 1982). In general, smoltification is timed to be completed as fish are near the fresh water to salt water transition. Too long a migration delay after the process begins is believed to cause the fish to miss the "biological window" of optimal physiological condition for the transition (Walters *et al.* 1978). The optimal thermal range for Chinook during smoltification and seaward migration is 50° F to 55° F (Rich 1997).

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% of returning spring-run adults are three years old based on observations of adult Chinook salmon trapped and examined at Red Bluff Diversion Dam on the Sacramento River between 1985 and 1991.

b. Range-wide Status and Trends of CC Chinook salmon

Available historical and most recent published Chinook salmon abundance information are summarized in Myers *et al.* (1998). The following are excerpts from this document:

> Estimated escapement of this ESU was estimated at 73,000 fish, predominantly in the Eel River (55,500) with smaller populations in; Redwood Creek, Mad River, Mattole River (5,000 each), Russian River (500), and several small streams in Del Norte and Humboldt Counties.
>
> Within this ESU, recent abundance data vary regionally. Dam counts of upstream migrants are available on the South Fork Eel River at Benbow Dam from 1938 to 1975. Counts at Cape Horn Dam, on the upper Eel River are available from the 1940s to the present, but they represent a small, highly variable portion of the run. No total escapement estimates are available for this ESU, although partial counts indicate that

escapement in the Eel River exceeds 4,000.

Data available to assess trends in abundance are limited. Recent trends have been mixed, with predominantly strong negative trends in the Eel River Basin, and mostly upward trends elsewhere. Previous assessments of stocks within this ESU have identified several stocks as being at risk or of concern. Nehlsen *et al.* (1991) identified seven stocks as at high extinction risk and seven stocks as at moderate extinction risk. Higgins *et al.* (1992) provided a more detailed analysis of some of these stocks, and identified nine chinook salmon stocks as at risk or of concern. Four of these stock assessments agreed with Nehlsen *et al.* (1991) designations, while five fall-run chinook salmon stocks were either reassessed from a moderate risk of extinction to stocks of concern (Redwood Creek, Mad River, and Eel River) or were additions to the Nehlsen *et al.* (1991) list as stocks of special concern (Little and Bear rivers). In addition, two fall-run stocks (Smith and Russian rivers) that Nehlsen *et al.* (1991) listed as at moderate extinction risk were deleted from the list of stocks at risk by Higgins *et al.* (1992), although the U.S. Fish and Wildlife Service reported that the deletion for the Russian River was due to a finding that the stock was extinct.

Observed widespread declines in abundance and the present distribution of small populations with sometimes sporadic occurrences contribute to the risks faced in this ESU. Based on this information, NOAA Fisheries concluded that the California Coastal Chinook salmon ESU is likely to become endangered in the near future (64 FR 50393).

c. Factors Responsible for Chinook Salmon Population Decline

Chinook salmon on the West Coast of the United States have experienced declines in abundance in the past several decades as a result of loss, damage or change to their natural environment. Water diversions for agriculture, flood control, domestic, and hydropower purposes (especially in the Columbia River and Sacramento-San Joaquin basins) have greatly reduced or eliminated historically accessible habitat and degraded remaining habitat. Forestry, agriculture, mining, and urbanization have degraded, simplified, and fragmented habitat. Studies indicate that in most western states, about 80 to 90 percent of the historic riparian habitat has been eliminated (Norse 1990, California State Lands Commission 1993). Washington and Oregon wetlands are estimated to have diminished by one-third, while wetland habitat in California has declined 91 percent. Loss of habitat complexity and habitat fragmentation have also contributed to the decline of Chinook salmon. For example, in national forests within the range of the northern spotted owl in western and eastern Washington, there has been a 58-percent reduction in large, deep pools due to sedimentation and loss of pool-forming structures such as boulders and large wood (Forest Ecosystem Management Assessment Team; FEMAT 1993). Similar or greater effects are likely in California.

Habitat loss and/or degradation is widespread throughout the range of the CC Chinook salmon ESU. The California Advisory Committee on Salmon and Steelhead Trout (CACSST) reported habitat blockages and fragmentation, logging and agricultural activities, urbanization, and water withdrawals as the most predominant problems for anadromous salmonids in California's coastal basins (CACSST 1988). They identified associated habitat problems for each major river system in California. CDFG (1965, Vol. III, Part B) reported that the most vital habitat factor for coastal California streams was "degradation due to improper logging followed by massive siltation, log jams, etc." They cited road building as another cause of siltation in some areas. They identified a variety of specific critical habitat problems in individual basins, including extremes of natural flows (Redwood Creek and Eel River), logging practices (Mad, Eel, Mattole, Ten Mile, Noyo, Big, Navarro, Garcia, and Gualala rivers), and dams with no passage facilities (Eel and Russian Rivers), and water diversions (Eel and Russian Rivers). Delivery of large sediment pulses during recent major flood events (February 1996 and January 1997) have probably affected habitat quality and survival of juveniles within this ESU.

Introductions of nonnative species and habitat modifications have resulted in increased predator populations in numerous rivers. Predation by marine mammals is also of concern in areas experiencing dwindling Chinook salmon run sizes. However, salmonids appear to be a minor component of the diet of marine mammals (Scheffer and Sperry 1931, Jameson and Kenyon 1977, Graybill 1981, Brown and Mate 1983, Roffe and Mate 1984, Hanson 1993). Principal food sources are small pelagic schooling fish, juvenile rockfish, lampreys (Jameson and Kenyon 1977, Roffe and Mate 1984), benthic and epibenthic species (Brown and Mate 1983) and flatfish (Scheffer and Sperry 1931, Graybill 1981). Predation may significantly influence salmonid abundance in some local populations when other prey are absent and physical conditions lead to the concentration of adults and juveniles (Cooper and Johnson 1992).

Infectious disease is one of many factors that can influence adult and juvenile Chinook salmon survival. Chinook salmon are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment. Very little current or historical information exists to quantify changes in infection levels and mortality rates attributable to these diseases for Chinook salmon. However, studies suggest that naturally spawned fish tend to be less susceptible to pathogens than hatchery-reared fish (Sanders *et al.* 1992).

Artificial propagation and other human activities such as harvest and habitat modification can genetically change natural populations so much that they no longer represent an evolutionarily significant component of the biological species (Waples 1991). Artificial propagation is a common practice to supplement Chinook salmon stocks for commercial and recreational fisheries. However, in many areas, a significant portion of the naturally spawning population consists of hatchery-produced Chinook salmon. In several Chinook salmon ESUs, more than 50 percent of the naturally spawning fish are from hatcheries. Many of these hatchery-produced fish are derived from a few stocks that may or may not have originated from the geographic area where they are released. However, in several of the ESUs analyzed, insufficient or uncertain information exists regarding the interactions between hatchery and natural fish, and the relative abundance of hatchery and natural stocks. Competition, genetic introgression, and disease transmission resulting from hatchery introductions may significantly reduce the production and survival of native, naturally-reproducing Chinook salmon. Collection of native Chinook salmon for hatchery brood stock purposes often harms small or dwindling natural populations. Artificial propagation may play an important role in Chinook salmon recovery, and some hatchery populations of Chinook salmon may be deemed essential for the recovery of threatened or endangered Chinook salmon ESUs. While some limits have been placed on hatchery production of anadromous salmonids, more careful management of current programs and scrutiny of proposed programs is necessary in order to minimize impacts on listed species. Artificial propagation programs within the CC Chinook salmon ESU are less extensive than those in Klamath/Trinity or Central Valley ESUs. The Rogue, Chetco and Eel River basins and Redwood Creek have received considerable releases, derived primarily from local sources. Current hatchery contribution to overall abundance is relatively low except for the Rogue River spring-run.

The CWA, enforced in part by the EPA, is intended to protect beneficial uses, including fishery resources. To date, implementation has not been effective in adequately protecting fishery resources, particularly with respect to non-point sources of pollution. In addition, section 404 of the CWA does not adequately address the cumulative and additive effects of loss of habitat through continued development of waterfront, riverine, coastal, and wetland properties that also contribute to the degradation and loss of important aquatic ecosystem components necessary to maintain the functional integrity of these habitat features.

Sections 303 (d) (1) (C) and (D) of the CWA require states to prepare Total Maximum Daily Loads (TMDLs) for all water bodies that do not meet State water quality standards. Development of TMDLs is a method for quantitative assessment of environmental problems in a watershed and identification of pollution reductions needed to protect drinking water, aquatic life, recreation, and other uses of rivers, lakes, and streams. Appropriately protective aquatic life criteria are critical to the TMDL process for affecting the recovery of salmon populations, as the criteria's exceedance will determine which waterbodies will engage in the TMDL process and criteria compliance goals are the impetus for developing mass loading strategies. The ability of these TMDLs to protect Chinook salmon should be significant in the long term; however, developing them quickly in the short term will be difficult, and their efficacy in protecting Chinook salmon habitat will be unknown for years to come (NMFS 2000).

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat) and ecosystem within the action area. The environmental baseline establishes the base condition for natural resources, human usage, and species usage in an action area which is used as a point of comparison for evaluating effects of an action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in progress (50 CFR § 402.02).

A. Redwood Creek Baseline

Most of this baseline is compiled and summarized from the *Redwood Creek Watershed Analysis* (RNSP 1997), the *Total Maximum Daily Load for Sediment: Redwood Creek, California* (EPA 1998), and the draft *Management and Restoration Alternatives for the Redwood Creek Estuary and Draft Environmental Assessment* (RNSP 2000). More detailed descriptions and analyses can be found in these documents.

1. Watershed Description

The Redwood Creek watershed is located in the northern coast ranges of California, and flows into the Pacific Ocean near the town of Orick. The drainage area at the stream mouth is about 285 square miles. The basin is narrow and elongated, with its long axis oriented northwest-southeast. The total length of the basin is about 65 miles, and its width varies from four to seven miles (Janda *et al.* 1975). Total basin relief is about 5,300 feet, with a mean annual basin-wide precipitation of approximately 80 inches (Janda *et al.* 1975).

Geologic structure in the Redwood Creek watershed is governed by several parallel north-northwest trending faults (Janda *et al.* 1975, Harden *et al.* 1982). These faults range from low-angle thrust faults to vertical faults and form the boundaries between the major lithologic units in the watershed. Late-Cenozoic uplift has resulted in steep, unstable "inner gorge" topography along major streams in Redwood Creek (Janda *et al.* 1975). The two major types of rocks within the Redwood Creek basin are sedimentary rocks (primarily sandstones) to the east of the Grogan Fault and metamorphic rocks (primarily schist) to the west of the fault.

2. Major Sources of Anthropogenic Impacts

a. Logging

Timber harvesting is the most widespread land use in the Redwood Creek basin. Over 85% of the basin upstream of the RNSP has been logged, including about 30% that was logged between 1978 and 1992. About three-quarters of this recently logged area was logged using intensive silvicultural methods, which remove all or almost all trees from the harvest area. Substantial areas of the RNSP were intensively logged prior to their inclusion in the RNSP. Harvested areas remain at greater risk of increased erosion (principally through landsliding) for several years following harvest, and possibly for longer periods of time. Most of the likely future erosion potential in the basin caused by human activity is associated with logging roads and skid trails, although roads constructed for other purposes also pose significant erosion potential. Increased sediment delivery derived from timber harvest activities has likely increased the amount and rate of aggradation of the stream channel in the action area.

b. Roads

Roads can be major sources of accelerated erosion (Kelsey *et al.* 1981b, Hagans and Weaver 1987, Best *et al.* 1995), depending on their location, design, and level of maintenance (Janda *et al.* 1975, Best 1984, Klein 1987). Common erosion problems associated with roads include washouts and stream diversions at stream crossings, mass wasting of unstable fills and oversteepened cutbanks, and interception of surface and subsurface water by cutbanks and inboard ditches.

About 1,200 miles of forest roads and 5,400 miles of skid trails were built within the Redwood Creek watershed as of 1978 (Best 1984). About 445 miles of roads and 3,000 miles of skid trails (Steensen and Spreiter 1992) were included within present RNSP boundaries as a result of expansion in 1978. Roughly 270 miles of logging haul roads remain on RNSP lands. Recent surveys located about 1,200 sites with potential or existing erosional problems along old haul roads in the RNSP (RNSP 2002). In addition, about 20 miles of state highway and county roads cross the watershed, including several miles of abandoned state highway.

Most of the upper- and middle-basin road network was built before enactment of current forest practice rules (as amended in 1983) that required new roads to be built without potential to divert streamflow. Of the 1,110 miles of roads upstream of the RNSP, about 340 miles were determined to be unmaintained and abandoned as of 1992. Another 180 miles were classified as unmaintained but still driveable. A large proportion of observed erosion is associated with an extensive road network (7.3 miles per square mile) on private lands, improperly designed and maintained roads and skid trails, and timber harvest (EPA 1998). An estimated 90% of gully erosion within Redwood Creek is road-related (Hagans *et al.* 1986, RNSP 1997). Furthermore, a study of 586 mainstem landslides revealed that approximately 50% of the slides had one or more associated roads (Kelsey *et al.* 1981). However, RNSP has been working with private landowners in the upper Redwood Creek Basin since 1997 to upgrade or decommission deteriorating roads, and significant improvements have already been made in several areas (Greg Bundros, geologist, RNSP, pers. comm., February 10, 2003). This cooperative approach is projected to continue in the future and should result in a gradual reduction in watershed impacts from existing roads. Increased sediment delivery derived from roads has likely increased the amount and rate of aggradation of the stream channel in the action area.

c. Mining

Mining within the Redwood Creek watershed has been limited to gravel mining within the channel of Redwood Creek and rock quarries and borrow pits used for road construction. Gravel has been mined between the flood-control levees on Lower Redwood Creek, near the mouth of Prairie Creek, at the mouth of Tom McDonald Creek, and near Highway 299 (Janda *et al.* 1975). According to information contained in RNSP (2000) most of the mining between the flood-control levees and near the mouth of Prairie Creek occurred in the 1980s and was used for construction of the Highway 101 bypass. Although we do not have a complete record of the quantities of gravel removed in the past, Humboldt County provided the following information in their permit application: (1) 100,000 cubic yards removed in 1987 from just above Highway 101 Bridge to the mouth of Redwood Creek; (2) 9,000 cubic yards removed in 1998 from the upstream portion of the action area, near the confluence with Prairie Creek; (3) 41,000 cubic yards removed in 1999 from throughout the action area; and (4) 2,700 cubic yards removed in 2000 from the most upstream portion of the action area.

Moffatt and Nichol (2003) also provided information on past mining and replenishment rates from information reported by RNSP, utilizing cross sections from 1987 to 1997. Moffatt and Nichol (2003) report that about 213,200 cubic yards of gravel were removed from the channel during 1987 and 1988, and that the areas extracted had an approximate 33% gravel replenishment the following year, and a total of about 44% gravel replenishment within 3 years. Additionally, qualitative observations of lower Redwood Creek indicate that the large amounts of gravel removed during the late 1980s affected the quality and quantity of pool and riffle habitats, such that the quality and quantity of riffle and pool habitats were decreased by simplification of the alluvial structure of the channel (J.Simondet, NOAA Fisheries, pers. comm., 2003).

d. Grazing

In other areas of the western United States, livestock grazing has been associated with increased runoff and erosion. Cattle grazing continues on grasslands in the middle and upper Redwood Creek basins and in the Orick Valley, where several dairies are located. However, RNSP considers the sediment related impacts of grazing in Redwood Creek to be insignificant in comparison to high natural rates of runoff and erosion and the effects of logging and road building (RNSP 1997). Still, cattle may affect water quality in Redwood Creek and its estuary through the introduction of nutrient-rich waste and reduction of riparian shading. An accurate determination of the effects of past and present grazing would require additional research. NOAA Fisheries also notes that the flood-control levees were constructed, in part, to protect dairy farms and grazing land on the Redwood Creek floodplain.

e. Watershed Restoration

The legislation expanding Redwood National Park in 1978 (PL 95-250) authorized a major watershed restoration effort. Congress directed that this work focus on minimizing erosion from past land uses, re-establishing native vegetation, and protecting aquatic and riparian resources along RNSP streams (Spreiter *et al.* 1995).

Since 1981, former log-haul roads have been the primary focus of the watershed restoration efforts within RNSP. About 175 miles of logging roads have been treated since 1978. The total volume of sediment excavated from roads is approximately 1,300,000 cubic yards. These reductions in risk should provide a long-term benefit to Redwood Creek watershed conditions, but can be difficult to measure or quantify in the mainstem at the present time.

Presently, RNSP is working to remove approximately nine miles of roads and associated skid trails in the northern portion of Lost Man Creek watershed. Road removal work involves completely excavating stream crossings, restoring natural contours and landforms along road corridors and old landing sites by retrieving fill, uncovering buried topsoil, spreading woody debris on finished surfaces and replanting with native species. Watershed restoration is an ongoing RNSP program and NOAA Fisheries anticipates additional work in the future. NOAA Fisheries has identified activities associated with road removal projects in the Redwood Creek watershed that may cause potential short term adverse effects to salmonids and their habitat. However, as mentioned above, NOAA Fisheries thinks that these activities will result in long term benefits to listed salmonids, and that the short term adverse effects will be minor enough that effects may not be detectable within the action area of this consultation.

f. Flood Control Levees

In 1968, the Corps constructed flood control levees on either side of the lower mainstem channel of Redwood Creek (RNSP 2001). The levees confine the Redwood Creek channel to a width of 300 feet for 3.4 miles from the confluence of Prairie Creek to the mouth of Redwood Creek, and the south levee extends another one-half mile above the confluence with Prairie Creek. The objective of the levee project was to protect the town of Orick and other adjacent lands from floods with peak discharges of up to 77,000 cfs, which is of a magnitude that is expected to occur in a given year with a 1-in-250 probability. The highest recorded peak discharge is 50,500 cfs, which occurred in December 1964. A flood with the discharge of the December 1964 event is estimated to occur in a given year with a probability of 1-in-25 (Corps 1998).

Presently, based on estimates provided by the Corps (1998), and more recently by Moffatt and Nichol (2003) and Kamman (2003), the levees will contain a peak discharge of between 65,200 cfs and 50,770 cfs, estimated to be approximately equivalent to the 100-year and the 50-year flood events respectively. Land use practices, as described in previous sections of this Opinion, have accelerated sedimentation and filling of the Redwood Creek channel, which has contributed to the reduction of flood containment capacity between the levees. Approximately 75% of this loss of capacity is due to sediment filling the channel, while the other 25% of loss is due to increased vegetation within the channel between the levees (Corps 1998).

Construction of the levees removed streamside riparian tree cover, reduced adjacent wetlands, altered valley drainage patterns, decreased instream large woody debris (LWD), altered pool/riffle morphology and habitat forming processes, and reduced pool depths along lower Redwood Creek (RNSP 2001). These impacts are generally expected to negatively alter the habitat value of this reach of the creek for salmonids by reducing the availability and quality of rearing habitat for juveniles, and holding habitat for adults; reducing allochthonous nutrient input; creating adult passage problems over shallow reaches; reducing channel bed stability, which can increase redd scour; and altering the benthic invertebrate community that provides an important food resource for salmonids. Previous maintenance of the flood control channel and the levees has prevented recovery of habitat values over time. However, in recent years the reach within the action area has remained relatively undisturbed resulting in the growth of both riparian vegetation and gravel bars, which has produced significant improvement in the channel's salmonid habitat value.

Moffatt and Nichol (2003) also describe the channel conditions below Highway 101 Bridge by comparing RNSP cross sections from 1988 to 1995, the 1997 cross sections surveyed by the Corps, the 2002 LiDAR remote sensing used for the 2003 hydraulic analysis, and the cross sections surveyed by the County in 2002. Moffatt and Nichol (2003) describe that most of the cross sections show a lower thalweg, a higher point bar, and a narrower bankfull channel (banks defined as the point bars), such that the width to depth ratio has either remained the same or decreased. The lower width to depth ratio is an indicator that the channel has a greater ability to transport sediment, and also indicates more complex salmonid habitat. Moffatt and Nichol also report that channel aggradation below the Highway 101 Bridge between 1988 and 2002 was not substantial, even though there were three floods in the 30,000 to 40,000 cfs range during the 1988-2002 time period. Moffatt and Nichol (2003) state that the reach below the Highway 101 Bridge may be healing by adjusting to a more stable sediment load, but they also report that Humboldt County has verbally communicated that the leveed reach above Highway 101 Bridge is believed to be aggrading, which may indicate that a sediment wave from the floods of the late 1990s could be moving downstream.

The levees also bisect the estuary at the mouth of Redwood Creek, which has the combined effect of disconnecting Redwood Creek from its last downstream meander and reducing water circulation within the North and South sloughs. Reduced circulation into the sloughs has compromised water quality, thus reducing the estuary's value as suitable rearing habitat for listed salmonids. Additionally, the reconfiguration of the estuary that resulted from levee construction has altered the way sediment is transported into and out of the estuary. This altered sediment regime has caused the channels connecting the embayment to the sloughs to fill in, and has caused filling of the embayment to produce a combined areal reduction of the estuary of approximately 50 percent, and an overall reduction in the depth of the estuary (RNSP 2000). This alteration of the estuary has further reduced its value to rearing salmonids.

Presently the North and South sloughs are partially isolated from the embayment because sand from large winter storm events has been deposited into the outlet channels. During high tide/high sea and storm events, waves overtop the sand spit into the estuary filling up the channel outlets with sand. To a lesser extent, sedimentation of the South Slough channel also occurs during the spring and summer when the mouth of the creek is open and waves propagate into the channel and transport sand up the channel. On the north side, driftwood is also deposited back into the channel and acts as a dam that increases the water level in the North Slough and floods adjacent private pastures. The deposition of sand and driftwood is caused by the configuration of the flood control levees that altered the historic sedimentation and circulation patterns of the Redwood Creek estuary. These changes have decreased the area, volume, and quality of fish habitat in the estuary. Because there is no tidal exchange with the North Slough, water quality in the North Slough is very poor (RNSP 2000).

The levees' influence on the sediment regime of the estuary and the changes in watershed hydrology that have occurred due to upstream land use have also altered the timing of the closing and breaching of the sand berm that forms across the mouth of the estuary. The sand berm now tends to close more rapidly and earlier in the year than it did before the levees were constructed. In general, the Redwood Creek estuary becomes a lagoon as flows decrease in the spring and the sand berm between the estuary and the ocean closes. The lagoon may breach and close periodically during spring and summer before fall and winter stream flows are able to maintain the breach.

The levees have also restricted the width of the breach through the sand berm, which has allowed the berm on either side of the breach to build, thereby placing more sand between the estuary and the ocean for a greater distance along the berm. The effect has been to reduce the seepage rate of water out of the estuary when the breach is closed. The reduced seepage rate has likely increased flooding of adjacent land, and increased the need for artificial breaching.

The effect of uncontrolled breaches of the berm on salmonids and their habitat, whether the breaches are human-induced or natural, has been made worse by the levees. Chinook salmon are known to depend on estuaries for extended rearing until they achieve a size that helps maximize their survival in the ocean (Reimers 1973), and this life-history strategy has been confirmed in Redwood Creek (Anderson and Brown 1983). So if an uncontrolled breach of the berm occurs before Chinook salmon have reached an optimal size, they may be entrained into the ocean prematurely, making them less likely to survive to adulthood. Such an event occurred on July 2, 1980, as reported by RNSP (2000). The levees have exacerbated the problem of premature entrainment because the pre-levee lagoon was much deeper, which afforded juvenile salmonids refuge from being entrained during a breach event.

Additionally, rearing salmonids cannot access the sloughs during periods when the breach is open because the water in the embayment is too low to provide continuity with the sloughs through the sediment filled channels. Because uncontrolled breaches allow deep scour of the breach channel, uncontrolled breaches have resulted in extended periods during which the estuary has remained open. In April 1981, an artificial breach resulted in an open estuary for the entire summer, which resulted in less habitat being available to rearing salmonids. Presently the RNSP controls breaching in an effort to maximize habitat while minimizing flooding of adjacent land (RNSP 2000).

RNSP (2001) concluded that the degraded condition of the Redwood Creek estuary due to the levees serves as a factor that limits fish production in the watershed by decreasing subsequent ocean survival of salmonids and their rate of returning as spawning adults. Based on the rationale that RNSP provides to support this conclusion, NOAA Fisheries concurs that this conclusion is likely correct

3. Floods

Floods are critical events for the resources of Redwood Creek because they erode hillslopes, reshape channels, and transport large proportions of fluvial sediment loads. Numerous major floods have occurred on Redwood Creek during the past 150 years, including 1953, 1955, 1964, 1972 (two floods), 1975 and 1997.

The 1964 flood was a regionally significant event that caused major damage to towns, highways, and other structures, as well as significant hillslope erosion and channel changes. Massive amounts of sediment were deposited in tributaries and the upper and middle reaches of the mainstem during the 1964 flood (Janda *et al.* 1975, Iwatsubo *et al.* 1976, Nolan and Janda 1979, Kelsey *et al.* 1981; 1981a, Pitlick 1982; Madej 1984, 1995; Varnum 1984; Varnum and Ozaki 1986; Nolan and Marron 1995; Madej and Ozaki 1996). Subsequent floods, particularly in 1972 and 1975, scoured sediment from tributaries and the upper mainstem and re-deposited it in lower reaches (Varnum 1984, Varnum and Ozaki 1986; Madej 1995). Analysis of the effects of the 1997 "New Year's" storm (approximately an 11-year recurrence interval storm) indicates that numerous landslides were triggered or reactivated, with multiple road failures occurring both within and outside of RNSP lands (RNSP 1997). Approximately 900,000 tons of sediments were discharged into Redwood Creek. The landscape's response to this storm indicates that unaddressed erosion potential remains and additional action is needed to prevent destructive sediment loading in the basin.

4. Habitat Conditions Within the Watershed

Based upon the relationships between habitat quality and the health of salmonid populations, NOAA Fisheries expects the population numbers of ESA listed anadromous salmonids to remain depressed relative to historic estimates in the foreseeable future. However, improvements in local habitat and salmonid populations may develop more rapidly within the portion of Redwood Creek under RNSP control, particularly within tributaries that lie completely within RNSP ownership, which are not impacted by ongoing land-use practices in the upper basin. RNSP's watershed restoration program should, in the long-term, result in the accelerated recovery of salmonid habitat within the RNSP boundaries. For this reason, NOAA Fisheries expects the portions of the Redwood Creek watershed within RNSP to serve as an important stronghold for the eventual recovery of ESA listed salmonids in the watershed.

5. Habitat Conditions Within the Action Area

Habitat conditions, including the conditions of designated critical habitat for SONCC coho salmon, are degraded relative to pristine conditions. The action area generally lacks an adequate pool-riffle structure and cover. Coarse sediment deposited in the action area allows a large proportion of summer base flows to infiltrate and flow subsurface, thereby limiting the surface water available to fish. Water temperatures are sub-optimal for salmonids in the action area in the summer. Recruitment of large woody debris and nutrients is below historic levels in the action area where vegetation capable of providing functional habitat elements is reduced from historic levels. This condition is likely to persist into the future as deciduous willows and alders take the place of evergreen conifers along much of the mainstem and tributaries, including upstream of the action area.

B. Status of Listed Salmonids in the Redwood Creek Watershed

The total population of native salmonids in Redwood Creek has declined substantially – by perhaps as much as 90% by the mid-1970s (EPA 1998), but few data are available to describe past and present salmonid populations in Redwood Creek (RNSP 1997). Therefore, most of the descriptions presented below are general in nature. The following accounts piece together the existing data.

1. Local Population of SONCC Coho Salmon in Redwood Creek

Coho salmon distribution in the Redwood Creek basin is limited to the mainstem and the larger low gradient tributaries – primarily in Prairie Creek and its tributaries, possibly owing to the lower gradient and more pristine nature of that watershed (Anderson and Brown 1983). The RNSP conducted general stream surveys of the basin in 1980 and 1981 to describe and characterize the salmonid rearing habitat and distribution of juvenile salmonids (Anderson 1988a, Brown 1988). Based on these data, RNSP has estimated that coho can be found occupying 26 miles of stream within the Lower Redwood Creek Basin (RNSP 2002). Although coho salmon migrate, hold and rear in the 3.4 miles of lower Redwood Creek that is within the action area, although there are no reports of spawning within this reach.

Downstream migration of coho salmon juveniles to the ocean from rearing areas in Redwood Creek occurs from late March through early June. Survey data from RNSP indicate that these coho salmon presently move directly into the ocean, spending a minimal amount of time rearing in the Redwood Creek estuary (Anderson 1995). Furthermore, a recent study by Bell (2001) indicates that some juvenile coho salmon in Prairie Creek (a third order tributary of Redwood Creek) rear for a second year in freshwater habitat. Adult coho salmon migration through the Redwood Creek estuary is dependent upon the mouth being open to the ocean. Whether or not the mouth is open depends on a combination of wave action on the sand berm, the volume of water in the estuary, and the flow of water in the stream. Adult coho salmon typically migrate upstream to spawn from late October to early March depending on access through the estuary (Anderson 1995), with the peak of the spawning run beginning in late November (Anderson 1998a).

Current coho salmon runs are far below those that occurred 70-80 years ago. News accounts and recollections of longtime residents of the Redwood Creek watershed suggest that both the size and numbers of salmonids have declined in recent decades (Van Kirk 1994). The Prairie Creek Hatchery propagated coho salmon in the basin from 1926 through 1992, planting non-indigenous coho salmon taken from outside the Redwood Creek basin (D. Anderson, biologist, RNSP, pers. comm., February 11, 2003). Hallock (1952) reported seining a total of 9,610 coho juveniles from Prairie Creek and its tributaries in 1951. The population of SONCC coho salmon in Redwood

Creek may have numbered more than 2,000 adults at the time the hatchery closed, but the current adult population of SONCC coho salmon in Prairie Creek is almost certainly well below that number (D. Anderson, biologist, RNSP, pers. comm., February 11, 2003). Documented escapement numbers of adult coho salmon in Prairie Creek for the years 1999-2002 are 69, 53, 252, and 363 individuals for each year, respectively (Duffy unpublished data 2003).

2. Local Population of CC Chinook Salmon in Redwood Creek

In 1965, CDFG estimated a spawning escapement of 5,000 Chinook salmon in Redwood Creek (EPA 1998). However, CDFG derived these estimates by using data from the Eel River, so the estimate cannot be considered as reliable as field data from Redwood Creek. Ridenhour and Hofstra (1994) estimated the 1979 Chinook salmon spawning run to be 1,850 fish based on that summer's estuarine juvenile population.

Most of the CC Chinook salmon found within the Redwood Creek watershed begin their upstream migration around November, if access through the Redwood Creek estuary is possible, and have spawned and died by January. Staff from RNSP observed adult spring-run Chinook salmon in only one season since summer steelhead surveys began in 1981.

Juvenile Chinook salmon in Redwood Creek do not spend time rearing in upstream areas (Anderson and Brown 1983), but instead migrate downstream in spring to rear in the Redwood Creek estuary before entering the ocean in the fall. Thus, the Redwood Creek estuary is important as rearing habitat for Chinook salmon. RNSP research shows that juvenile Chinook salmon will spend an extended period (to late summer) rearing in the estuary before entering the ocean. The lower section of Redwood Creek that is within the action area, but above the estuary, also provides rearing habitat for Chinook salmon, although there are no reports of Chinook salmon spawning within the 3.4 miles of lower Redwood Creek.

Winter spawning surveys and carcass counts in RNSP continue to indicate low numbers of Chinook salmon (D. Anderson, RNSP, pers. comm., 2002). The highest number of live, adult Chinook salmon observed in Prairie Creek in any year since 1983 was 101 (RNSP 1997). On Bridge Creek, the highest number of adult Chinook salmon observed was 272 fish in 1986 (RNSP 1997). CDFG has trapped outmigrant juvenile Chinook salmon leaving upper Redwood Creek since March 2000, using a rotary screw trap located approximately 5.6 miles downstream of the Chezum summer dam site (Sparkman 2002). Based upon mark and recapture efficiency rates, CDFG estimated the number of 0+ Chinook salmon leaving upper Redwood Creek in 2003 at 987 compared with 518,189 in 2002, 378,063 in 2001 and 427,542 in 2000 (Sparkman 2003). This large discrepancy between 2003 and other recent years may be due to high flow events in December 2002, which may have scoured reads. For example, according to Scarman (2003) the USES gaging station at O'Kane Blue Lake recorded a flow of 6,240 cfs on December 28, 2002, while the highest flow recorded prior to fry emergence from Chinook redds during the previous three years was 4,293 cfs on February 14, 2000.

RNSP has conducted seine net surveys of juvenile Chinook salmon populations in the Redwood Creek estuary every summer since 1997 (Anderson 1998, 1999, 2000, 2001, 2002, 2003). Sampling dates vary, but population sampling efforts are conducted for three days in each of the months of June, July, and September. The largest monthly population estimates of juvenile Chinook salmon in the Redwood Creek estuary have ranged from a low of 12,030 in July 1998 (Anderson 1999), to a high of 58,630 in June 2001 (Anderson 2002). Unfortunately, the number of adult Chinook salmon expected to return to spawn in Redwood Creek cannot be extrapolated from these data; thus no reliable estimate of the current adult population size of Chinook salmon in Redwood Creek is available.

3. Local Population of NC Steelhead in Redwood Creek

Steelhead are found in most small, high gradient tributaries to Redwood Creek. The majority of juvenile steelhead in Redwood Creek spend their second year of life rearing in the estuary and lower part of Redwood Creek that includes the action area (Anderson 1988). Although there are no reports of steelhead spawning within the action area, adult steelhead must pass through and hold within the lower 3.4 miles of Redwood Creek on their way upstream to spawn.

In 1965, CDFG roughly estimated a spawning escapement of 10,000 winter steelhead from Redwood Creek (EPA 1998). RNSP began summer steelhead surveys in a Redwood Creek index reach (Lacks Creek to Tom McDonald Creek) in 1981 and survey data indicate a continuous decline (Anderson 2003). The 44 adult steelhead observed in both 1984 and 1985 represent the highest counts within this reach from 1981-2002 (Anderson 2003). No adult steelhead were seen in 1989 or 2001, and only 3 were observed in 2002 (Anderson 2003). During sampling efforts in the summers of 1980 and 1981, steelhead occurred in 57 of the 111 tributaries surveyed. Over the past 14 years, adult summer steelhead surveys in a 16 mile long index reach of Prarie Creek determined a high of 44 summer steelhead; however, in a some years, the surveys found no summer steelhead (Anderson 1993, 1995). On Bridge Creek, the highest number of live steelhead and carcasses was 126 in 1985 (RNSP 1997). A 1994 analysis found that summer steelhead continued to decline, most likely because of the lack of adequate holding pool habitat (Meyer 1994, RNSP unpublished data).

CDFG has trapped outmigrant juvenile steelhead leaving upper Redwood Creek since March 2000, using a rotary screw trap located approximately 5.6 miles downstream of the Chezum summer dam site (Sparkman 2002). Based upon mark and recapture efficiency rates, CDFG estimated the number of 1+ steelhead leaving upper Redwood Creek in 2003 as 30,670, compared with 28,501 in 2002, 50,654 in 2001 and 68,328 in 2000 (Sparkman 2003). Approximately 2,838 2+ steelhead passed this trap in 2003 compared with 7,370 in 2002, 12,668 in 2001, and 4,739 in 2000 (Sparkman 2003). RNSP has conducted seine net surveys of juvenile steelhead populations in the Redwood Creek estuary every summer since 1997 (Anderson 1998, 1999, 2000, 2001, 2002). Sampling dates vary, but populations sampling efforts are conducted for three days in each of the months of June, July, and September. The largest monthly population estimates of juvenile steelhead in the Redwood Creek estuary have ranged from a low of 7,990 in July 1998 (Anderson 1999), to a high of 38,460 in June 2001 (Anderson 2002).

Unfortunately, the number of adult steelhead expected to return to spawn in Redwood Creek cannot be extrapolated from these data; thus, no reliable estimate of the current adult population size of steelhead in Redwood Creek is available.

4. Summary

Populations of SONCC coho salmon, CC Chinook salmon, and NC steelhead in Redwood Creek are much reduced in comparison to historic accounts. However, a great deal of uncertainty remains with respect to the actual adult population sizes and population trends of ESA listed salmonids returning to spawn in Redwood Creek and its tributaries. Spawning surveys and dive survey data do not provide data suitable for population size estimates, but can give an indication of the numbers of individuals returning to use specific stream reaches over time. Lacking more complete data sets, spawning surveys and dive surveys represent the best measure of adult population indicators; however, conditions such as transient variations in habitat quality within survey reaches, as well as the water visibility at the time of surveys can also produce variations in survey results that are not necessarily reflective of changes in total adult escapements. Keeping these caveats in mind, available adult survey data from Redwood Creek and its tributaries suggest that yearly adult population numbers for both SONCC coho salmon and CC Chinook salmon number in the hundreds to perhaps a few thousand, and well below historic estimates. Surveys of NC steelhead suggest that their yearly adult population numbers fall within the range of hundreds of individuals. No data exist to support conclusions that populations of any of the three ESA listed anadromous salmonids in the Redwood Creek watershed are viable, as described in *Viable Salmonid Populations and the Recovery of Evolutionary Significant Units* (McElhany *et al.* 2000)

V. EFFECTS OF THE ACTION

NOAA Fisheries provided an overview of the proposed action in the *Description of the Proposed Action* section of this Opinion. In the *Status of the Species* section of this Opinion, NOAA Fisheries provided an overview, at the ESU scale, of the status and trends of SONCC coho salmon and their designated critical habitat, CC Chinook salmon, and NC steelhead. In the *Environmental Baseline* section of this Opinion, NOAA Fisheries summarized the effects of past and present Federal, State, local and private activities on SONCC coho salmon and their designated critical habitat, CC Chinook salmon, and NC steelhead within the action area. The *Environmental Baseline* section established that numerous human activities occurring upstream of and within the action area have adversely affected SONCC coho salmon and their designated critical habitat, CC Chinook salmon, and NC steelhead, and the distribution and abundance of these species in the action area.

In this section of the Opinion, as required by the ESA and its implementing regulations (50 CFR 402), NOAA Fisheries assesses the direct and indirect effects of the proposed action on SONCC coho salmon and their designated critical habitat, CC Chinook salmon, and NC steelhead together with the effects of other activities that are interrelated and interdependent with that action. The purposes of this assessment are to determine if the proposed action: (1) is likely to have effects on SONCC coho salmon, CC Chinook salmon, or NC steelhead that appreciably reduce their likelihood of both survival and recovery in the wild (the jeopardy standard identified in 50 CFR 402.02); or (2) is likely to appreciably diminish the value of designated critical habitat for the conservation of SONCC coho salmon in the wild.

Critical habitat is defined as the specific areas within the geographical areas occupied by the species, at the time it is listed, on which are found those physical and biological features essential to the conservation of the species and which may require special management considerations or protection, or specific areas outside the geographical area occupied by the species at the time it is listed when the Secretary determines that such areas are essential for the conservation of listed species. The ESA further defines conservation as "to use all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the ESA are no longer necessary." As a result, NOAA Fisheries approaches its "destruction and adverse modification determinations" by examining the effects of actions on the *conservation value* of the designated critical habitat; that is, the value of the critical habitat for the conservation of threatened or endangered species.

A. Assessment Approach

To conduct our assessment of the proposed action, NOAA Fisheries considers the direct and indirect effects of the proposed action, and any interrelated and interdependent activities associated with the proposed action, on the area, connectivity, and quality of habitats that support listed species as well as effects that result in injury or death to listed species. NOAA Fisheries uses published and unpublished data and studies of interactions between elements of the proposed action and listed species or their habitats to estimate the likelihood of future effects. There is an extensive amount of published literature on the relationship between changes in habitat quantity, quality, and connectivity and the persistence of animal populations. For detailed summaries of this literature, readers can refer to the work of Fiedler and Jain (1992), Gentry (1986), Gilpin and Soule (1986), MacArthur and Wilson (1967), Nicholson (1954), Odum (1971, 1989), Shafer (1990), and Soule (1986, 1987). With respect to listed species, NOAA Fisheries bases its assessment on the relationship between habitat and species populations and assumes that an activity that destroys or adversely modifies habitat listed species are dependent upon may be followed by a demographic response (e.g., changes in birth rates, death rates, or other vital rates, abundance) and assumes this response will result in a reduction in the diversity of the ESU.

Diversity of salmonid populations includes both genotypic and phenotypic diversity. Regardless of whether the diversity is genetically controlled or not, diversity allows greater exploitation of a variety of habitats and, therefore, leads to greater abundance and increases resilience by spreading risk and providing redundancy in the face of unpredictable catastrophes and environmental stochasticity (NRC 1995). For example, steelhead in the action area include both summer- and winter-run life history types. This variability in run timing reduces the risk that complete loss of a year's adult return would occur in the event of a catastrophe and also allows exploitation of habitats that might otherwise be unavailable.

A fundamental assumption that NOAA Fisheries uses in this effects analysis is that salmonids are limited by habitat in the action area and that adverse effects on habitat equate to adverse effects on individual salmonids. Gregory and Bisson (1997) stated that habitat degradation has been associated with greater than 90% of documented extinctions or declines of Pacific salmon stocks. This assumption is also supported by Lichatowich (1989) who identified habitat loss as a significant contributor to stock declines of coho salmon in Oregon's coastal streams. Beechie *et al.* (1994) estimated a 24% and 34% loss of coho salmon smolt production capacity of summer and winter rearing habitats, respectively, in a Washington stream since European settlement. Beechie *et al.* (1994) identified three principal causes for these habitat losses, in order of importance, as hydromodification, blocking culverts, and forest practices. Several authors have found positive relationships between habitat complexity, LWD in streams, and salmonid populations (McMahon and Holtby 1992, Reeves *et al.* 1993, Tschaplinski and Hartman 1983). Nickelson and Lawson (1997), in modeling extinction risk of coho salmon along the Oregon coast, found that probability of extinction was inversely related to habitat quality for starting populations of 50 and 100 individuals. Furthermore, Nickelson and Lawson (1997) found that there would be a substantial increase in risk of extinction for Oregon coast coho salmon in basins with poor habitat quality if habitat quality declines by 30-60% over the next century.

Thus, if our assessment determines that the proposed action is likely to result in adverse effects to salmonid habitat in the action areas, it would then be reasonable to expect that SONCC coho salmon, CC Chinook salmon, and/or NC steelhead populations may experience demographic changes (that is, changes in population size, distribution, reproduction, mortality, etc.) as a result of the proposed actions.

Additionally, our assessment must consider the effects of maintaining or inhibiting recovery of habitat conditions that led to the initial listing of salmonids under the ESA. If we determine that habitat conditions will be maintained in a degraded condition and, therefore, will limit potential for recovery or substantially decrease the rate of recovery of listed salmonid populations, then we must consider the increased risk that genetic, demographic, and environmental stochasticity will further negatively affect populations. In essence, if the action maintains habitat in a degraded condition or inhibits its recovery, then it also decreases the probability that species will survive over the long-term (NRC 1995).

The effects of the action are considered in separate sections. First, we describe the general effects associated with gravel extraction and vegetation removal in river channels. Second, we consider the short-term, direct effects of the proposed action on salmonids. These include effects that occur at the time of the activity, such as bridge construction and use, heavy equipment operation near the wetted channel, and the short-term impacts of gravel extraction and excavation of the estuary slough channels. We then describe the indirect, long-term effects associated with gravel extraction and vegetation removal, particularly in lower Redwood Creek. These effects primarily occur as changes in channel form and function and are described in terms of expected changes to stream habitat types used by salmonids for various life history stages. Prior to synthesizing the effects of the action, we consider the cumulative effects that are reasonably certain to occur in the action area.

Finally, we integrate and synthesize the effects of the action combined with the effects of any interrelated and interdependent actions and cumulative effects. In this step, we consider the aggregate of effects on the populations of the three salmonid species and SONCC coho salmon designated critical habitat. The expected response of salmonid populations is determined by assessing any potential reductions in the numbers, reproduction, or distribution of listed salmonid populations in the action area. We then determine whether any expected reductions in numbers, reproduction or distribution will appreciably reduce the likelihood of survival and recovery of listed salmonids. These final steps take into account the status and trends of the population or ESU in question, the factors currently and cumulatively affecting them, and the role the affected population likely plays in the ESU.

B. General Discussion of Effects

Impacts from gravel extraction on physical channel conditions have been well documented in the published literature. Brown *et al.* (1998), and Pauley *et al.* (1989) conducted studies that include biological effects of gravel extraction. Brown *et al.* (1998) compared mined sites to reference reaches in gravel bed streams and found that total fish densities in pools were higher in reference reaches than in extraction sites and downstream reaches. Biomass and densities of invertebrates were also higher in reference reaches. Bankfull channel widths were significantly increased at extraction sites; and distance between riffles was increased, resulting in fewer pools in reaches downstream of extraction sites. Although the Pauley *et al.* (1989) study was of short duration and their sample size was not large enough for statistical testing for some effects, the authors were able to make inferences regarding changes in channel form and resultant impacts to habitat function for salmonids from gravel bar skimming, including: (1) decreased channel confinement, with widening and shallowing of the low flow channel and decreased water depths over riffles, which created adult salmonid migration barriers; (2) obliteration of side channels with complex habitat on skimmed bars and formation of secondary channels that lack complex habitat features, resulting in reduced habitat for salmonids; and (3) channel instability at the top of skimmed bars, with an increase in the probability of redd scouring.

The proposed action will impact listed salmonids, and their habitats, within the action area of this Opinion. These impacts include: (1) direct effects, which are those effects that occur at the actual time of extraction; and (2) indirect effects, which are those effects to the species that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Examples of effects that occur at the time of gravel extraction include mortality during heavy equipment use in the wetted channel; disruption of rearing, holding and migration patterns by heavy equipment noise and vibration disturbance; and elevated turbidity/sediment from connection of dry trenches to the wetted channel and excavation of the estuary slough channels. Examples of indirect effects include reductions in velocity refugia due to vegetation removal, simplification of pool and riffle habitats; and reduction in food sources. Some of the impacts from gravel extraction are reduced through project design features (e.g., project timing restrictions). Other impacts may be chronic in nature, and occur incrementally with, subsequent to, and offsite from the extraction activity (e.g., possible reduction of substrate size, and the decline in riffle stability). The potential direct and indirect effects of the proposed action are discussed in detail in the sections below.

B. Direct Effects

NOAA Fisheries expects that the following elements of the proposed action may have adverse direct effects on salmonids and their habitat:

- Stream Crossing Construction and Use
- Fish Migration Channel and Alcove Construction

1. Stream Crossing Construction and Use

Temporary bridge channel crossings are placed for access of sediment hauling equipment. The placement and removal of temporary channel crossings can cause direct adverse effects on salmonids and their habitat by: (1) injury or death from equipment contact; (2) increases in turbidity and sedimentation from pushing up bridge approaches and abutments and bridge use (D. Free, NOAA Fisheries, pers. comm. 2002), including the reduction of invertebrate production at temporary channel crossing locations; (3) attraction of spawning adults and redd building by changes to local channel form; (4) noise and vibration disturbance from heavy equipment use; and, (5) introduction of petroleum products.

a. Injury or Death from Equipment Contact

Sediment removal operations require heavy equipment and often need to access gravel bars across the low flow wetted channel. Interactions with equipment can be potentially harmful or lethal to salmonids by several mechanisms, as explained below.

Salmonids select gravel substrate in shallow water with intra-gravel flow, typically the crests of riffles, to bury their fertilized eggs. The number of days required for eggs to hatch varies from about 19 days to about 90 days depending on species and water temperature. Alevin then emerge from the gravel two to three weeks after hatching (Barnhart 1986). Once they emerge, alevin disperse to occupy available low-velocity portions of the stream and areas with cover (Raleigh *et al.* 1984). During this early life stage, juveniles usually occupy shallow water along the stream banks (Barnhart 1986). Steelhead also use riffles and other areas not strongly associated with cover that provide increased foraging opportunities (Bradford and Higgins 2001) and large pore spaces in the stream bed. In one experiment using artificial stream channels, over 50% of juvenile steelhead 31-44 mm in length were located in riffle habitat (Bugert and Bjornn 1991). They remain in these rearing areas throughout the summer, with some shift in habitat use as they age and as conditions change (Chapman and Bjornn 1969).

Cover is an important habitat component for juvenile salmonids, both as a velocity refuge and as a means of avoiding predation (Shirvell 1990, Meehan and Bjornn 1991). Salmonid juveniles will balance their use of cover and foraging habitats based on their competing needs for energy acquisition and safety (Bradford and Higgins 2001). Critical forms of cover include submerged vegetation, woody debris, and the interstitial spaces of streambed gravel substrate (Raleigh et al. 1984). Steelhead juveniles will respond to threats of predation, including overhead motions, by huddling together and/or fleeing to nearby cover (Bugert and Bjornn 1991). Few young of the year (YOY) salmonids are found more than one meter from cover (Raleigh et al. 1984). Juvenile steelhead, particularly the younger, smaller individuals, have a notably docile response to disturbance; they rely on nearby substrate particles (i.e., gravel) for cover more than other salmonids (Chapman and Bjornn 1969, Everest and Chapman 1972, Wesche 1974). Food for juvenile salmonids is also more abundant in riffle locations, and juvenile salmonids use riffles and the areas upstream and downstream of riffles extensively, increasing the risk of temporary displacement or crushing. Although juvenile steelhead may be at greatest risk of crushing by heavy equipment, Chinook salmon juveniles are also at risk of crushing at riffle locations. Temporary channel crossings also can be located at other shallow, narrow channel locations, such as areas upstream and downstream of riffles, and in runs where juvenile salmonids are present.

Frequently, disturbed stream channels have relatively less abundance and diversity of cover habitat for juvenile salmonids. Therefore, in sediment removal areas, hiding in substrate pores may be the main response to threats (Chapman and Bjornn 1969, Wesche 1974, Everest and Chapman 1972). Even where other forms of cover are present, YOY will respond to noise, movement, and other disturbances by entering pore spaces in the streambed at riffles (Shirvell 1990, Meehan and Bjornn 1991).

Heavy equipment used to construct temporary stream crossings for access to sediment removal areas usually cross wet stream channels where water depth is shallowest, such as riffles. Because this is an important habitat for salmonid juveniles (Bradford and Higgins 2001), where these fish occur in areas of channel crossing, a portion of the juveniles in the path of equipment would likely take cover within the gravel and be crushed as the equipment passed over. Multiple observations by NOAA Fisheries biologists (D. Free, NOAA Fisheries, pers. comm. 2003) indicate that even wading fishermen can crush juvenile salmonids hiding within gravel substrate. Therefore, startling, herding, or chasing juveniles from stream crossings ahead of equipment is difficult, with poor confidence that the tactics adopted are fully effective. For example, Halligan (2002) documented the death by suffocation of at least 48 steelhead fry during the May 29, 2002, berm construction operations for the Humboldt Bay Water District on the Mad River, despite significant efforts to herd fish to safer locations. Halligan observed steelhead fry readily using interstitial spaces between gravel and cobbles for cover and rescued many fish by turning over cobbles, capturing the fish, and moving them to the main flow. Larger salmonid juveniles are less prone to crushing from heavy equipment crossings. They will likely flee the area because the substrate size is not large enough to provide cover for them. However, these juveniles could flee into areas of higher predator concentration or lower quality instream habitat, resulting in injury to rearing juveniles.

Timing of temporary channel crossing construction is important to reduce the number of juveniles that may be crushed or otherwise injured. Delaying the construction of temporary channel crossings provides time for juvenile growth and would reduce the number of juveniles that would seek cover in substrate. Delaying the construction of temporary channel crossings until June 15, as described in the *Proposed Action* section of this Opinion, provides some time for juvenile growth and would reduce the number of juveniles that would seek cover in substrate. However, delaying construction until later in the summer would allow for more complete outmigration of Chinook salmon and would result in size increases and behavioral changes in coho salmon and steelhead, thereby further reducing the potential for death or injury to individuals from crushing.

Although Halligan (1997a) described that installation/removal of a temporary channel crossing requires one loader to cross through the wetted channel to prepare the gravel abutment and secure (or remove) the flatcar bridge, NOAA Fisheries (L. Wolff, NOAA Fisheries, pers. comm. 2000) has observed that heavy equipment may have to cross the wetted channel more than once in order to construct or remove a crossing. In order to better understand how channel crossings are constructed and removed, and the potential effects of these activities to listed salmonids, we observed channel crossing construction and removal over the past few years. NOAA Fisheries (L. Wolff, NOAA Fisheries, pers. comm. 2000, 2001) observed that the minimum number of times that heavy equipment crosses the channel is two times per installation and two times per removal.

NOAA Fisheries expects that adherence to strict timing of crossing construction and removal would reduce the potential that salmonids in the project area would be killed during crossing construction/removal. The proposed action limits the season of crossing construction and removal between June 15 and October 15. NOAA Fisheries expects that adults, smolts, and older juveniles should be able to avoid or flee areas when loaders are building/removing channel crossings as authorized the levee maintenance program. However, young juveniles may still be killed. NOAA Fisheries estimates that a small number of juvenile steelhead and juvenile Chinook salmon may die due to bridge construction/removal under the Redwood Creek Levee Maintenance Program. While we cannot estimate the number of steelhead or Chinook salmon that will die due to bridge construction/removal, we expect that a portion of juveniles in the footprint of the bridge location will be killed due to burial or crushing by equipment. The number of Chinook salmon that may be killed is estimated to be very low, based on outmigration timing and development of Chinook salmon. NOAA Fisheries expects no coho salmon will be killed based on the development and habitat preferences of coho salmon (refer to the *Status of the Species* section for information on juvenile growth rates, migration timing and habitat preferences).

b. Increases in Turbidity and Sedimentation from Temporary Bridge Construction and Removal (Episodic) and Bridge Use (Chronic)

Gravel extraction can result in elevated turbidity and suspended sediment levels through installation, removal, and use of temporary channel crossings. Elevated turbidity/sediment levels can affect stream biota, including salmonids, in numerous ways:stream primary productivity can be reduced if sunlight cannot reach the substrate; benthic macro-invertebrate production can be hindered; salmonid feeding opportunities can be reduced; and suspended sediment may deposit on redds, suffocating incubating salmonid eggs. When background turbidity levels are low, typically during the low flow season, sediment inputs cloud otherwise clear waters making salmonid prey and predator detection difficult, and reduce invertebrate production when the sediment settles.

Turbidity and sedimentation occurs during construction and removal of temporary bridge abutments and approaches, as well as during use of the bridges. Turbidity also may occur if abutments are constructed of native gravel bar sediments and are not protected by brow logs, concrete blocks or large cobble.

Turbidity is generally highest in streams during the first high flow of the flood season. However, various instream sediment disturbance or removal actions may increase turbidity caused by suspended sediment at different time periods. Careful scheduling to avoid inflicting adverse effects on anadromous salmonids may alleviate most episodic turbidity concerns. Extraction of sediment from wet stream channels suspends fine sediment during times of the year when concentrations are normally low and the river is less able to assimilate suspended sediment (Weigand 1991).

The severity of impacts to fish from suspended sediment pollution is generally acknowledged to be a function of sediment concentration and duration of exposure. Newcombe and Jensen (1996) demonstrated increased ill effects with increasing suspended sediment concentration and duration of exposure. If feeding is affected, growth could be reduced which could reduce smolt to adult survival (Sigler *et al.* 1984, Ward and Slaney 1988, Holtby *et al.* 1990, Newcombe and Macdonald 1991).

Aquatic macroinvertebrates are the principal food source for most juvenile salmonids (Spence *et al.* 1996). Immature mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera), referred to collectively as EPT, are considered the most productive, preferred, and available foods for stream fishes (Waters 1995). Indeed, the abundance of these three groups of aquatic macroinvertebrates is commonly used as a food availability index (Lenat 1988). The diversity and abundance of EPT can be affected by sediment removal operations because they are dependent upon substrate conditions (Behnke *et al.* 1987).

The EPT group typically inhabit the interstitial spaces of coarse substrates (gravel to cobble sized particles), although some species of mayfly and certain other aquatic insects (*e.g.*, midges) prefer highly organic fine sediments. Sands and silt are the least productive substrates for aquatic macroinvertebrates (Hynes 1970) and are more easily mobilized, making them unsuitable because they are less stable (Fields 1982). Therefore, sediment intrusion that reduces the interstitial spaces of cobbles and gravel directly decreases the habitable area for EPT (Bjornn *et al.* 1974, Bjornn *et al.* 1977).

Changes in the biomass and structure of macroinvertebrate assemblages can adversely affect the salmonid populations dependent on them. The importance of abundant food sources becomes even greater when stream temperatures are at the upper tolerance limits for steelhead, and Chinook salmon and coho salmon. Fish may respond to thermal stress by decreased growth rates (Brett *et al.* 1982) and reduced survival (Rich 1987). Since food conversion efficiencies decline at elevated temperatures, and metabolic demands increase, fish must eat more food simply to maintain homeostasis (Smith and Li 1983). Increased foraging to maintain homeostasis also costs more energetically and may increase predation risk if fish are forced to range farther or increase feeding in the presence of predators. Therefore, reductions in food availability due to streambed sedimentation, or other changes to substrate sizes, can compound adverse affects of elevated water temperatures. As stated previously, decreases in growth and consequent decreases in smolt size will result in decreased smolt to adult survival.

Impacts to aquatic macroinvertebrates may be protracted. The average life cycle of EPT species is one year, although several species have two-year life cycles. Fine sediments intruded deeply into the bed require mobilization of the bed itself to remove fines (Beschta and Jackson 1979, Diplas and Parker 1985). Bed mobilizing flows generally do not occur annually, so there is potential for the aquatic invertebrate food base to be diminished for some time and for some distance downstream from sediment removal areas. Brown *et al.* (1998), who sampled substrates upstream, downstream, and within an in-stream gravel mining project area, found that upstream from the disturbance: (1) biomass densities of all invertebrates were higher; (2) total fish densities in pools were higher; and (3) silt-sensitive fish species were more abundant, than within the project area or downstream.

Channel crossing construction and removal methods may reduce the amount of fine sediment associated with these activities. Although a maximum number of eight channel crossings are proposed to access the 10 gravel bars within the action area, NOAA Fisheries does not expect that all bars in the action area would be mined in any year of the five-year permit period, and that the maximum number of channel crossings would not be used in any one-year period. Additionally, the proposed action requires that the use of temporary channel crossings is minimized. If encroachment into the low flow channel is necessary to span the wetted channel, then brow logs or large concrete blocks could be used to hold back native gravel abutments from the live channel. All abutment materials will be removed from the site upon bridge removal. Thus, NOAA Fisheries anticipates that low levels of fine sediment from stream crossing construction and removal will enter the low flow channel, and that the duration of the sediment plume will be short. In addition, NOAA Fisheries expects that the sediment plume would not be as wide as the low flow channel, and that there would be nearby habitat not affected by the sediment plume.

Sediment also may be released to the stream from use of the bridge during hauling. NOAA Fisheries anticipates that fine sediment inputs to the stream channel from bridge use may reduce invertebrate production for approximately 10 meters downstream of bridges and may result in behavior modification of juvenile salmonids, especially steelhead, which may be present at the bridge sites. Fish will avoid the immediate area when turbidity is present and may impinge on other rearing salmonids' territories, thereby resulting in energy expenditure through territorial defense, reduced feeding potential, and increased predation potential as a result of interactions between individual fish. However, since NOAA Fisheries expects that only a portion of the gravel bars will be mined in any year of the five-year permit period, we also expect that only a portion of the maximum number of channel crossings (i.e., approximately four-five temporary channel crossings) would be used in any given year of the five-year permit period.

c. Noise and Vibration Disturbance from Heavy Equipment Use

Noise and vibration produced by use of heavy equipment adjacent to and over the wetted low flow channel (channel crossings) may disrupt migration and holding patterns by harassing or frightening fish. Habitat types, salmonid holding locations, and run timing were documented during gravel mining on other nearby rivers (Halligan 1997b, 1998, 1999; Jensen 2000; Halligan 2002). The data from these reports showed that salmonids were holding in suitable habitat (deep pools with structural complexity and deep runs with sufficient flow and cover), regardless of whether or not extraction operations were occurring nearby. The observers performing the monitoring also reported that no agitation or flight behavior was observed in any fish, even though gravel extraction operations were occurring as close as 13.7 m (45 feet) away, and heavy equipment was crossing on nearby flatcar bridges. Jensen (2000) also documented that early migrating adult Chinook salmon and steelhead appeared to move continuously through the Mad and Trinity rivers during the fall portion of the extraction season, with no apparent effects to migration patterns from gravel extraction operations.

The above monitoring suggests that salmonids are able to hold and migrate through active gravel extraction areas despite noise and vibration. Therefore, although there may be some undetected delay or disruption, NOAA Fisheries does not anticipate that noise and vibration from active gravel extraction will have a significant impact on listed adult salmonids in the action area.

Juvenile salmonids (YOY steelhead in particular) were recently observed during the day in the vicinity of operating heavy equipment on Redwood Creek (used to install a summer dam), although increased numbers were observed in the same vicinity in the absence of operating equipment (D. Ashton, NOAA Fisheries, pers. comm. 2002). This observation suggests that operation of heavy equipment used to construct channel crossings, or heavy equipment used to skim gravel bars adjacent to the low flow channel, (especially early in the season) may have an effect on juvenile salmonids,YOY life stage in particular. The potential for temporary displacement of juveniles exists from the disturbance caused during heavy equipment operation. Whether the habitat that juveniles may be displaced into is less favorable than the habitat that they were utilizing prior to disturbance is unknown at this time.

d. Use of Petroleum Products

All sediment removal operations use equipment powered by diesel fuel and lubricated by other petroleum products that are potentially hazardous to listed salmonids. With the use of this equipment, there is potential for spill of hazardous compounds in the stream or on bars in contact with the hyporheic zone. The risk of potential chemical pollution should be considered significantly higher near or in streams because of the proximity of sensitive aquatic species and because of the role of water in transporting contaminants to sensitive receptors. The proposed action does not include spill contingency plans for heavy equipment working in, or near, the live channel. The potential exists for a petroleum product spill to result in death or injury to Chinook salmon and steelhead juveniles. The magnitude of potential petroleum product introductions associated with implementation of the proposed action is unknown at this time.

2. Effects of Migration Channel and Alcove Construction

Although the description of the proposed action does not detail the methods that may be used to construct a fish migration channel or alcoves, NOAA Fisheries expects the construction process to be similar to the gravel mining technique known as " dry trenching." Known dry trenching operations have excavated on the dry gravel bar, and then typically connected the excavation to the wetted channel to prevent salmonid stranding. Dry trenching to construct a fish migration channel, and to construct an alcove at the downstream end of gravel bars have effects that occur at the time of extraction which are described as follows.

a. Increased Turbidity/Sediment

The effects of increased turbidity are as described above under the section on "Stream Crossing Construction." Increased turbidity would also result from the connection of a dry channel or alcove to the wetted channel. Project design features that reduce the amount and duration of turbidity are typically used when connecting a dry trench to the low flow channel. These include the use of berms to separate the trench from the low flow channel, and waiting for settling of fine sediment in the trench before connection to the wetted channel. However, during connection of the dry trench, a pulse of turbidity is released to the otherwise clear, low flow river. Based on observation of the magnitude and duration of the pulse of turbidity associated with such trenches, and the number of alcoves and dry trenches expected to be implemented under the proposed action annually, NOAA Fisheries anticipates that the pulse of turbidity from channel or alcove construction will be limited in both extent and duration, and will not be as wide as the low flow channel, so that juvenile salmonids will be able to flee the area affected by the pulse of turbidity. However, we do expect that there will be a small reduction in macroinvertebrate food sources and feeding opportunities for juvenile salmonids. The adverse effects of increased turbidity and sedimentation were previously described in the section on temporary channel crossing construction and removal.

b. Decreased Invertebrate Production from Habitat Change

Habitat change may occur due to fish migration channel construction and alcove construction. These habitat changes include changes in substrate composition, and resulting changes in aquatic macroinvertebrates as is described in the above section on "Stream Crossing Construction." NOAA Fisheries expects minimal change to invertebrate production as a result of fish migration channel or alcove construction because sediment replenishment is expected to be rapid, and these excavations are not expected to affect existing adjacent habitats.

c. *Increased Susceptibility to Poaching and Predation*

Alcoves or channels that are constructed on a dry gravel bar with connection to the wetted channel have the potential to attract migrating adults for holding opportunities during fall migration periods, as well as rearing juveniles. If the newly excavated areas do not provide cover and hiding opportunities, then a potential increase in predation of juveniles would be expected, as well as the potential for an increase in susceptibility to poaching of adults. The Redwood Creek Levee Maintenance Program requires that when alcoves or a fish migration channel is constructed vegetative cover must be provided in the form of placing woody debris within the excavation in order to reduce impacts to salmonids. Based on the requirement to provide cover within these types of excavations, the number of alcoves or dry trenches that may be proposed in any year of the five-year maintenance program, and site specific geomorphic design features for the fish migration channel, such as primarily creating a migratory channel rather than deeper habitat for holding, NOAA Fisheries expects that susceptibility to poaching will be low to moderate for adults in migration channels or alcoves. NOAA Fisheries also anticipates that few juveniles will occupy the trenches due to the lack of forage associated with recently excavated dry trenches and alcoves, and that the cover provided in the extractions will reduce predation for those individuals that do utilize the excavations.

C. Indirect Effects

Gravel and vegetation removal have numerous potential indirect effects on salmonids, primarily by modifying the stream habitat that various life stages depend upon. Sediment and vegetation removal from streams can result in reductions in spawning, feeding, and resting habitats. Other undesirable physical effects include bed degradation, bank erosion, channel and habitat simplification, and reduced effectiveness of geomorphic processes such as pool maintenance, sediment sorting, and sediment intrusion. Adverse biological effects include reduced egg and alevin growth and success, reduced riparian vegetation and all associated aquatic benefits, reduced water quality, and mortality of juveniles.

1. <u>Indirect Effects of Sediment and Vegetation Removal on Habitat and Salmonids</u>

In this section we describe the general effects of sediment and vegetation removal on salmonids and their habitat based on changes in various alluvial river attributes. Additionally, we describe the specific effects of sediment and vegetation removal on salmonids and their habitat in Redwood Creek.

A naturally functioning channel, with mature alternate bars, has two efficiencies; a lower conveyance efficiency when flows are contained within and steered around alternate bars, and a higher efficiency when flood flows significantly overtop the bars. Sediment removal projects that decrease bar elevation (*e.g.*, bar skimming) cause bar overtopping to occur at lower discharges. One result is greater flow velocities within the channel during lower discharges that occur in early winter. Channel bed shear stress relations show that reducing sinuosity through reductions in bar heights can result in erosion of the channel in locations where it would not naturally occur. This local erosion increases the delivery of sediment to downstream areas (Olson 2000). Consequently, the changes in channel geometry and flow energy resulting from sediment removal can cause sediment accumulation in pools and erosion from riffles, which is the opposite of what normally occurs at habitat-shaping flows. The reduced convergence and divergence results in a more simplified channel with less concentrated and less effective particle-sorting processes. Therefore, reductions in bar height will simplify stream habitat by causing decreases in the area and quality of potential spawning sites, reductions in pool area and depth, and by decreasing the quality and quantity of riffle habitat.

In addition to this overall simplification of stream habitat, sediment removal can have additional impacts on specific salmonid habitat attributes. These specific habitat elements are:

a. Loss of pool habitat quantity and quality
b. Increased riffle instability and migration blockage at riffles
c. Loss of velocity refugia
d. Increased water temperatures
e. Elevated turbidity and sediment loads
f. Increased stranding of salmonids on extraction surfaces

a. Loss of Pool Habitat Quantity and Quality

Sediment and vegetation removal from the stream in the action area may decrease the overall quality and quantity of pools. This reduction in pool quantity and quality may occur in three ways: (1) increased width-to-depth ratio, (2) channel degradation, and (3) reduced riparian vegetation.

(1) Changes in Width-to-Depth Configuration

Removal of sediment from the active channel alters the natural channel configuration. The ratio of width-to-depth (W/D) of the channel is one reflection of the topographic relief along a given cross-section. In general, we expect sediment removal from bars to create a wider, more uniform channel cross section with less lateral variation in depth, and reduced prominence of the pool-riffle sequence (Collins and Dunne 1990, Church *et al.* 2001). For example, where bars are skimmed, a more rectangular channel is created with a wider and shallower section (i.e., increased W/D) (Church *et al.* 2001). This results in a change in the sediment transport regime indirectly influencing habitat by reducing or removing the steering effect provided by the bar, thereby lessening the hydraulic controls on pool and riffle formation and maintenance. Pools may become shallower, or disappear altogether as more uniform, flatwater habitat forms. Riffle crests may become less pronounced and substrate quality may degrade due to the reduced sediment sorting ability provided by the adjacent bar. This is consistent with observations by Church *et al.* (2001) who note simplified channel morphology as a result of reductions in topographic complexity and changes in channel width to depth configurations following sediment removal. We note that these changes can be from a single instance of sediment removal at a site, as well as chronic changes when bars are repeatedly skimmed and natural bar recovery is inhibited.

The relationship between channel widening and habitat values are well documented in the literature. Overall, salmonid habitat is reduced in unstable (widening) channels (e.g.; Newport and Moyer 1974, Behnke 1990, Kanehl and Lyons 1992, Hartfield 1993, Waters 1995, Brown *et al.* 1998) and the associated riparian habitat deteriorates (Rivier and Seguier 1985, Sandecki 1989). Effects on salmonids from channel widening include reduced pool depth and complexity, decreased riffle quality and less influence from streamside vegetation in the form of instream cover and shade.

Where multiple, sequential bars are lowered or removed, a reach-scale effect can also occur. The removal of sediment from multiple bars over a reach can create a channelized condition where former topographic roughness elements in the channel (*e.g.*, bars) may be reduced or eliminated. Habitats may be simplified over a much greater length than the single pool-riffle sequences adjacent to a given bar when reach-scale hydraulic and sediment transport characteristics are changed. Therefore, we note two processes by which stream habitat may become simplified--site-specific adjustments of the channel associated with a particular extraction site, and reach-scale changes in channel morphology as a cumulative effect of multiple extraction sites.

Changes in the channel W/D configuration should be considered at the appropriate spatial scale with respect to water elevation as well. The relevant spatial scale is both the low-flow channel and the high-flow channel. Potential changes in the high-flow configuration may be constrained by resistant valley walls or levees, such as in the flood control project on lower Redwood Creek, where there is a finite limit to the amount of channel widening that may occur. Conversely, channels in wide, alluvial valleys, such as portions of the nearby Mad and Eel Rivers, are relatively less constrained and have the potential to affect larger areas as the channel is free to migrate via bank erosion. Changes in the high-flow channel dimensions could cause changes in habitat at the larger reach scale in alluvial channels that are unconfined. Multiple habitat elements could be affected by the changing channel configuration in these unconfined settings. This is in contrast to changes in the low flow W/D configuration where increases would be more confined to individual habitat elements, such as would be found in lower Redwood Creek, where the levees confine the high flow channel.

Therefore, the high flow confinement provided by the Redwood Creek levees will minimize the extent of channel widening found at high flows, and minimize the likelihood of altering habitat elements at the larger, reach scale. NOAA Fisheries expects that bar skimming will cause channel widening at lower flows, however, we also expect that habitat impacts from low-to-moderate flow channel widening will occur to individual habitat elements adjacent to, and downstream of, skimmed bars, and will not result in reach scale habitat alterations.

Pools in lower Redwood Creek are mainly found adjacent to alluvial features, such as higher elevation gravel bars armored with riparian vegetation, and adjacent to the large rock faces of the levees. We expect that bar skimming and vegetation removal over the five-year permit period will reduce the quality and quantity of pool habitat in lower Redwood Creek, and will likely perpetuate the lack of adult holding and juvenile rearing habitat currently found. We expect that this effect will be reduced by protecting the upper portion of the bar, rotating bar skimming to different bars during the five-year permit period, thus allowing for some bar height recovery, implementation of alternative extraction designs, such as the fish migration channel that is proposed for the widest section of channel at the upstream end of the flood control project reach, and the interagency review team process that will result in avoidance or minimization of vegetation removal adjacent to areas of high habitat value, such as pools.

(2) Channel Degradation

Sediment removal can result in localized or reach-scale bed degradation. Over time, stream channels adjust towards equilibrium between the sediment load and dominant sediment transporting flows. A gradual migration of the channel by eroding the outside of bends and depositing equal volumes on the inside of bends creates the dynamic equilibrium condition where the bed and banks are not net sources of sediment. Therefore, the equilibrium stream channel is efficient at maintaining its geomorphic form and pattern although the system remains dynamic as it responds to cyclic floods and sediment delivery events. Dunne *et al.* (1981) stated that *"bars are temporary storage sites through which sand and gravel pass, most bars are in approximate equilibrium so that the influx and downstream transport of material are equal when averaged over a number of years. If all the sand and gravel reaching such a bar is removed, the supply to bars downstream will diminish. Since sand and gravel will continue to be transported from these downstream bars by the river, their size will decrease."*

If stream bed lowering increases bank heights to the degree that banks become unstable, rapid bank retreat may occur, further destabilizing the width but supplying the channel with sediments that make good the transport-supply imbalance, to prevent further degradation until they are flushed out (Knighton1984, Little *et al.* 1991). Thus, sediment removal from a relatively confined reach can trigger erosion migrating upstream, causing erosion of the bed and banks which increases sediment delivery to the site of original sediment removal. Channel morphology is simplified as a result of degradation following sediment removal (Church *et al.* 2001). Also, Simon and Hupp (1992) show there is a positive correlation between bed lowering and channel widening, or bank retreat. As discussed above, channel widening can simplify habitats (Collins and Dunne 1990) and increase bank erosion, which can deliver sediment to downstream sites (Olson 2000), further reducing the quality of pools. Repeated sediment extraction at a certain percent of natural sediment replenishment rates can also deplete sediment sources and impact habitats downstream.

As implied above, increases in W/D ratio and bed degradation due to sediment removal are inter-related. Where extraction occurs in excess of rates of natural replenishment, bars may become smaller, the channel may widen and/or the channel bed may degrade. The specific response(s) will depend on the confinement of the river in the valley, the volume of extraction relative to natural replenishment rates, and the methods of extraction. Where the river is confined, such as Redwood Creek is between the levees, changes from gravel removal could occur in the form of bed lowering, decreases in bar size and height, and erosion migrating upstream. These changes in channel form can lead to similar effects on pool habitat: that of simplification and reduction in overall quantity and quality.

Overall, the channel of lower Redwood Creek is somewhat aggraded when compared to the design for the flood control project from 1967, although it is not known if there is current channel aggradation or degradation when compared with the pre-levee condition of lower Redwood Creek. Moffatt and Nichol (2003) note that the channel was excavated when the levees were built and that the channel area downstream of the Highway 101 Bridge has not aggraded substantially beyond the 1968 excavated elevations (i.e., an observed 0 to 2.5 feet of aggradation) while the sediment load has not decreased substantially and there have been flows in excess of 40,000 cfs since 1968. However, much of Redwood Creek above the levees is believed to be aggraded by sediment derived from land management activities and transported by large flood events, and this sediment has been migrating down the mainstem of Redwood Creek (RNSP 2000). Additionally Humboldt County believes that the channel between the levees above the Highway 101 Bridge is aggraded.

We expect that the channel confinement provided by the levees will provide resistance to channel instability and some control over changes in channel morphology. In addition, the County proposes to limit the annual amount of gravel removal to a maximum of an estimate of the amount of gravel that is annually transported, on average, to the project reach, as measured at Highway 101 Bridge (Moffatt and Nichol 2003). The County also proposes to prioritize gravel removal by annually identifying hydraulic hot spots so that the gravel removal would be localized in areas with the greatest amount of aggradation As proposed by the County, the maximum annual gravel removal of 90,000 cubic yards would represent a response to an extreme flow event, such that NOAA Fisheries expects that significantly less than 90,000 cubic yards (i.e., approximately 50,000 cubic yards) of gravel would be removed in average or above average flow years. Therefore, NOAA Fisheries expects that the effects on pool habitat would be localized adjacent to, and directly downstream of, gravel removal sites.

(3) Reductions in Riparian Vegetation Quantity and Size

Pool quality in the alluvial rivers of Humboldt County is strongly influenced by the presence of riparian vegetation (Halligan 2003). Riparian vegetation provides channel stability which may locally resist scour and form deeper pools. Mature vegetation provides additional benefits to juvenile salmonids in the form of physical structure. Structure in the form of LWD, when recruited into the active channel promotes localized scour, pool formation and is, itself, utilized as cover. Cover is also provided to juvenile salmonids by overhanging vegetation, submerged vegetation and exposed roots. The cover provided by complexities in structure can increase survival rates for salmonids rearing in summer, overwintering, and as outmigrating smolts (Meehan 1991).

Ecological energy is typically derived from detritus in streams (Cummins *et al.* 1973, Vannote *et al.* 1980) and is processed by different organisms (Anderson and Sedell 1979) in a continuum from larger to smaller particles (Boling *et al.* 1975). Riparian vegetation provides important nutrient inputs to streams such as leaf litter (Cummins *et al.* 1973) and terrestrial invertebrates that drop into the stream. Such "allochthonous inputs" can serve as the principal source of energy for higher trophic levels in stream ecosystems (Reid 1961, Gregory *et al.* 1991). Leaf litter provides the trophic base for aquatic macro-invertebrate communities that in turn are the fundamental food source for salmonids (Hawkins *et al.* 1982, Beschta 1991, Bretscko and Moser 1993).

Annual bar skimming can remove riparian vegetation that would otherwise colonize a portion of gravel bar surfaces. As discussed above, the stream channel in the action area can be expected to become somewhat less stable as a result of gravel removal. If sediment removal exceeds sediment input, resulting in channel degradation, the water table may decline, further reducing the ability of riparian vegetation to become established or survive on bar surfaces. In addition to bar skimming, the County also proposes to remove riparian vegetation from both the levee faces and the channel bed.

Decreases in pool quality and quantity would impact both adult holding by reducing the ability of pools to provide for cool water and cover, and by an overall reduction in the number of pools available for holding. Decreases in pool quality and quantity would also reduce juvenile rearing success through decreases in the overall amount of habitat available, and reductions in available food base and cover. Juvenile salmonids are morphologically, behaviorally and ecologically different, which results in differential interspecific exploitation of riverine habitats (e.g., pools) Bisson *et al.* (1988). For example, coho salmon are dorso-laterally compressed and have larger fins which enables maneuverability in slower velocity pool habitats (Bisson *et al.* 1988). Steelhead are more cylindrically-shaped and have smaller fins which enables utilization of higher velocity habitats such as riffles and runs (Bisson *et al.* 1988). These morphological differences demonstrate one reason why coho salmon are found in pools and steelhead are typically found in higher velocity habitats. Coho salmon out-compete juvenile steelhead for preferred pool habitats, but are unable to compete with steelhead in higher velocity habitats (Hartmann 1965).

If pool quality and quantity declines, competitive interactions between coho salmon and steelhead will increase and steelhead will gain a competitive advantage. Increased overlap between steelhead and coho salmon in habitats where steelhead hold a competitive advantage is likely to result in decreased growth of coho salmon (Harvey and Nakamoto 1996) which can affect size of smolts and subsequent smolt to adult survival (Ward and Slaney 1988, Holtby *et al.* 1990).

Historically, larger streamside vegetation was found adjacent to lower Redwood Creek. These large vegetation sources have been removed by land management activities, and construction of the levees further reduced the large vegetation available for recruitment. These reductions in large woody debris sources have likely contributed to the decreased quality and quantity of pool habitat found within lower Redwood Creek. Currently, willow and alder within the channel bed and on the banks provide localized habitat complexity. Part of the levee maintenance program is to remove mature and emergent riparian vegetation from the channel bed and banks, and from the levee faces.

We expect that the annual interagency review and approval process, and the vegetation buffers described in the *Description of the Proposed Action* section of this document, will focus the majority of vegetation removal on the levee faces, above bankfull channel water surface elevation. We also expect that the levee-confined channel will not experience large lateral shifts away from existing riparian vegetation. Additionally, providing for a head of bar buffer, and utilizing alternative extraction techniques, such as construction of a fish migration channel and alcoves will reduce effects on emergent riparian vegetation from bar skimming. However, we do expect a reduction in emergent riparian vegetation on skimmed surfaces, and a reduction in overall riparian vegetation from vegetation removal. This will reduce the extent of habitat complexity provided by vegetation and reduce allochthonous inputs occurring in the vicinity of gravel and vegetation removal sites. Effects to fish from this reduction in habitat complexity and reduced allochthonous inputs will be manifested in a reduced yield of eggs to adults, by reducing growth and survival rates of juvenile salmonids.

b. Increased Riffle Instability and Migration Blockage at Riffles

Sediment removal has three principal effects on riffle habitats: (1) impacts to spawning habitat, (2) impacts to rearing habitat, and (3) increased migration blockage. Additional impacts to spawning habitat resulting from increased sedimentation are described in a following section discussing the impacts of elevated turbidity and sediment loads.

(1) Impacts to Spawning Habitat

Similar to decreases in pool quality, sediment removal can cause channel instability that has consequent effects on the stability and quality of riffle habitats. Sediment removal can cause bed lowering to propagate both upstream and downstream, thereby scouring spawning areas. Increased channel instability, either through degradation or lateral migration, increases the risk that salmonid redds will be destroyed. For example, the loss of egg inoculated gravel from riffles was documented by Pauley *et al.* (1989), who concluded the eggs were scoured because bar skimming reduced bar heights, increasing shear stress over riffles. Where flow diverges over riffles, the flow depth and velocity-field become more uniform, providing conditions conducive to the formation of well sorted patches of gravel. It is these gravel patches, combined with the gradient of the hyporheic flow field (subsurface water), that provide optimal substrates for spawning salmonids (Groot and Margolis 1991). Where habitat is simplified and the pool-riffle sequence is less pronounced as noted by Collins and Dunne (1990), spawning habitat quantity, and more importantly, quality, will be reduced. Sediment extraction at a site has also been demonstrated to reduce the overall substrate size. Therefore, in lower rivers, where larger particles may be in short supply, extraction at a site could reduce the quality of spawning habitat by reducing the size of spawning substrate needed for various salmonids, particularly Chinook salmon, and by increasing the shear stress at riffles. Decreased particle size and changes in shear stress due to sediment removal activities would lead to increased bed mobility and a higher likelihood of premature redd scour.

However, there is not evidence of Chinook or coho salmon, or steelhead, utilizing lower Redwood Creek within the action area for spawning, probably due to preferred and available spawning habitat upstream of the levee reach, and also due to the run timing of Chinook salmon in Redwood Creek. Therefore, NOAA Fisheries does not expect impacts to spawning habitat from implementation of the proposed action.

(2) Impacts to Rearing Habitat

As described previously, the shallow, swift flows over riffles are also important habitats for numerous species of invertebrates, many of which are important food sources for salmonids. Reductions in the quality of riffles can occur by a decrease in overall substrate size by chronic sediment removal, resulting in changes, and overall reductions, in macro-invertebrates, decreasing food availability for rearing juvenile salmonids. Riffle quality also may be reduced by increased shear stress and scour potential due to a less confined channel and a shortened flow path over a more easily inundated skimmed bar. Decreased food availability will result in smaller juveniles. Decreases in smolt size at the time of ocean entry has been shown to decrease ocean survival, and thus reduce the number of returning adults (Ward and Slaney 1988, Holtby *et al.* 1990).

Gravel removal decreases the quality of rearing habitat at riffles by affecting food and cover availability for rearing juvenile salmonids, particularly steelhead. However, rearing coho and Chinook salmon would also be affected by an overall decrease in aquatic macroinvertebrate availability. An overall decrease in riffle stability will lead to a decrease in the quality and quantity of juvenile rearing habitat at riffles adjacent to, and directly downstream of, mined sites. We expect a decrease in food availability at riffles adjacent to, and directly downstream of, mined sites which will mainly affect juvenile steelhead rearing at riffles, and may lead to a small decrease in smolt to adult survival. However we expect that there will also be annually undisturbed rearing habitat at riffles in the project reach, and we also expect that the provisions for head of bar buffer and minimum skim floor elevation, as well as the channel confinement provided by the levees, and the limits on the quantities of gravel removed annually will reduce the likelihood of riffle instability, and therefore minimize impacts to rearing habitat at riffles.

(3) Increased Migration Blockage

Thompson (1972) provided minimum depth and maximum velocity criteria that enable upstream migration of adult salmon species that have been widely cited (Bovee 1982, Bjornn and Reiser 1991). According to those recommendations, Chinook salmon, the largest salmonid species, require minimum riffle depths of 24 cm, for successful passage. This depth should be provided "on at least 25% of the total [cross-sectional] transect width and a continuous portion equaling at least 10% of its total width." Sediment removal operations that increase W/D ratios (particularly bar skimming) increase the probability that shallow flows at riffles will form migration barriers. Increased W/D ratios (particularly from bar skimming) increase the probability that shallow flows at riffles will form migration barriers. Pauley *et al.* (1989) and Woodward-Clyde (1980) verified that flow depths decreased over riffles, creating barriers to upstream-migrating adult salmonids, adjacent to and upstream from skimmed bars.

Migration blockages may be created through two mechanisms. First, where a skim floor is taken down to the level of an adjacent riffle at low-flow, rising flows will not be confined. Therefore, during the first rising flows of the fall, river width would increase rapidly while depth would increase very little and the riffle continues to be a migration barrier.

A second mechanism by which migration would be impeded is through longer-term increases in the W/D ratio due to repeated sediment removal at a site. As discussed previously, various sediment extraction methods can increase the W/D ratio at the site. In general, especially in unconfined alluvial settings, channel bed degradation is accompanied by channel widening (Simon and Hupp 1992). This occurs as bars are lowered or removed, and stream habitat becomes less complex. The habitat simplification that occurs as a result of sediment removal produces a greater amount of "flat water" habitat, with an overall decrease in topographic complexity. Adult migration may be impeded if long stretches of flat water habitat absent holding cover are present (Thompson 1972).

In addition to reducing stream depths over riffles (as a result of increasing W/D ratio), sediment removal operations can increase current velocities and reduce flow-field complexity, thereby forcing migrating salmonids to expend additional energy from their finite energy reserves used for migration and spawning. Reduced flow-field complexity and increased migratory velocities, particularly reduced edge-water eddies and low velocity zones, result from reduced sinuosity, increased W/D ratio at bars, and reduced topographic complexity of geomorphic features, which can all affect adult salmonids during their upstream migrations across riffles by increasing their energy expenditure. Adult salmonid migration can also be adversely affected when sediment removal activities diminish the size and frequency of main stem pool habitat used for resting.

NOAA Fisheries does not expect significant adult migration impediment as a result of the levee maintenance program. We expect that the two-foot minimum vertical offset from summer low flow will protect the required depth needed for migration over riffles, and that construction of a fish migration channel in the uppermost reach of the action area may improve adult migration in a portion of lower Redwood Creek. NOAA Fisheries expects that vegetation and sediment removal may reduce the quality and quantity of available pool habitat in lower Redwood Creek, which would affect the quality and quantity of holding habitat and energy expenditures of some migrating adult salmonid individuals. However, NOAA Fisheries also expects that maintenance activities would not occur adjacent to all of the pools in any given year of the five-year permit period, so that there will be a portion of the approximately 10 pools in the project reach that will not be disturbed each year.

c. Loss of Velocity Refugia

Sediment and vegetation removal can alter the distribution of velocity refugia in stream channels. This effect may occur through: (1) impacts due to habitat changes or maintenance of existing habitat, (2) changes in channel bed roughness, and (3) reductions in riparian vegetation.

(1) Impacts Due to Habitat Changes or Maintenance of Existing Habitat

Pools provide a complex of deep, low velocity areas, backwater eddies, and submerged structural elements that provide cover, winter habitat and flood refuge for fish (Brown and Moyle 1991). During their upstream migrations, adult salmonids typically move quickly through rapids and pause for varying duration in deep holding pools (Briggs 1953, Ellis 1962, Hinch *et al.* 1996, Hinch and Bratty 2000). Holding pools provide salmon with safe areas in which to rest when low-flows and/or fatigue inhibit their migration. Pools are also the preferred habitat of juvenile coho salmon (Hartman 1965, McMahon 1983, Fausch 1986), the subset of Chinook salmon juveniles that over-summer, and they are a preferred habitat of juvenile steelhead, although this latter species is also able to utilize riffle habitat if it is complex with velocity refuges behind cobble and small boulders (Hartman 1965, Raleigh *et al.* 1984, Hearn and Kynard 1986, Nielson *et al.* 1994). Pools with sufficient depth and size can also moderate elevated water temperatures stressful to salmonids (Matthews *et al.* 1994). Deep, thermally stratified pools with low current velocities, or connection to cool groundwater, provide important cold water refugia for cold water fish such as salmonids (Nielson *et al.* 1994).

Channel bed degradation initially creates a deeper, narrower channel. Back channels are cut off and river-edge wetlands are de-watered during channel bed degradation. Initially complex channels tend to degrade to less complex channels with a decrease in the pool/riffle expression of topographic complexity; these effects amount to reduction in habitat diversity (Lisle *et al.*, 1993). Lack of both margin and topographic complexity reduces important velocity refugia.

Existing velocity refugia in the form of complex pools, off-channel habitat, and topographic complexity are limited in lower Redwood Creek. We expect that gravel and vegetation removal will maintain these existing habitat conditions near the individual removal sites. The effects of lowering the downstream ends of bars by skimming, which impedes the development of natural alcove and backwater habitat, will be manifested in reduced fry habitat and high-flow refuge. Construction of alcoves for gravel removal may provide short-term refuge and fry rearing sites. In addition, limiting sediment removal to no more than the estimate of recruitment to the reach that is confined by the levees, utilizing the interagency review team, and implementing the vertical offset from summer low flow and head of bar buffer are features of the proposed action that will reduce effects to pool habitat. However, we expect that maintenance of simplified habitat conditions will continue to limit habitat, including high flow refuge, for salmonid fry near the mined sites. We expect a small decrease in the survival of salmonid fry in lower Redwood Creek due to a loss of, or maintenance of existing, high flow refuge habitat.

(2) Changes in Channel Bed Roughness

Reductions in exposed particle size result from the removal of overlying coarse sediments and abrasion and particle breakage caused by the passage of heavy equipment. The Redwood Creek watershed is composed of sedimentary and low-grade metamorphic rocks. Particles that easily break into smaller particles when moving downstream, and when heavy equipment crushes them, dominate the coarse sediment load in Redwood Creek. As a result of disrupting the natural armoring process and as a result of mechanical crushing by heavy equipment, disturbed bar surfaces are typically finer-grained than undisturbed bar surfaces.

Areas of heavy bed armor can provide valuable fish habitat during high flows (Church *et al.* 2001) because of low near-bed velocity, and productive benthic habitat whenever inundated (Bjornn *et al.* 1977). Loss of pool quality discussed above is one manner in which important velocity refugia can be reduced. In addition, riffles with course substrate such as cobble and small boulders provide velocity refuges for juvenile salmonids (Hartman 1965, Raleigh *et al.* 1984, Hearn and Kynard 1986, Nielson *et al.* 1994). As described previously, sediment removal may result in finer substrate sizes, and decreases in riffle stability, both of which increase bed mobility. Increased bed mobility will result in less stable velocity refugia.

NOAA Fisheries expects that sediment removal in lower Redwood Creek will reduce the surface armor and substrate size of skimmed gravel bars, which will locally decrease bed mobility, and thus we expect localized reductions in high-flow velocity refugia to occur adjacent to mined sites. We expect a small decrease in the survival of salmonid fry in lower Redwood Creek due to a loss of coarse substrate velocity refugia.

(3) Reductions in Riparian Vegetation and Distribution

Vegetative structure increases hydraulic boundary roughness resulting in relatively lower velocities near the flow-substrate interface (Beschta and Platts 1986), and increases channel and habitat stability (Lisle 1986). These low velocity zones provide refuge habitat to salmonids during high-flow events. Many salmonids seek out low velocity areas close to high velocity areas in order to optimize foraging and maximize net energy gain (Fausch 1984).

The County proposes to remove vegetation from the levee faces, and from within the channel bed of lower Redwood Creek. Since the lower 3.4 miles of Redwood Creek has been confined by the construction of levees, which included straightening the channel and eliminating connectivity to the flood plain, there has been a decrease in the amount of velocity refugia provided by low velocity areas. Given the lack of connectivity and off channel habitats, the lack of larger vegetation, the generally small particle sizes, and the lack of complex pool habitat, we expect that the vegetation located within the channel bed provides one of the few velocity refuge habitats in lower Redwood Creek.

Direct removal of vegetation within the channel bed and banks will result in loss of velocity refugia for rearing juvenile salmonids. Additionally, suppression of emergent vegetation by gravel bar skimming and will also result in loss of velocity refugia, but to a lesser degree. Removal of vegetation from the levee faces, above bankfull channel levels, will result in a loss of high flow refuge habitat, but also to a lesser degree, as the frequency of inundation above bankfull is much less than the frequency of inundation of the channel bed, most of the vegetation on the channel bed will be retained, and the five foot vegetated buffer along the toe of the levees will reduce the loss of velocity refugia above bankfull stage height.

We expect the loss of velocity refugia to affect juvenile salmonids because they are highly dependent upon edgewater and submerged riparian vegetation. Given the limited availability of adequate high flow refuge habitat, we expect that any additional loss of velocity refuge will result in a concomitant decrease in juvenile survival, as these fish will be more readily swept downstream and will fail to acquire habitat that supports their growth and survival to the smolt stage. We cannot adequately estimate the numbers of juveniles that will not survive to smolt as a result of the loss of velocity refugia under the proposed action. However, we expect that there will continue to be production of salmonids occurring within the action area, and there will continue to be riparian vegetation that is not affected by the proposed action and that will provide high flow refuge. The interagency review team will limit the amount of vegetation that can be removed from the channel bed and banks, and we expect that the majority of vegetation removal will be from the levee faces, above the bankfull channel level. In addition, the various site-specific measures such as head of bar buffer and vegetation removal buffers will also limit the effects on velocity refugia, as only small portions of vegetation patches below bankfull flow are expected to be removed. NOAA Fisheries expects that effects to velocity refugia will be limited to site-specific instances. Although there will be a reduction in the amount of vegetation that will be utilized for high flow refuge, and a reduction in juvenile survival, the lower 3.4 miles of Redwood Creek will continue to have vegetation that will provide high flow refuge for juvenile survival to the smolt stage.

d. Increased Water Temperatures

Riparian vegetation protects cool stream temperatures by providing canopy that shades the water and reduces direct solar radiation reaching the water surface (Beschta 1991, Hetrick *et al.* 1998). Stream temperatures are affected to a lesser degree by ambient air temperatures (Spence *et al.* 1996). In addition, riparian vegetation lessens the temperature differential between the air and the water by creating a cool and moist microclimate near the water surface.

As streams get larger, they typically get wider. The resulting increase in surface area exposes the water to more insolation and more heat gain (Beschta *et al.* 1987). The influence of riparian vegetation decreases in proportion to the fraction of the water's surface shaded by trees adjacent to the watercourse. The influence of heat energy transfer is also diminished as stream flows increase (Beschta *et al.* 1987). This decreases the cooling influence of shade on main stem waters. Stream temperature is also influenced by season, latitude, elevation, topography, orientation, and local climate (Spence *et al.* 1996).

Increased water temperatures due to losses of riparian vegetation are of particular concern, given that salmon and steelhead prefer relatively cold water habitats with water temperatures less than about 15°C. Water temperature influences juvenile steelhead growth rates, population densities, swimming ability, ability to capture and metabolize food, and disease resistance (Barnhart 1986, Bjornn and Reiser 1991). Upper lethal temperature limits generally range in the vicinity of about 23-25°C, although many salmonid species can survive short-term exposures to temperatures as high as 27-28°C (Lee and Rinne 1980). Fluctuating diurnal water temperatures also help salmonids survive short episodes of high temperature (Busby *et al.* 1996). Large, thermally stratified pools, springs, and cool tributary inflow can also provide cold water refuges that help juveniles survive hot summer temperatures (Nielson *et al.* 1994).

Water temperatures are sub-optimal for salmonids in the action area in the summer and there has been a reduction in the quality and quantity of pool habitat in the action area since construction of the levees, decreasing the availability of cool water refugia (RNSP 2001). Where gravel removal reduces the depth of pools, as is expected to locally occur adjacent to, and downstream of, gravel bar skimming, lack of thermal stratification or loss of cool water seeps may reduce thermal refugia. A reduction in stratification or cool water seeps is expected to result in a reduction in juveniles that would ordinarily occupy that habitat. Alternative extraction techniques, such as construction of fish passage channels and alcoves may reduce the impacts on pool habitats, as will limits on bar skimming, such as head of bar buffers and minimum vertical offsets. It is not expected that construction of fish passage channels or alcoves will have a detectable effect on water temperatures, as it is expected that these extractions will fill in with gravel during the winter season.

NOAA Fisheries expects that the loss of riparian vegetation by small amounts of direct cutting of riparian vegetation from the channel bed and banks may cause a local increase in water temperatures in low flow channel areas adjacent to the cut vegetation. In addition, suppression of riparian vegetation from bar skimming will maintain existing water temperatures. However, we expect that the vegetation buffers described in the *Proposed Action* section, and the interagency review process will limit the amount of vegetation removed from the channel bed and banks and will limit the effect of vegetation removal on water temperatures.

The harm to salmonids associated with water temperature effects is difficult to determine. Approximately 10 pools exist in the action area, and not all of these pools would be affected by gravel bar skimming in any given year of the five-year permit period. We estimate that the levee maintenance program will reduce the quality of at least one pool annually, but that gravel removal will rotate among the bars within the action area over the five-year permit period, allowing some recovery of pool habitat within the five-year period. We expect that some portion of the juvenile salmonids that reside in affected pools, or in limited areas of vegetation removal, may be lost each year, but that there would be nearby areas not affected by vegetation removal, and nearby pools not affected by gravel bar skimming.

e. Elevated Turbidity and Sediment

Sediment generated from upstream eroding banks or eroded off of freshly skimmed bar surfaces can smother incubating salmonid embryos. Sediment intrusion resulting from the excavation of in-channel bars is likely a transient process that occurs when an altered bar is initially overtopped and flushed of its fine-grained surface layer. This process, in terms of increased sediment load, is difficult to detect, especially in streams with high background sediment concentration. However, the potential for harm to spawning and incubating salmonids in areas within and downstream of altered bars is great because of the critical timing between reproductive activities and the first winter storms. Additionally, as discussed previously, increased sedimentation of riffle habitats reduces the interstitial spaces of cobbles and gravel, directly decreasing the habitable area for aquatic invertebrates, an important food source for juvenile salmonids (Bjornn *et al.* 1974, Bjornn *et al.* 1977).

Removal of an armor layer, which protects the stream bed or bar from sediment transport, creates a less stable bed or bar and results in particle sizes that can be transported earlier in a given flood season. The finer-grained disturbed surfaces, which are at a reduced elevation, create a new source of fine sediment within the active channel that can be mobilized by the first freshets during late fall or early winter. The first freshets may entrain the fine-grained surface material but lack the magnitude or duration to transport the locally derived fine sediment sufficiently downstream.

Fine sediments generated during sediment removal operations contribute to the anthropogenically-induced concentration of sand and fines that is known to be a factor contributing to the decline or loss of salmon and steelhead populations (Cordone and Kelley 1961). As discussed previously, increased levels of fine sediment have been shown to have direct impacts on salmonid behavior, physiology, growth, reproductive success and the availability of food (Waters 1972, Bjornn *et al.* 1974, Bjornn *et al.* 1977, Sigler *et al.* 1984).

Proposed bar skimming along lower Redwood Creek will allow inundation of unarmored bar surfaces. Although the minimum skim floor elevation of two feet above summer low flow, approximately corresponds to the 35% exceedence flow will ensure that the river is already transporting fine sediment from other sources when the bar is overtopped (NMFS 2002), we expect the effect will be to add additional sediment to the river. Injury could occur through reduced interstitial spaces in the channel bed available for sheltering, and impaired feeding ability in the turbid water. However, given the already high background sediment levels when flows reach the skimmed bar surfaces, we anticipate that inputs of sediment from extraction areas would be diluted by the background sediment levels found at the 35% exceedence flow. Therefore, the amount of additional sediment allowed into the stream as a result of gravel mining would be a relatively small fraction of what is already in the system at the 35% exceedence flow. While we expect injury associated with increased sediment production, NOAA Fisheries thinks these impacts will be confined to the areas adjacent to, and directly downstream of, the extraction areas and only affect a portion of the juvenile and adult Chinook and coho salmon, and steelhead individuals present in the area.

The construction of a fish passage channel will result in increased turbidity and sedimentation downstream of the extraction site. This has been previously discussed in the *Direct Effects* section and, therefore, will not be covered here.

f. Increased Stranding on Extraction Surfaces

Gravel extraction surfaces (i.e., skimmed bars, trenches and alcoves) all have an increased potential for salmonid stranding after inundation and subsequent receding flows. Increased stranding potential can occur in the following ways: (1) if skimmed bars have been left with closed undulations or depressions, (2) fish passage channels have not been connected to the wetted channel, and (3) if sediment berms form at the mouths of alcoves. As described in the *Proposed Action* section of this Opinion, skimmed surfaces will be final graded to provide a free draining surface. NOAA Fisheries expects that the increased potential for stranding on skimmed surfaces will be low, but that in some cases not enough slope may be left for free drainage, or small depressions may be left on the skimmed surface. Additionally, fish migration channels and alcoves are connected to the wetted channel. However, during storm events sediment berms may form at the mouths of alcove excavations, increasing the potential for stranding. The interagency review process, and the use of adaptive management will reduce the likelihood of berm formation by ensuring large enough openings to these types of excavations. NOAA Fisheries expects that there will be a low increase in stranding potential for juvenile salmonids with alcove excavations. The potential stranding associated with these extraction techniques may or may not be lethal, depending on the inundation frequency and potential berm formation.

g. North and South Slough Channel Excavation

As a part of the five-year Redwood Creek Levee Maintenance Program, the County proposes to excavate the channels between the North Slough and Redwood Creek embayment, and between the South Slough and the embayment. This activity is intended to improve fish habitat by increasing and improving access to rearing habitat in the sloughs, and improving water quality in the sloughs. RNSP personnel and equipment will do the work. Over the five-year span of the permit, the work may occur once or multiple times, depending on sedimentation conditions.

As explained in the *Description of the Proposed Action* and *Environmental Baseline* sections of this Opinion, the North and South sloughs are often isolated from the embayment because sand has been deposited into the outlet channels. The deposition of sand and driftwood is caused by the configuration of the flood control levees, which altered the historic sedimentation and circulation patterns of the Redwood Creek estuary (RNSP 2000). These changes have decreased the area, volume, and quality of fish habitat in the estuary.

During excavation of the channels there will likely be a temporary increase in suspended sediment and turbidity in the sloughs and main estuary. NOAA Fisheries anticipates that fine sediment inputs to the sloughs and estuary will reduce invertebrate production and will result in behavior modification of juvenile salmonids that may be present. Fish will avoid the immediate area when turbidity is present and may impinge on other rearing salmonids' territories, thereby resulting in energy expenditure through territorial defense, reduced feeding potential, and increased predation potential as a result of interactions between individual fish.

Excavation of the slough channels will increase the volume of the estuary, thereby increasing the tidal prism. This larger volume of water cycling in and out of the estuary will result in more total energy being available to move sediment and scour channels. Therefore, the main outlet channel to the ocean could remain open longer before closing in the spring or summer. As described in the *Environmental Baseline* section of this Opinion, the lagoon tends to close earlier in the year than it did before the levees were constructed, so if the outlet remains open longer the general effect would be closer to natural conditions. However, the availability and quality of habitat within the embayment/lagoon have been decreased by the levees due to sediment filling, so we need to consider the possibility that improvement in one condition (timing of closure) does not exacerbate the adverse effects of another condition (decreased habitat).

The following excerpt from the Chinook salmon section of a species accounts paper prepared by RNSP (2002) discusses Chinook salmon utilization of the Redwood Creek estuary:

> "Juvenile Chinook salmon in Redwood Creek do not spend time rearing in upstream areas (Anderson and Brown 1982), but instead, utilize the Redwood Creek estuary. In spring, Chinook salmon fry migrate downstream to rear in the estuary before entering the ocean in the fall. Thus, the Redwood Creek estuary is important as the sole rearing habitat for this ESU in the park. Research shows that if given the opportunity the

> juveniles will spend an extended period (to late summer) in the estuary before entering the ocean. Reimers (1973) documented the role estuaries play in fall Chinook salmon production. From scale analysis of spawning fall Chinook from the Sixes River, Oregon, he determined that the majority of returning adults spent June, July, and August as juveniles within the estuary before completing their seaward migration. His investigations determined that juvenile Chinook spending less than three months in the estuary seldom returned to spawn in the natal stream. He concluded that these fish did not survive as well in the ocean as the fish that had spent three months in the estuary. Apparently a survival advantage was conferred upon the fish that remained in the estuary and grew to a larger size before entering the ocean."

Because Chinook salmon are particularly reliant on the estuary, any alteration of the estuary must be carefully examined to ensure that Chinook salmon do not experience additional adverse effects. One possible adverse effect of the estuary remaining open longer is that downstream Chinook salmon migrants would have access to the open ocean for a longer period, and as their density increases they may be more likely to be swept out with the tide because of the presently reduced size and volume of habitat in the embayment. However, the added volume of tidal prism, which would tend to keep the estuary open, will originate from an area that provides increased area and volume of rearing habitat. Therefore, NOAA Fisheries thinks that any possible adverse effect due to the estuary remaining open longer will be balanced by the increase in habitat availability, and that the result is likely to be an overall benefit to the species.

The species account for coho salmon prepared by RNSP (2002) includes the following excerpt:

> "Downstream migration of coho to the ocean from upstream Redwood Creek rearing areas occurs in early spring (March-April). Survey data from RNSP indicate that these young salmon move directly into the ocean, spending a minimal amount of time in the Redwood Creek estuary (Anderson 1995). Migration through the Redwood Creek estuary is dependent upon the mouth being open to the ocean."

Therefore, coho salmon smolts that may outmigrate later in the spring would not be as likely to be "trapped" in the estuary if the mouth remained open longer on average. And smolts or fry that did rear over the summer in the estuary would likely encounter more favorable rearing conditions. Therefore, NOAA Fisheries does not expect adverse effects to coho salmon due to possible open channel conditions later in the season.

According to the life history periodicity table compiled by RNSP (2000), one- and two-year-old juvenile steelhead outmigrate from Redwood Creek into the estuary between mid-April and mid-July, and then spend the summer rearing in the estuary before outmigrating in the fall. As with juvenile Chinook salmon migrating to the estuary, these juvenile steelhead may be more likely to encounter an open estuary if the mouth remains open longer in the spring. However, the juvenile steelhead would be larger than the outmigrating Chinook salmon, so would be less likely to be swept to sea by the tide. And, again, they would likely encounter more favorable rearing conditions once the mouth has closed. Therefore, NOAA Fisheries does not expect adverse effects to steelhead due to possible open channel conditions later in the season.

3. General Effectiveness of the Proposed Action at Reducing Adverse Effects

This section provides an overview of the ability of project standards to reduce the adverse effects of the proposed action.

a. Interagency Review and Approval Process

The interagency review process is intended to ensure that the proposed action will minimize site specific geomorphic and related habitat impacts. Because "hydraulic hot spots" and corresponding high-value habitat locations will be identified annually, specific locations and dimensions of various channel features and work items are not analyzed in some sections below. Certain work elements, such as the total area to remain undisturbed at the head of bars, will be determined by the interagency review team, and NOAA Fisheries will evaluate the annual work plan's consistency with the analyses in this Opinion before giving final approval. Therefore, while the following analyses necessarily lack specific details, NOAA Fisheries is confident that adverse impacts to ESA-listed salmonids due to future work items will be consistent with those predicted in this Opinion.

b. Minimum Skim Floor Elevation and Bar Treatments

The proposed action sets a minimum two-foot vertical offset from the water surface elevation of the summer low flow elevation. This minimum skim floor elevation corresponds approximately to the water surface elevation of the flow that is exceeded 35% of the time in the historic record of daily average flows for rivers in Humboldt County. This 35% exceedence flow is the flow where significant movement of fine bed load material begins in the rivers of Humboldt County (NMFS 2002a) and is a relatively low flow. Calculations of water surface elevation using cross sections available in mined areas indicate that the 35% exceedence flow provides for a water depth sufficient to allow for adult salmonid migration that is consistent with observations and recommendations for depths across a cross section that is consistent with Thompson (1972).

NOAA Fisheries also expects that this minimum skim floor elevation to delay the mobilization of fine bed load material from skimmed bar surfaces until background movement of fine bed load has begun to significantly increase, thus diluting the effect of additional fine bed load material from skimmed bars, and possibly delaying the entrainment of fine bed load from skimmed bars until later in the fall or early winter. Timing of sediment increases can be critical for spawning and migration during the fall and early winter. Storm flows in this period can cause earlier sediment increases where bars are lowered by skimming. The minimum skim floor elevation that corresponds to the 35% exceedence flow will delay the onset of extraction-induced sediment increases until sediment loads are elevated and additional contributions from skim surfaces may be relatively smaller. Therefore, the amount of additional sediment allowed into the stream as a result of gravel extraction would be a relatively smaller fraction of what is already in the system at the 35% exceedence flow, although the 35% exceedence flow may still occur early in the late fall and early winter. In the absence of the two-foot vertical offset from summer low flow minimum skim floor, increased sediment from lower skimmed surfaces would be entrained prior to the beginning of significant movement of fine bed load material in the rivers of Humboldt County. Therefore, the general effect of skim floor elevations is that effects associated with sediment inputs are reduced as the elevation of the skim floor increases.

Ten inches of water over the riffle crest in an undisturbed river should be sufficient to provide unimpeded fish passage (Thompson 1972). However, in disturbed channels fish expend additional energy to migrate through simplified and reduced pool-riffle structures. Frequently disturbed rivers are often missing some of the important attributes of a natural river that allow unimpeded migration or spawning. Those attributes include channel margin complexity, bed roughness, and vegetative cover. The lower 3.4 miles of Redwood Creek is considered a frequently disturbed river due to the elevated sediment input resulting from land management practices in the watershed; past gravel extraction; and the confinement of the channel caused by the levees, which contains flood flows and thereby increases disturbance to the channel bed. Additional flow depth beyond the cited minimums can help offset the lack of habitat complexity. NOAA Fisheries thinks that a flow depth over riffles of 20 inches during migratory flows, twice the cited minimum, may help offset the lack of channel complexities that aid in migration and spawning (NMFS 2003a).

Additionally, the minimum skim floor elevation should be used in conjunction with limits on gravel volume extracted, area disturbed and with consideration for specific geomorphic features. At the 35% exceedence flow, some spawning sized bed material will have been put into motion, and the depth for migration should be protected. The 35% exceedence flow is far below the flow that moves significant sized bed material, and cannot provide for maintenance of morphological features of a stream or for the reconstruction of degraded morphological features, particularly if too large of an area is skimmed, or too large a cumulative volume is extracted. Bar elevations considerably above the minimum extraction elevation are necessary to drive the hydraulics necessary to form essential channel morphology (e.g., deep pools and the related riffle structure, moderate flow meanders, velocity diversity, and all other associated geomorphic features).

In addition to leaving a two-foot minimum vertical offset from the low flow elevation that approximately corresponds to the 35% exceedence flow, the proposed action will also leave the upper end of bars undisturbed (i.e., at their existing elevation), and will slope the skim surface toward the thalweg or downstream. NOAA Fisheries expects this overall bar configuration to reduce adverse geomorphic responses and to aid in maintaining beneficial geomorphic responses during channel forming flows.

c. Undisturbed head of bar

An upstream portion (head) of any skimmed bar would be left undisturbed to ensure retention of the meander pattern and single narrow creek channel. Typically, the head of the bar is defined as that portion of the bar extending from the widest point of the bar to the upstream end of the bar that is exposed at summer low flow, or the upstream one-third portion of the bar. The head of bar buffer will reduce the potential for geomorphic changes to the creek. Increased braiding and localized alteration of hydraulic controls that dictate areas of scour and deposition would consequently alter pool riffle morphology if extraction occurred on the head of the bar.
As indicated in our effects analysis, measures that provide for maintaining important elements of the pre-extraction bar topography will provide a corresponding degree of protection to existing habitats. The head of bar, or upstream portion of the bar, is an important component in this strategy. The head of bar largely guides streamflows that are effective at creating and maintaining habitats. In the absence of the hydraulic control provided by the head of bar, habitats adjacent to and downstream of the extracted bar would become simpler; pools would fill in, riffles would degrade in overall substrate quality and the entire reach would become more unstable. The head of bar buffer provides for bar slope and form that provides for reach and site scale hydraulic roughness as described above. Therefore, NOAA Fisheries expects that adverse geomorphic responses will be reduced by leaving the head of skimmed bars undisturbed.

d. Total annual extraction

Presently, the proposed action calls for no more than 90,000 cubic yards of gravel to be extracted in a given year. The proposed action also states that 90,000 cubic yards of extraction in a given year would represent an "extreme situation," in response to a very large flood and sediment deposition event within the five-year permit period. This volume is based on sediment transport information at Highway 101 Bridge (Moffatt and Nichol 2003), and although not part of the proposed action, the volume estimate may be refined over time by continued hydraulic analysis, and by cross section analysis. The objective of a maximum annual extraction volume is to prevent more volume from being extracted than can be stored in the reach the following year. If extraction exceeds the annually stored volume, the channel will not maintain alluvial structure and related salmonid habitat. A correctly determined maximum annual extraction rate will provide for some of the sediment necessary to form stable, functional bedforms, and will, in part, minimize continued degradation of habitat conditions in the extraction reach. NOAA Fisheries expects that the typical, annual extraction volume will be significantly less than 90,000 cubic yards (i.e., approximately 50,000 cubic yards), reducing the risk of habitat simplification associated with removing more gravel than can be stored in a given reach.

e. Construction and Use of Temporary Bridges

As described in the *Description of the Proposed Action* section of this Opinion, construction and use of temporary bridges is timed to reduce impacts to sensitive life stages of listed salmonids, and designed to minimize the amount of channel disturbance and sediment input to flowing waters. The proposed bridge construction timing and techniques described in this element are mostly consistent with NOAA Fisheries' standard recommendations for minimizing adverse impacts to salmonids. Therefore, NOAA Fisheries expects that adverse effects from temporary bridge construction, use and removal will be low.

f. Vegetation Removal

As described in the *Description of the Proposed Action* section, vegetation removal would be prioritized using the decision matrix, and would focus primarily on the high ranked hydraulic hot spots with low to moderate ranked adjacent salmonid habitat. All vegetation would be removed from the rip-rap slope of the levees down to within five feet of the toe of the slope, which is defined as the intersection between the rip-rap and the current bed of Redwood Creek. Within the five-foot zone, upslope of the toe, trees with a basal diameter greater than four inches at four inches above ground level would be removed, and all other vegetation would be retained. The selection of various treatments to be implemented in any one year of the five-year permit period will be accomplished through use of the decision matrix coupled with on-site visits and discussion with, and approval by, the interagency team.

During the technical assistance phase of this consultation, NOAA Fisheries made a series of recommendations for vegetation management intended to minimize geomorphic and habitat impacts. Many of those recommendations have been incorporated into the proposed action. For example, an analysis of Redwood Creek floodway conveyance (Corps 1998) determined that approximately 75% of the total increase in river stage height is due to sediment aggradation in the channel, while 25% is due to vegetation in the channel. Based on this analysis, NOAA Fisheries recommended that this approximate relative proportion of influence also be applied to annual management of sediment and vegetation. The proposed action's vegetation management guidelines appear to follow this recommendation by leaving vegetation in strategic locations in order to limit removal areas to those least likely to cause adverse impacts to salmonids and their habitat, and by utilizing the interagency review team and decision matrix. Therefore, NOAA Fisheries thinks that the proposed action will leave adequate vegetation on gravel bars to continue providing habitat, including velocity refugia, for salmonids and geomorphic stability. Vegetation remaining adjacent to the low flow channel will continue to provide shade, cover, and allochthonous energy input. Additionally, the interagency review process will enable protection of higher quality habitat locations, which are likely to include areas of key vegetation functions.

g. Slough Channel Excavation

When analyzing the effects of beneficial actions, NOAA Fisheries must be certain that any short-term adverse impacts caused by project construction do not jeopardize the species before the future beneficial effects of the action accrue. In this case, we have identified possible adverse effects that may be caused by elevated turbidity during construction of the slough channels. However, the proposed action will be timed to occur before outmigrating juvenile salmonids are expected to reach the estuary and after fall and winter run adult salmonids have completed their upstream migrations through the estuary. (These work timing conditions leave a work window of approximately February 15 through March 15.) NOAA Fisheries expects that this work timing will minimize any adverse impacts to the three listed salmonids in Redwood Creek, and that turbidity will be short lived due to settling and flushing by tidal action. Therefore, NOAA Fisheries thinks that, in sum, construction of channels to connect the sloughs to the estuary will not result in population-level adverse impacts.

VI. CUMULATIVE EFFECTS

NOAA Fisheries must consider both the effects of the proposed action and the cumulative effects of other activities in determining whether the action is likely to jeopardize the continued existence of the three salmonid species considered in this Opinion or result in the destruction or adverse modification of SONCC coho salmon designated critical habitat. Under the Act, cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

NOAA Fisheries expects that listed species may be affected by numerous State, tribal, local, or private actions that are reasonably certain to occur in the action area. These actions include those discussed below. Although each of the following actions may reasonably be expected to occur based on their past occurrence, we lack definitive information on the extent or location of many of these categories of actions. The following discussion provides available information on the expected effects of these activities on the salmonid species analyzed in this Opinion. Section 9 of the ESA prohibits take of listed fish and wildlife species, unless authorized by Incidental Take Permits. Take of State listed species is also prohibited under the California Endangered Species Act (CESA). In addition to the ESA and CESA, other laws regulating certain of these activities provide protections for listed species, especially the Federal Clean Water Act, the California Environmental Quality Act (CEQA), the California Fish and Game Code, and the California Forest Practice Rules (FPRs). Enforcement of existing law is expected to reduce the impacts of these activities on listed species.

A. Timber management

Timber management, with associated activities such as harvest, yarding, loading, hauling, site preparation, planting, vegetation management, and thinning, is the dominant human activity upstream of the action area. Future timber harvest levels cannot be precisely predicted; however, NOAA Fisheries assumes that harvest levels on private lands in Humboldt County in the foreseeable future will be within the approximate range of harvest levels that have occurred since the listing of the northern spotted owl in 1992.

Implementation of Timber Harvest Plans under the FPRs has not consistently provided protection against unauthorized take in relation to Pacific salmonids listed under the Act by NOAA Fisheries. NOAA Fisheries has informed the California Department of Forestry (CDF) of its ongoing concern over the lack of specific provisions for salmonids in the FPRs.

Discussions continue on this issue between NOAA Fisheries, CDF, and the California Resources Agency. Recent revisions to the FPRs address many concerns related to salmonids. However, until these issues are resolved, unauthorized take from direct, indirect, and cumulative effects of salmonids from timber harvest and its associated activities may be occurring and likely will continue to occur. The extent and amount of any unauthorized take of salmonids is unknown. However, private timberland owners are currently collaborating with RNSP to reduce impacts, especially road related sediment impacts, which is likely to reduce the extent and amount of unauthorized take of listed salmonids.

Reasonably foreseeable effects of timber management activities also may impact designated critical habitat for SONCC coho salmon. Within the action area, direct, indirect, and cumulative effects of timber harvesting may degrade the habitat features identified as essential for coho salmon critical habitat. The extent of the effect to critical habitat is unknown given the uncertainty of protective measures in THPs.

B. Control of wildfires

Control of wildfires may include the removal of modification of vegetation due to the construction of firebreaks or setting of backfires to control the spread of fire. An undetermined amount of suitable habitat for salmonids may be removed or modified by this activity. The effects of wildfires range from increased sediment inputs to streams, further degrading habitat, to the effects of fire retardants and other chemicals associated with fire suppression that may introduce toxic substances into watercourses. Sediment and fire suppression substances have the ability to travel downstream and affect water quality, habitat and listed salmonids within the action area.

C. Recreation

Expected recreation impacts to salmonids include increased turbidity, impacts to water quality, barriers to movement, and changes to habitat structures. Streambanks, riparian vegetation, and spawning redds can be disturbed wherever human use is concentrated. Construction of summer dams to create swimming holes causes turbidity, destroys and degrades habitat, and blocks migration of juveniles between summer habitats. Fishing within the action area is expected to continue subject to the California Fish and Game Code. Fishing is the dominant recreational activity within the action area, however the level of take of salmonids within the action area from angling is unknown, but is expected to remain at current levels.

D. Water withdrawal

An unknown number of permanent and temporary water withdrawal facilities exist within the Redwood Creek basin. These include diversions for agricultural, commercial, and residential use, along with temporary diversions, such as drafting for dust abatement. NOAA Fisheries expects impacts to salmonids to include entrapment and impingement of younger salmonid life stages, localized dewatering of reaches, and depleted flows necessary for migration, spawning, rearing, flushing of sediment from the spawning gravels, gravel recruitment, and transport of large woody debris. NOAA Fisheries expects water diversions to be conducted under applicable laws, including the California Fish and Game Code, and Clean Water Act, however, unauthorized water withdrawals may exist. NOAA Fisheries is not aware of water withdrawals within the action area.

E. Chemical use

NOAA Fisheries anticipates that chemicals such as pesticides, herbicides, fertilizers, and fire retardants will continue to be used within the Redwood Creek basin and will impact the action area. Chemical application is under the jurisdiction of several Federal, state, and local agencies and their use should be conducted under applicable laws.

VII. INTEGRATION AND SYNTHESIS OF EFFECTS

When considered in aggregate, elements of the Proposed Action, as discussed above, have the potential to directly and indirectly adversely affect listed salmonids and their habitats. However, NOAA Fisheries thinks that few listed salmonid juveniles will be directly killed or injured by the elements of the proposed action. Additionally, NOAA Fisheries thinks that indirect effects caused by impacts to habitat are reduced to a point that the overall value of the action area to salmonids will not be diminished such that production of salmonids in Redwood Creek will be reduced. Therefore, NOAA Fisheries concludes that the resulting take of ESA listed anadromous salmonids and the modification of their habitats will not threaten the long-term persistence or recovery of their populations in Redwood Creek, and as such, will not diminish the likelihood of survival or recovery of their respective ESUs.

VIII. CONCLUSIONS

After reviewing the best available scientific and commercial information, current status of SONCC coho salmon, CC Chinook salmon, NC steelhead, designated critical habitat of SONCC coho salmon, the environmental baseline for the action area, the anticipated effects of the proposed action, and the cumulative effects, it is NOAA Fisheries' biological opinion that the implementation of the Redwood Creek Levee Maintenance Program, as proposed, is not likely to jeopardize the continued existence of SONCC coho salmon, CC Chinook salmon, or NC steelhead, and is not likely to destroy or adversely modify designated critical habitat of SONCC coho salmon.

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, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is defined further by NOAA Fisheries 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 refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

A. Amount or Extent of Take Anticipated

NOAA Fisheries anticipates that the Redwood Creek Levee Maintenance Program will result in take of listed salmonids. This will primarily be in the form of harm to rearing juvenile and holding and migrating adult Chinook salmon, coho salmon and steelhead by impairing essential behavior patterns as a result of reductions in the quality or quantity of their habitat. If the proposed action is implemented as described in the previous section, NOAA Fisheries anticipates that the number of harmed juvenile and adult Chinook salmon, coho salmon and steelhead will be low. In addition, NOAA Fisheries anticipates that a small number of Chinook salmon and steelhead juveniles may be killed, injured, or harassed during construction and removal of temporary stream channel crossings.

The take of listed salmonids will be difficult to detect because finding a dead or injured salmonid is unlikely as the species occurs in habitat that makes such detection difficult. The impacts of levee maintenance activities that increase flow capacity of the channel will result in changes to the quality and quantity of salmonid habitat. These changes in the quantity and quality of salmonid habitat are expected to correspond to injury to, or reductions in, survival of salmonids by interfering with essential behaviors such as spawning, rearing, feeding, migrating, and sheltering. Because the expected impacts to salmonid habitat correspond with these impaired behavior patterns, NOAA Fisheries is describing the amount or extent of take anticipated from the proposed action in terms of limitations on habitat impacts. NOAA Fisheries expects that physical habitat impacts will be: (1) consistent with the length Redwood Creek adjacent to the 10 gravel bars identified for potential gravel extraction in the permit application; (2) consistent with a maximum of eight temporary bridges per year during the five-year permit; and (3) compliant with the project design features of the modified proposed action and this Incidental Take Statement, and within the expected effects of gravel and vegetation removal as described in the accompanying Opinion. Critical project design features in the maintenance program include the interagency review team, implementing a head-of-bar buffer, implementing a two-foot vertical offset from summer low flow for the bar skimming method of gravel extraction, limiting the amount of vegetation removal from the channel bed and banks, excavation of the North and South Slough channels, and NOAA Fisheries approval of the annual maintenance plan.

B. Effect of the Take

In the accompanying Opinion, NOAA Fisheries determined that the level of anticipated take from the Redwood Creek Levee Maintenance Program is not likely to result in jeopardy to SONCC coho salmon, CC Chinook salmon or NC steelhead.

C. Reasonable and Prudent Measures

Pursuant to section 7(b)(4) of the ESA, the following reasonable and prudent measures are necessary and appropriate to minimize the impact of incidental take of SONCC coho salmon, CC Chinook salmon and NC steelhead resulting from implementation of the Redwood Creek Maintenance Program.

The Corps shall:

1. Ensure that the annual gravel and vegetation removal planning process minimizes the amount or extent of incidental take.
2. Ensure that measures that minimize adverse effects to listed species and designated critical habitat are implemented as part of the Redwood Creek Levee Maintenance Program.
3. Ensure that the monitoring necessary to track changes to salmonid habitat quality and quantity in the vicinity of gravel and vegetation removal sites is implemented.
4. Ensure that the timing of actions associated with the Redwood Creek Levee Maintenance Program are designed to minimize incidental take of listed SONCC coho salmon, CC Chinook salmon and NC steelhead.

D. Terms and Conditions

In order to be exempt from any prohibitions of sections 4(d) and 9 of the ESA, the Corps, and its applicant, the County, must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

RPM 1. Ensure that the annual gravel and vegetation removal planning process minimizes adverse effects to listed species and designated critical habitat.

1. In order for NOAA Fisheries to be able to track compliance, effectiveness and channel response of the annual maintenance program during the five-year permit period, annual monitoring cross-sections of all 10 identified bars within the project area shall be provided to NOAA Fisheries prior to the annual interagency review. If a given bar is mined, then in addition to the monitoring cross-sections, extraction cross-sections measured pre- and post-mining operations shall also be provided to NOAA Fisheries. Cross section survey specifications shall be the same as those in the Corps' most recent Letter of Permission procedure (LOP 96-1C) for gravel mining activities in Humboldt County, published on August 28, 2003. The monitoring cross sections for Redwood Creek shall be located at the cross section locations already established by the Corps in 1996 and by the County in 2002. Or, monitoring cross sections may be located according to the specifications contained in the LOP 96-1C procedure. Both electronic and hard copies of cross sections shall be provided annually to NOAA Fisheries.

2. In order for NOAA Fisheries to be able to track compliance, effectiveness and channel response of the annual maintenance program during the five-year permit term, aerial photos of the project reach shall be provided to NOAA Fisheries if a flood event equivalent to the 10-year recurrence interval occurs. If the 10-year flood event occurs, then the aerial photos shall be taken in the spring or summer when flows have receded, but prior to the interagency review process.

3. As part of the annual interagency review process, the Corps shall ensure that NOAA Fisheries receives the County's annual plan for maintenance activities, in order for NOAA Fisheries to determine the plan's consistency with the accompanying Opinion, and for NOAA Fisheries to provide approval of the annual maintenance plan. The annual maintenance plan shall include monitoring and extraction cross section information, as well as plans for sediment and vegetation removal drawn on the aerial photos, and narratively described. Plans for fish passage channel construction, if proposed, shall also be included. NOAA Fisheries shall then respond in writing to both the Corps and the County with our consistency determination and approval within seven working days from the date of receipt of the draft annual maintenance plan. Additionally, the Corps shall ensure that the County notifies the designated NOAA Fisheries staff representative and alternate representative to the interagency team, via email, when the annual plan for maintenance activities has been sent out, to ensure that NOAA Fisheries staff have the full seven working days for review of the draft annual maintenance plan.

RPM 2. Ensure that measures that minimize adverse effects to listed species and designated critical habitat are implemented as part of the Redwood Creek Levee Maintenance Program.

1. The upstream end of the bar (head of the bar) shall not be mined or otherwise altered by gravel removal activities. The minimum head of the bar buffer shall be defined as the upstream one-third portion of the bar. The intent of the head of the bar buffer is to provide protection of the steering effect to stream flow provided by an undisturbed bar.

2. The amount of time that heavy equipment is in the wetted low-flow channel shall be minimized by limiting the number of heavy equipment crossings per each temporary channel crossing installation and removal. A maximum of two equipment passes across the channel per installation or removal shall be allowed.

3. All temporary channel crossings and associated fills must be identified and approximately located in the annual pre-extraction information. If the flatcar used to construct the temporary bridge is not long enough to span the live channel, then brow logs, or concrete blocks shall be used to prevent native gravel material used for abutment construction from entering the live channel.

4. In order to reduce the direct effects to juvenile salmonids from temporary stream channel construction, all temporary channel crossings shall be constructed after June 30 each year of the five-year permit.

5. In order to minimize impacts to salmonids from alcoves and fish passage channel construction, woody debris must be provided to function as cover within the excavated alcove or fish passage channel (e.g., cut branches, trunks or root wads). The annual pre-extraction mining plan shall describe the cover that will be associated with the alcove or fish passage channel for NOAA Fisheries review and approval.

6. In order to minimize the effects of vegetation removal on habitat for juvenile salmonids, the priority for annual vegetation removal shall be removal of vegetation from the levee faces above the five-foot buffer found at the toe of the levees. The Corps (1998) has estimated that approximately 25% of the total reduction in flow capacity is from vegetation, and approximately 75% of the total reduction in flow capacity is from gravel accumulation. The overall maintenance plan shall focus on gravel removal and vegetation removal from the levee faces above the five-foot buffer, such that annual vegetation removal from the channel bed (not including vegetation removal from the levee faces above the five-foot buffer found at the toe of the levees) shall be limited to a maximum of 25% of the entire annual maintenance plan. This will result in the annual maintenance plan being "weighted" towards gravel removal and vegetation removal from the levee faces above the 5-foot buffer found at the toe of the levees, with vegetation removal from the channel bed and banks as a much smaller component of annual maintenance plans.

7. In order to reduce the cutting of deposited large woody debris within the action area and to reduce the effects to salmonids from reductions in large woody debris, all access roads owned or controlled by the County, and roads owned or controlled by the contractors used to implement the proposed action, shall be gated and locked.

8. Stream and riparian areas shall not be used as equipment staging or refueling areas. Equipment, both hand tools and heavy equipment, must be stored, serviced, and fueled away from riparian areas (i.e., equipment must not be stored, serviced or fueled within the channel bed or channel banks, nor on the levee faces themselves; equipment maintenance, re-fueling of equipment and storage of fuel shall be done within a fueling containment area with an impervious layer to provide containment of any spills). Machinery (e.g., chainsaws, bulldozers) will be inspected for leaks prior to use in riparian areas. Heavy equipment will be cleaned (e.g., power washed, steam) prior to use below the ordinary high water mark. The Corps shall ensure that the County has the materials necessary to implement spill cleanup plans, and that these materials are available to all work crews using heavy machinery, providing multiple sets of cleanup materials to each crew if sharing would prevent timely implementation of cleanup plans.

9. Contract(s) associated with the Redwood Creek Levee Maintenance Program shall contain all of the measures identified in the proposed action, and all of the measures identified in this Incidental Take Statement as necessary to avoid or minimize incidental take of SONCC coho salmon, CC Chinook salmon, and NC steelhead. If it is determined that the contractor is not in compliance with the contract, and said non-compliance could result in greater effects than previously anticipated to SONCC coho salmon, CC Chinook salmon, NC steelhead salmon or the designated critical habitat of SONCC coho salmon, the Corps will contact NOAA Fisheries to discuss the need for any additional minimization measures, and reinitiation of consultation.

RPM 3. Ensure that the monitoring necessary to track changes to salmonid habitat quality and quantity in the vicinity of gravel and vegetation removal sites is implemented.

1. Residual pool depth monitoring (i.e., the measurement of riffle crest elevations and maximum pool depths) shall be used in conjunction with the monitoring cross sections, that are required under RPM 1 (as described in Term and Condition number 1), in order to track changes in salmonid habitat quality and quantity. The protocol for residual pool depth monitoring is contained in Appendix A. Residual pool depth monitoring shall be performed a total of three times during the five-year permit period, once at the beginning, once in the middle, and once at the end of the five-year period. The monitoring shall be performed during the low flow season. Additionally, NOAA Fisheries will provide an Excel file workbook to be used as a template for reporting residual pool depth monitoring, and the monitoring cross section information required under RPM 1, as described in Term and Condition number 1.

2. All required monitoring shall be completed and reports provided to NOAA Fisheries each year prior to December 31, on an annual basis, during the five-year permit period. Monitoring information shall be submitted to:

Irma Lagomarsino
Supervisor Arcata Area Office
National Marine Fisheries Service
1655 Heindon Road
Arcata, CA 95521

RPM 4. Ensure that the timing of actions associated with the Redwood Creek Levee Maintenance Program are designed to minimize incidental take of listed SONCC coho salmon, CC Chinook salmon and NC steelhead.

1. All ground disturbing actions associated with the Redwood Creek Levee Maintenance Program, other than slough channel excavation, will occur between June 15 and October 15 annually during the five-year permit period. If periods of dry weather are predicted after October 15, additional work may be done with NOAA Fisheries' approval, if the work can be completed within the window of predicted dry weather. Prior approval, via email, must be granted by NOAA Fisheries for extensions to work beyond October 15 for gravel extraction operations or other ground disturbing activities.

2. In order to minimize the likelihood of the presence of listed salmonids during the work period, slough channel excavation work shall occur between February 14 and March 15, annually during the five-year permit period. Annual plans for slough channel excavation shall be reviewed by NOAA Fisheries to determine consistency with the accompanying Opinion, prior to implementation of the slough channel excavation work.

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 threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

NOAA Fisheries thinks the following conservation recommendations are consistent with these obligations, and therefore should be implemented by the Corps:

1. The Corps should encourage and facilitate the Redwood Creek flood control levee setback planning process, designed to alleviate to the extent practicable the adverse impacts to fish and wildlife habitat caused by the present levee configuration.

In 2001, the California Resources Agency established a California Coastal Salmon and Watersheds Program, which seeks to recover coastal salmon and steelhead populations to sustainable levels. This program identified a Redwood Creek Recovery Program as a pilot project, and identified the California Coastal Conservancy as a key partner in the Redwood Creek Recovery Program.

Towards this end, several enhancement and alternative flood control configurations have been suggested. Construction of setback levees would allow for some channel migration and the development of habitat complexity, while still providing flood protection. At meetings in 1999, 2000, and 2001, attended by representatives of RNSP, the Corps, NOAA Fisheries, the EPA, the USFWS, CDFG, the County, and the Conservancy, it was recognized by all that setback levees would help minimize the many negative environmental effects which the current levee configuration has on the estuary, lower river morphology, riparian vegetation, and fish and wildlife resources.

2. The Corps should modify the Operations and Maintenance manual specifications for the Redwood Creek flood control reach. Specifically, the Corps should allow for a reduction in design flow capacity by allowing some vegetation growth and gravel accumulation within the flood control channel, such that flow conveyance capacity of the flood control channel is reduced to 65,200 cfs, which is the estimate of the 100-year storm flow. The original design capacity of the flood control channel was 77,000 cfs, thus a reduction to 65,200 cfs is less than 20%. The Corps has indicated that they have the local authority within the San Francisco District to modify the Operations and Maintenance manual by 20% or less, and that a modification would require a National Environmental Policy Act (NEPA) analysis and decision by the Corps.

3. In order to monitor changes in channel capacity and to assist in determining hydraulic "hot spots," the high water level at approximately equal to, or greater than, the 2-year storm flow event and approximately equal to, or greater than, the 10-year storm flow event should be surveyed on the levee faces. The surveyed elevations of these high water levels should be tied to datum, and used to help determine the roughness coefficient (Mannings "n" value) used in hydraulic modeling of channel conveyance capacity.

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

XI. REINITIATION OF CONSULTATION

This concludes formal consultation on the actions and processes described in the Redwood Creek Levee Maintenance Program. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Arcata Fish and Wildlife Office
1655 Heindon Road
Arcata, CA 95521
(707) 822-7201
FAX (707) 822-8411

JUN 02 2003

In Reply Refer To:
AFWO

May 30, 2003

Mr. Calvin C. Fong
Department of the Army
Corps of Engineers
333 Market Street
San Francisco, California 94105

Dear Mr. Fong:

Subject: Informal Consultation on the 5-Year Maintenance Plan for the Redwood Creek Flood Protection Project in Humboldt County, California (AFWO file number 1-14-2003-1774)

This letter responds to your May 12, 2003, letter requesting U.S. Fish and Wildlife Service's (Service) concurrence with your determinations for the 5-year maintenance plan for the Redwood Creek flood protection project near Orick, Humboldt County, California. You have determined that the project may affect but is not likely to adversely affect the endangered California brown pelican (*Pelecanus occidentalis californicus*), tidewater goby (*Eucyclogobius newberryi*), and beach layia (*Layia carnosa*).

This consultation is based on information provided in your May 12, 2002, letter and Humboldt County's March 31, 2002 amendment to the November 2000 permit application. The March 31, 2002, amendment contains a description of the proposed action and its effects on the above species.

We concur with your determination that the proposed project may affect but is not likely to adversely affect the California brown pelican. Our concurrence with your determination is based on the following factors:

1. Levee maintenance activities may temporarily disturb loafing or foraging pelicans in the Redwood Creek estuary. However, because of the temporary nature of the disturbance and the availability of other loafing and foraging areas, this disturbance is not expected to significantly alter essential behaviors such as feeding and loafing. No known pelican breeding colonies exist along the Humboldt County coastline.

2. No suitable pelican habitat will be removed or degraded.

EXHIBIT NO. 8
APPLICATION NO.
1-04-005
USFWS Consultation
LETTER (Page 1 of 2)

We do not concur with your determination that the proposed project may affect but is not likely to adversely affect the tidewater goby. We have determined that the proposed project will have no effect on the tidewater goby. This determination is based on the following factors:

1. In 1980, gobies were captured in the north slough of Redwood Creek. Since 1996, annual goby surveys have been conducted in the Redwood Creek estuary. No gobies have been detected during these annual surveys.

2. Based on the degraded conditions of the estuary and past survey results, it is reasonable to assume that gobies are no longer present in the Redwood Creek estuary.

We do not concur with your determination that the proposed project may affect but is not likely to adversely affect the beach layia. We have determined that the proposed project will have no effect on beach layia. This determination is based on the following factors:

1. In 1999, a population of beach layia was discovered on the southern end of Freshwater Spit. Since 1999, surveys have been conducted in all potentially suitable habitat in Redwood National and State Parks. The Freshwater spit population is the northernmost known population. The proposed project site is located approximately 1 mile north of this population.

2. Based on recent survey results, no known beach layia populations occur within the project area.

This concludes informal consultation on the proposed 5-year maintenance plan for the Redwood Creek flood protection project. Unless new information reveals that the proposed actions (1) may affect listed species in a manner or to an extent not considered in your correspondence, (2) the action is modified in a manner that causes an effect on the listed species or critical habitat not considered in your correspondence, or (3) a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to the Act, is necessary. Contact staff biologist Robin Hamlin at (707) 822-7201 if you should have further questions regarding this consultation.

Sincerely,

Acting for Michael M. Long
Field Supervisor

Contains Revised Pages Per Letter of 8-5-69

SERIAL NO.

REDWOOD CREEK
LOCAL FLOOD PROTECTION PROJECT

HUMBOLDT COUNTY

OPERATION AND MAINTENANCE MANUAL

JUNE 1969

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO

CORPS OF ENGINEERS

SAN FRANCISCO, CALIFORNIA

EXHIBIT NO. 9
APPLICATION NO.
1-04-05 EXCERPT,
Redwood Creek Local Flood Protection Project Operation & Maint. Manual (Page 1 of 16)

FOREWORD

This manual has been prepared by the District Engineer, to acquaint responsible local interests with the requirements of maintaining the earthen channel, earth levees, drainage structures, riprap protection and service roads constructed for the flood control project completed on 24 October 1968 on Redwood Creek, Humboldt County, California. Timely effective maintenance in accordance with this manual is required to assure the proper functioning of the improved channel and the continuation of beneficial results from the project.

REDWOOD CREEK
HUMBOLDT COUNTY, CALIFORNIA
LOCAL FLOOD PROTECTION PROJECT

OPERATION AND MAINTENANCE MANUAL

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REDWOOD CREEK
HUMBOLDT COUNTY, CALIFORNIA
LOCAL FLOOD PROTECTION PROJECT

OPERATION AND MAINTENANCE MANUAL

INTRODUCTION

1. AUTHORIZATION

The Redwood Creek Flood Control Project, Humboldt County, California, was authorized by the Flood Control Act of 1962, Public Law 87-874, Eighty-seventh Congress, Second Session, under the provisions of Section 203, approved 23 October 1962, which act reads in part as follows:

> "Section 203. The following works of improvement for the benefits of navigation and the control of destructive flood waters and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and the supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth herein."
>
> * * * * * *

* * * * * *

REDWOOD CREEK BASIN

> "The project for flood protection on Redwood Creek, Humboldt County, California, is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers and House Document No. 497, Eighty-seventh Congress, at the estimated cost of $2,580,000."

2. LOCATION

The project is located along the lower reaches of Redwood Creek near Orick, Humboldt County, California. The creek discharges into the Pacific Ocean approximately 50 miles south of the Oregon-California border. The basin is an elongated area of approximately 280 square miles. It extends about 56 miles from the northwest to the southeast and has a maximum width of about 7 miles. The largest tributary to Redwood Creek is Prairie Creek which drains the northern part of the watershed and joins the main stream about 3.5 miles above its mouth. Prairie Creek drains an area of about 40 square miles, extending approximately 12 miles north of the junction of the two streams. The other tributaries are short steep-gradient creeks which extend to the main stream from each side throughout its length. The area protected from floods by the completed project is the lower 3.5 miles of Redwood Creek and the town of Orick.

3. DESCRIPTION OF PROJECT

The Redwood Creek flood control project consists of an improved channel with a bottom width of 250 feet and levees along both banks. A gravity drainage system has been provided to collect and divert local drainage from behind the levees into the Pacific Ocean. Stone riprap slope protection has been provided for the slopes of the channel and the channel side slopes of the levees. The project extends from the mouth of the creek upstream approximately 3.4 miles. A derrick stone control sill was constructed at the lower end of the improved channel to stabilize the ends of the levees and to prevent degradation of the channel bottom in the lower reach. The two center piers of the U.S. 101 Highway bridge were extended upstream to provide for more efficient hydraulic conditions. A system of relief wells was installed adjacent to the landward toe of the levees, in critical areas, to discharge the anticipated seepage at high stages into the interior drainage system. Debris deflectors were installed on each side just upstream of the highway bridge to prevent log jams. County roads affected by the construction of the project were relocated as necessary. Details of these features of the project as constructed are shown on the appended plans.

4. PROTECTION PROVIDED

The project, as constructed, will provide protection to the community of Orick and the adjacent agricultural and grazing areas behind the levees against all floods up to the design flood of 77,000 cubic feet per second. This design flood is about 40 percent greater than the largest flood of record, that of December 1964. Protection from local flooding behind the levees is provided by a gravity drainage system of open ditches and storm drains with inlets as required.

5. CONSTRUCTION HISTORY

The project constructed under Contract No. DA-04-203-CIVENG-66-190 dated 20 April 1966 by Eugene Luhr & Co., was initiated in 1966, completed in October 1968, and formally transferred to Humboldt County on 14 November 1968 for maintenance and operation.

REQUIREMENTS OF LOCAL COOPERATION

6. ASSURANCE OF COOPERATION

By an unnumbered resolution, dated 16 November 1965, the Board of Supervisors of Humboldt County stated that they would:

a. Provide, without cost to the United States, all lands, easements and rights-of-way necessary for construction of the project;

b. Hold and save the United States free from damages due to the construction works;

c. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

d. Make all relocations of buildings, utilities, roads and related facilities necessary for the construction and maintenance of the project;

e. Prevent any encroachment on flood channels, or ponding areas, which will result in decreasing the effectiveness of the flood control improvements.

A copy of this resolution is included as Exhibit A.

7. SEMIANNUAL REPORT

Attention is directed to paragraph 208.10(a)(6) of the Flood Control Regulations (inclosed with this manual as Exhibit B) which states that it shall be the duty of the responsible supervising official, hereinafter referred to as the Superintendent, to submit a semiannual report to the District Engineer covering inspection, maintenance and operation of the protective works. The report should be submitted within a 10-day period, prior to 1 June and 1 December of each year, and should include all dated copies of reports of inspections made during the period of report. The report should also include the nature, date of construction and date of removal of all temporary repairs and the dates of permanent repairs. In accordance with the regulations, inspections shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days during flood seasons to forestall deterioration and insure that all equipment is in proper working order and ready for instant use. Immediate steps shall be taken to remedy any adverse conditions disclosed by such inspections. The checklists shown in Exhibit C should be used in each inspection to insure that no feature of the protective system is overlooked. Items requiring maintenance should be noted thereon; if items are satisfactory, they should be so indicated by a check.

MAINTENANCE AND OPERATION

8. PURPOSE

The purpose of this manual is to assist the responsible local authorities in carrying out their obligations through provision of information and advice as to the operation and maintenance requirements of the project. The appended construction plans are included as an aid in proper maintenance and should be adhered to.

9. REGULATIONS

Section 208.10, Title 33 of the Code of Federal Regulations contains rules for the maintenance and operation of local flood protection works approved by the Secretary of the Army in accordance with authority contained in Section 3 of the Flood Control Act of 22 June 1936, as amended and supplemented. A copy of the complete regulations will be found in Exhibit B. Compliance with these regulations is one of the requirements of local cooperation. Applicable portions of the regulations are as follows:

"<u>General</u>

(1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits.

(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of the Army, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the 'Superintendent,' who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States.

(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times.

(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities.

(5) No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation of construction be permitted within the limits of the project rights-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the Department of the Army, or his authorized representatives that such improvement,

excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work.

(6) It shall be the duty of the superintendent to submit a semi-annual report to the District Engineer covering inspection, maintenance, and operation of the protective works.

(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works.

(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made.

(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods.

(10) The Department of the Army will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under this part."

10. DUTIES OF SUPERINTENDENT

In line with the provisions covered by the regulations, the general duties of the Superintendent should include the following:

a. Training of key personnel. Key personnel should be trained in order that regular maintenance work may be performed efficiently and to insure that unexpected problems related to flood control may be handled in an expeditious and orderly manner. The Superintendent should have available the names, addresses and telephone numbers of all his keymen and a reasonable number of substitutes. These keymen should in turn have similar data on all of the men that will be necessary for assistance in the discharge of their duties. The organization of keymen should include the following:

(1) An assistant to act in the place of the Superintendent in case of his absence or indisposition.

(2) Section foremen in sufficient number to lead maintenance patrol work of the entire levee during flood fights. High qualities of leadership and responsibility are necessary for these positions.

b. Streamflow stages. Permanent arrangements should be made by the Superintendent with the United States Weather Bureau at Eureka, California, to secure forecasts of weather conditions to plan adequate measures of protection.

c. Semiannual report. The semiannual reports required under the regulations should be submitted within a 10-day period prior to 1 June and 1 December of each year and should include all dated copies of reports of inspections made during the period of report. Also, the nature, date of construction, and date of removal of all temporary repairs and the dates of permanent repairs should be included in the report. Other items and suggestions relative to public cooperation are considered pertinent and desirable data for inclusion in the report, but are not required. In addition, a brief narrative statement on general functioning of the project, condition of the works and proposals for repairing damages or remedying any defects that become apparent will be helpful. A suggested form for submission of the semiannual report covering the major features of maintenance, inspection and operation is furnished as Exhibit C for the convenience of the Superintendent. The organization responsible for the maintenance and operation of the project is required to provide its own forms in accordance with the sample.

d. Checklists. The checklists shown in Exhibit C should be used in each inspection to insure that no features of the protective system are overlooked. Items requiring maintenance should be noted thereon; if items are satisfactory, they should be so indicated by a check.

e. Proposed improvements or alterations. Drawings or prints of proposed improvements or alterations to the existing Flood Control Works must be submitted for approval to the District Engineer, U.S. Army Engineer District, San Francisco, Corps of Engineers, San Francisco, California, sufficiently in advance of the proposed construction to permit adequate study and consideration of the work. The Humboldt County Public Works Department shall review all proposed plans of improvement for appropriateness and assure the improvements are located on the plans with reference to project centerline station. This review will be accomplished prior to submittal to the District Engineer. Drawings or prints, in duplicate, showing any improvements or alterations as finally constructed should be furnished to the District Engineer, U.S. Army Engineer District, San Francisco, Corps of Engineers, after completion of the work.

11. CHANNEL

a. Description. The improved channel, with a 250-foot-bottom width throughout the project, extends from the mouth of Redwood Creek at station 15+50 approximately 3.4 miles upstream, to station 192+90. The natural earth channel bottom was constructed with a slope of 0.0014 throughout the project. The channel slopes were excavated to a slope of 1 vertical on 3 horizontal. Riprap was placed on the slopes the full length of both slopes. This riprap varies in thickness from 12 inches to 24 inches and the toe was carried to a vertical depth of 7 or 10 feet below the channel bottom as shown on the appended plans. Where riprap was placed under water, the thickness of the blanket was increased by 50 percent. On the right bank, the thickness of the riprap for the upstream 10 feet was increased to 60 inches; on the left bank, the upper end of the riprap was keyed in with a 24-inch-thick layer to prevent erosion. A control sill was constructed of derrick stone at the lower end of the project to protect the downstream end of the project and to prevent degradation of the channel bottom. Details of this sill are shown on Sheet 21 of the appended plans. Maintenance of the sill to the correct line and grade is essential to the proper functioning of the project.

b. Maintenance. Inspection and maintenance of channels and floodways shall be in accordance with paragraph 208.10(a) General, (see paragraph 9 of this manual) and 208.10(g) which states:

"Channels and floodways

(1) Maintenance. Periodic inspections of improved channels and floodways shall be made by the Superintendent to be certain that:

(i) The channel or floodway is clear of debris, weeds and wild growth;

(ii) The channel or floodway is not being restricted by the depositing of waste materials, building of unauthorized structures or other encroachments;

(iii) The capacity of the channel or floodway is not being reduced by the formation of shoals;

(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of banks has occurred;

(v) Riprap sections are in good condition;

(vi) Approach and egress channels adjacent to the improved channel or floodway are sufficiently clear of obstructions and debris to permit proper functioning of the project works.

Such inspections shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days. Immediate steps will be taken to remedy any adverse conditions disclosed by such inspections. Measures will be taken by the Superintendent to promote the growth of grass on bank slopes. Maintenance of the riprapped chutes at stations 59+80 and 68+34 is particularly important in order to preserve the hydraulic characteristics of the structures and to prevent an increase of velocity in this reach of the channel. The structures should be maintained to the dimensions and elevations that are shown on the appended plans.

(2) Operation. The banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or by wave wash. Appropriate measures shall be taken to prevent the formation of jams of debris. Large objects which become lodged against the bank shall be removed. The improved channel shall be thoroughly inspected immediately following each major high water period as soon as practicable. Thereafter, all snags and other debris shall be removed and all damage to banks, riprap, deflection dikes and walls, drainage outlets or other flood control structures repaired."

12. LEVEES

a. Description. Levees were constructed along both banks upstream from station 17+00, tying into high ground near the upper end of the project. The right bank levee extends upstream to station 171+75 that on the left bank to station 192+80. The levees, with an impervious core, were constructed with a crest width of 12 feet, the creekside slopes continue the slopes of the channel and are 1 vertical on 3 horizontal; the land side slopes are 1 vertical on 2.5 horizontal. The channel riprap was continued up the creekside slopes the entire length of both levees. The riprap was continued on around the downstream ends of the levees in order to prevent erosion at these points. Relief wells were installed at the landside toe of the levees at appropriate points along both levees. The wood stave screen type was used. The locations of relief wells are shown on Sheet 22 of the appended plans. The wells will discharge into the gravity interior drainage system at high flow stages. Earthen berms of pervious fill, averaging about 3 feet high were constructed along the landside toe of both levees at various points. Since the crests of the levees will be used as service roads in maintaining the project, access roads, ramps and turnarounds were provided as necessary. Wire-rope barricades were erected to prevent unauthorized entry at various points. The location and all details of the above features are shown on the appended plans.

b. Maintenance. Inspection and maintenance of levees shall be in accordance with paragraph 208.10(a) General, (see paragraph 9 of this manual) and 208.10(b) which states:

"Levees

(1) Maintenance. The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for deposits, and repair of damage caused by erosion or other forces. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out and, further, to be certain that:

(i) No unusual settlement, sloughing or material loss of grade or levee cross section has taken place;

(ii) No caving has occurred on either the land side or the river side of the levee which might affect the stability of the levee section;

(iii) No seepage, saturated areas, or sand boils are occurring;

(iv) Drains through the levees and gates on said drains are in good working condition;

(v) No revetment work or riprap has been displaced, washed out, or removed;

(vi) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(vii) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

(viii) Encroachments are not being made on the levee rights-of-way which might endanger the structure or hinder its proper and efficient functioning during times of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high-water period, and otherwise at intervals not exceeding 90 days, and such intermediate times as may be necessary to insure the best possible care of the levee by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

(2) Operation. During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

(i) There are no indications of slides or sloughs developing;

(ii) Wave wash or scouring action is not occurring;

(iii) No low reaches of levee exist which may be overtopped;

(vi) No other conditions exist which might endanger the structure.

Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section."

Compliance with the provisions prescribed is essential for the efficient maintenance of the levee system and the successful operation of the project. Checklists suggested under Exhibit C should be used in each inspection to insure that no feature of the protective works is overlooked. Items requiring maintenance should be noted thereon; if items are found satisfactory, they should be so indicated by a check.

13. RELIEF WELLS

a. Description. Fifty-four relief wells have been installed at the left and right land side levee toes along Redwood Creek between Station 78+00 and Station 158+25. Locations and details of the relief well installations are shown on Plates 1 through 5.

b. Inspection. The relief wells shall be sounded annually to check for sanding. The inspection should include an examination of the cover plates, locks, tee outlets and other appurtenances. Any indication of piping or slumping of the ground around or near wells shall also be included in the inspection. Relief wells shall be pump tested at 5-year intervals to obtain the specific yield of the well (gallons per minute per foot of well screen per foot of well drawdown). If this yield is less than 80 percent of the installed yield as shown on Table I, then corrective treatment surging and flushing shall be made and the well pump tested again. The wells shall be checked for sanding before and after each pumping. Damages to relief wells and associated discharge systems shall be corrected as soon as practicable. Wells which sand badly shall be filled with concrete and replacement wells installed. During periods of high stream flow in Redwood Creek, the relief wells shall be checked for discharge to determine specific yield and possible sanding. Results of inspections shall be reported to the District Office, Engineering Division, ATTN: Design Branch, except that relief wells which do not function properly during periods of high stream flow shall be reported immediately to the above by telephone.

c. Maintenance. Prior to 15 October of each year the relief wells shall be sounded to determine the amount of sand that has accumulated in the bottom of the pipes. If there is more than 12 inches in the wells, they are to be flushed with a mixture of air and water until all the material has been removed from inside the pipes. In addition, any trash or debris which has accumulated in the outlets of collector pipes shall be removed. Damaged relief wells and associated discharge systems shall be corrected as soon as practicable. Wells which sand badly shall be filled with concrete and replacement wells installed.

14. DRAINAGE STRUCTURES

a. Description. The area behind the levee is protected from inundation by local runoff by a gravity drainage system composed of concrete inlets, manholes where necessary and reinforced concrete pipes discharging into ditches which in turn conduct the flow into natural channels which drain into the Pacific Ocean at a point downstream of the end of the levees.

b. Maintenance. Inspection and maintenance of drainage structures shall be in accordance with paragraph 208.10(a) General, (see paragraph 7 of this manual) and 208.10(d) which states:

"Drainage structures

(1) Maintenance. Adequate measures shall be taken to insure that inlet and outlet channels are kept open and that trash, drift, or debris is not allowed to accumulate near drainage structures. Flap gates on drainage structures shall be examined, oiled, and trial operated at least once every 90 days. Periodic inspections shall be made by the Superintendent to be certain that:

(i) Pipes, gates, operating mechanism, riprap, and headwalls are in good condition;

(ii) Inlet and outlet channels are open;

(iii) Care is being exercised to prevent the accumulation of trash and debris near the structures and that no fires are being built near bituminous coated pipes;

(iv) Erosion is not occurring adjacent to the structure which might endanger its water tightness of stability.

Immediate steps will be taken to repair damage, replace missing or broken parts, or remedy adverse conditions disclosed by such inspections.

(2) Operation. Whenever high water conditions impend, all gates will be inspected a short time before water reaches the invert of the pipe and any object which might prevent closure of the gate shall be removed. Automatic gates shall be closely observed until it has been ascertained that they are securely closed. All drainage structures in levees shall be inspected frequently during floods to ascertain whether seepage is taking place along the lines of their contact with the embankment. Immediate steps shall be taken to correct any adverse condition."

Failures caused by neglected drainage structures are of common occurrence; it is therefore of utmost importance that these structures always be kept in perfect working condition in accordance with the regulations.

15. MISCELLANEOUS FACILITIES

Inspection, maintenance and operation of miscellaneous facilities shall be in accordance with paragraph 208.10(a) General, (see paragraph 7 of this manual) and 208.10(h) which states:

"Miscellaneous facilities

(1) Maintenance. Miscellaneous structures and facilities constructed as a part of the protective works and other structures and facilities which function as a part of, or affect the efficient functioning of the protective works, shall be periodically inspected by the Superintendent and appropriate maintenance measures taken. Damaged or unserviceable parts shall be repaired or replaced without delay. The Superintendent shall take proper steps to prevent restriction of bridge openings.

(2) Operation. Miscellaneous facilities shall be operated to prevent or reduce flooding during periods of high water. Those facilities constructed as a part of the protective works shall not be used for purposes other than flood protection without approval of the District Engineer unless designed therefor."

16. FLOOD PLAIN MANAGEMENT

Flood plain zoning was not incorporated as a part of the plan as set forth in the project document. However, subsequent to the completion of project construction the subject was investigated and Humboldt County expressed an interest in flood plain zoning for these areas around the community of Orick, California and adjacent to the mouth of Redwood Creek. This interest is evidenced by Exhibit E.