NOAA FISHERIES

COASTAL MULTISPECIES PLAN

California Coastal Chinook Salmon Adults, Russian River, CA. Courtesy: Justin Smith, SCWA

VOLUME II

CALIFORNIA COASTAL CHINOOK SALMON

FINAL

2016

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INTRODUCTION TO CC CHINOOK SALMON ESU RECOVERY

The California Coastal (CC) Chinook salmon Evolutionarily Significant Unit (ESU) includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River (Humboldt County, CA.) to the Russian River (Sonoma County, CA) (70 FR 37160). The ESU was historically comprised of 38 populations which included 32 fall-run populations and 6 spring-run populations across four Diversity Strata (Spence *et al.* 2008). All six of the spring-run populations were classified as functionally independent, but are considered extinct (Williams *et al.* 2011). The delineation of the CC Chinook salmon ESU Diversity Strata was based on environmental and ecological similarities and life history differences between fall-run and spring-run Chinook. Four strata were identified by Bjorkstedt *et al*. (2005): North Coastal, North Mountain Interior, North-Central Coastal and Central Coastal. Of the 32 fall-run populations, 15 populations were considered either functionally independent or potentially independent, while the remaining populations were classified as dependent populations (Spence *et al.* 2008). We have selected 17 of the 32 fall-run populations across the four Diversity Strata to represent the recovery scenario for the CC Chinook salmon ESU (Figure 1). The biological recovery criteria for these populations are (See also ESU Recovery Goals, Objectives and Criteria):

1. 13 Independent essential populations attaining low extinction risk criteria (*i.e.*, Bear River, Big River, Garcia River, Humboldt Bay tributaries, Lower Eel River (Van Duzen and Larabee), Lower Eel River (South Fork and Lower mainstem Eel), Little River, Mad River, Mattole River, Noyo River, Redwood Creek (Humboldt Co.), Russian River, and Upper Eel River);
2. Three Supporting Independent populations attaining moderate extinction risk criteria (*i.e.*, Gualala River, Navarro River and Ten Mile River);
3. One Dependent population contributing to redundancy and occupancy (*i.e.*, Albion River).

All populations in the ESU will retain ESA protections and critical habitat designation regardless of their status or role in the recovery scenario.

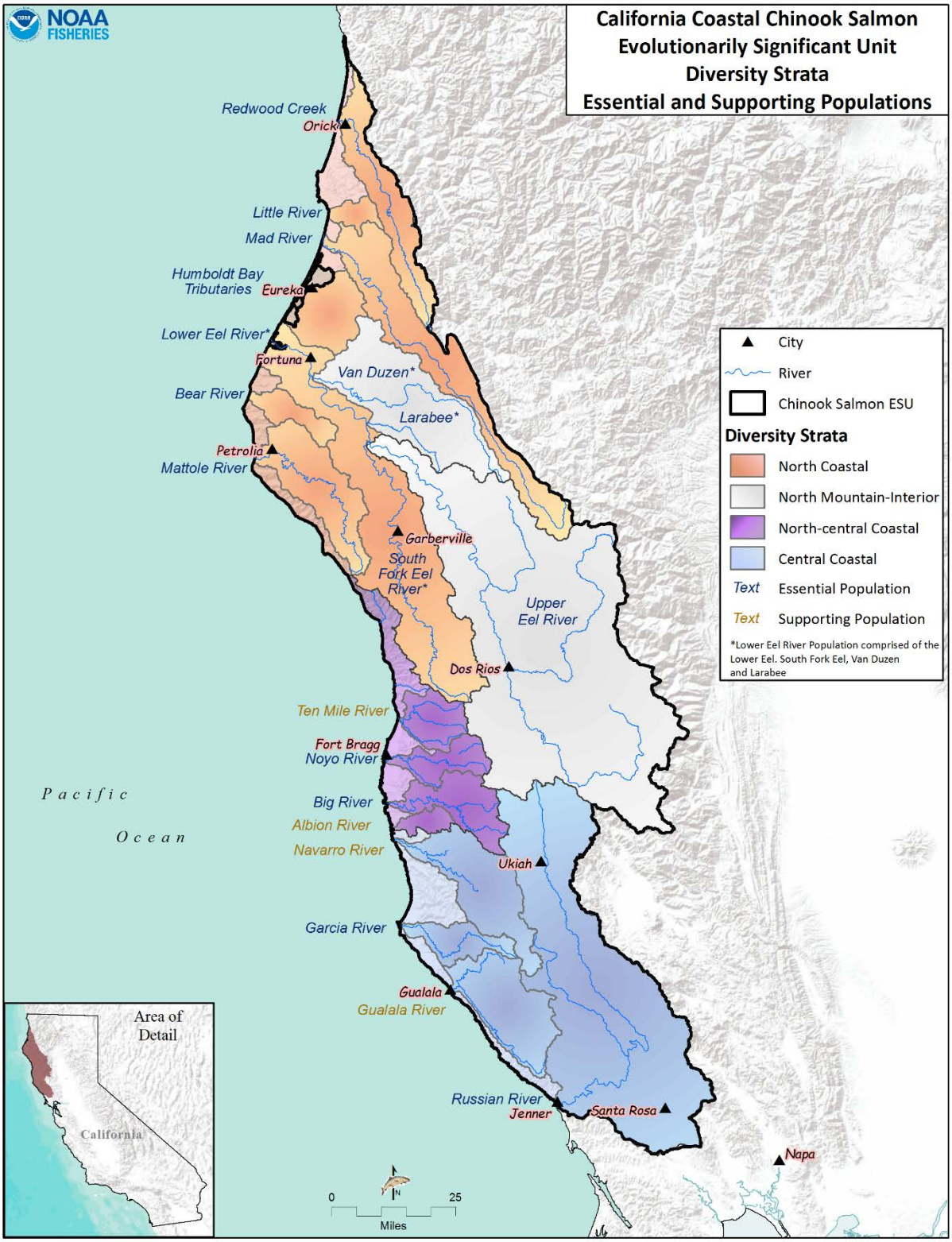

Figure 1: CC Chinook salmon ESU, Diversity Strata and Essential and Supporting Populations

CC CHINOOK SALMON ESU LISTING, STATUS REVIEWS & RECOVERY

The CC Chinook salmon ESU was originally listed as a federally threatened species in 1999 (64 FR 50394). Status reviews have been conducted in 2005, 2010, 2016 affirming the threatened status of the species. Details in this section of Volume II include the listing decision for CC Chinook salmon, a summary of the ESA section 4(a)(1) threats identified at listing, a summary of findings from the two status reviews including the status of protective/conservation efforts, prioritization of populations and CC Chinook salmon recovery criteria.

CC Chinook Salmon Listing

In September, 1994, NMFS initiated a status review of West Coast Chinook salmon populations in California, Oregon, Washington, and Idaho in response to a petition to list several populations of Chinook salmon in Washington under the ESA (Myers *et al.* 1998). Shortly thereafter, NMFS received a petition to list West Coast Chinook salmon throughout its entire range (63 FR 11482). NMFS' status review identified the Southern Oregon and California Coastal Chinook salmon ESU, which included all naturally spawned coastal spring- and fall-run Chinook salmon from Cape Blanco, Oregon, south to Point Bonita, California, and determined that this ESU was likely to become endangered in the foreseeable future (63 FR 11482). Following public input and a status review update, on September 16, 1999, NMFS published a final rule, in which NMFS indicated that it concluded that the Southern Oregon and California Coastal Chinook salmon ESU should be split into two smaller ESUs: (1) the Southern Oregon and Northern California Coastal Chinook salmon ESU, extending from Euchre Creek, Oregon, south through the Lower Klamath River, California (inclusive), which NMFS found to not warrant listing at that time; and (2) the CC Chinook salmon ESU, including all naturally spawned populations of Chinook salmon from Redwood Creek, California, south through the Russian River, California (inclusive), which NMFS listed as threatened under the ESA (64 FR 50394 ; Busby *et al.* 1999). Although several CC Chinook salmon hatchery stocks were considered part of the ESU at the time of listing, hatchery stocks were not considered to be essential for the ESU's recovery and were not included in the threatened listing in 1999 (64 FR 50394). In *Alsea Valley Alliance v. Evans*, 161 F.Supp.2d 1154 (D. Or. 2001) (Alsea Valley Alliance v. Evans 2001), the U.S. District Court in Eugene, Oregon, set

aside NMFS' 1998 ESA listing of Oregon Coast coho salmon (*O. kisutch*) because it impermissibly excluded hatchery fish within the ESU listing. The court ruled that the ESA does not allow listing a subset of a Distinct Population Segment (DPS) and that, since we had found an ESU constitutes a DPS, we had improperly excluded stocks from the listing that we had determined were part of the ESU. Following the *Alsea* decision, NMFS received numerous petitions to delist, or to redefine and list, 17 salmonid ESUs (70 FR 37160). In response, NMFS reinitiated a status review of 28 ESUs of West Coast salmon and steelhead (Good *et al.* 2005). On June 28, 2005, NMFS confirmed the listing of CC Chinook salmon as threatened under the ESA and also added seven artificially propagated populations from the following hatcheries or programs to the listing: Humboldt Fish Action Council (Freshwater Creek), Yager Creek, Redwood Creek, Hollow Tree, Van Arsdale Fish Station, Mattole Salmon Group, and Mad River Hatchery fall-run Chinook hatchery programs (70 FR 37160). However, these hatchery programs are no longer active.

CC Chinook Salmon Section 4(a)(1) Threats

Section 4(a)(1) of the ESA and the listing regulations (50 CFR part 424) set forth procedures for listing species. The Secretary of Commerce must determine through the regulatory process if a species is endangered or threatened based upon any one, or a combination of, the following ESA section 4(a)(1) factors:

(A) the present or threatened destruction, modification, or curtailment of its habitat or range;

(B) overutilization for commercial, recreational, scientific, or educational purposes;

(C) disease or predation;

(D) the inadequacy of existing regulatory mechanisms; and

(E) other natural or manmade factors affecting its continued existence.

Through the regulatory process, the Secretary of Commerce determined the CC Chinook salmon ESU was a threatened species based on their status and threats associated with the five section 4(a)(1) factors. The specific threats associated with the section 4(a)(1) factors at, and since, listing are summarized below.

Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Factor A At Listing:

Reduced habitat complexity, riparian removal, sedimentation, altered instream flows, degradation of water quality, instream wood removal and poor estuarine habitats were Factor A threats identified for CC Chinook salmon at the time of listing. At listing both natural conditions and anthropogenic activities were identified as the source of the habitat degradation. These included: agriculture, logging, ranching, recreation, mining, habitat blockages, water diversions, artificial propagation, estuarine destructions or modification, flooding, , hydropower development, instream habitat problems, lack of data, general land use activities, poaching, predation, recreational angling, urbanization, and water management.

Additionally, the distribution of the Chinook salmon in this ESU was curtailed by dam construction. The spring-run life history form, which historically used upstream habitat that was heavily impacted by construction of dams, was believed extirpated. Several dams were cited as curtailing or blocking access to spawning and rearing habitat within this ESU including Scott Dam on the Eel River. Peters Dam on Lagunitas Creek was also cited as a migration barrier even though the watershed was not included in the ESU.

Factor A Since Listing:

A more recently recognized threat, illicit agriculture (specifically, illicit marijuana cultivation, a growing new threat within the ESU), falls within the previously recognized threat category of agriculture, generally, but is distinguished by being an illegal unregulated activity that does not benefit from the resource management oversight afforded by regulated agricultural operations. Unregulated pesticides use, habitat destruction, and illegal damming and diversion of rural streams and rivers for the purpose of irrigating illegal marijuana growing operations is likely now the paramount threat to salmonid survival and habitat function in many first and second-order streams located in remote, rural areas.

The concept of expanding the range of CC Chinook salmon was raised since listing and during the 2010 status review. Tissue samples from 17 adult Chinook salmon found in Lagunitas Creek were analyzed (Garza, unpublished data in Williams *et al.* 2011). Half of the fish were found to be closely related to Central Valley Fall Chinook and the other half related to CC Chinook. Williams *et al.* (2011) suggests these fish are most likely part of the CC Chinook salmon ESU given the ecological similarities between Lagunitas Creek and other coastal basins and recommends Lagunitas Creek and other populations between the Russian River and the Golden Gate be placed in the CC Chinook salmon ESU. NMFS has not extended the ESU boundary to include these populations at this time. During the 2016 status review it was determined that there was no new information or recommendations at this time to include these coastal basins into the ESU due to the rare incidences of their presence in Lagunitas Creek (NMFS 2016; Williams *et al.* 2016). Nonetheless, this subject should be evaluated in future status reviews and recovery plan updates.

The restoration of salmon and steelhead habitats has been a primary focus of Federal, State and local entities. The State of California Fisheries Restoration Grant Program (FRGP) alone has invested over $250 million dollars and supported approximately 3,500 salmonid restoration projects[1]. These projects include fish passage, water conservation, improving instream habitats, watershed monitoring, education and organizational support to watershed groups. Many other entities have made investments to improve the range and habitat of steelhead. Please see the CC Chinook salmon 2016 ESA 5-Year Status Review for more details on the current status of Listing Factor A (NMFS 2016).

Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Factor B At Listing:

Harvest, hatchery and research were identified at listing as mortality factors for CC Chinook salmon. Harvest was identified as a potential contributor to the decline of some CC Chinook

[1] http://www.dfg.ca.gov/fish/Administration/Grants/FRGP/FundSummary.asp

populations. Harvest impacts to Chinook salmon in this ESU occurred primarily from incidental catch during the ocean fisheries of hatchery-produced Chinook salmon from outside the ESU (*i.e.* the Klamath basin and Central Valley). Limited data on the harvest of Chinook salmon in this ESU suggested that Chinook salmon from this ESU and Klamath River (*i.e.* Klamath River fall Chinook [KRFC]) shared a similar ocean distribution concentrated between central California and central Oregon. For this reason, the KRFC age-4 ocean harvest rate is used as a proxy for the ocean harvest rate on the CC Chinook salmon ESU. Concerns were expressed at listing that using these numbers was not representative and not protective of smaller weaker coastal stocks of CC Chinook salmon. Hatchery and research mortality was acknowledged at listing but there was no indication whether these were significant threats contributing to CC Chinook salmon declines.

Factor B Since Listing:

Direct mortality in Chinook salmon fisheries

All marine fishing occurring within three nautical miles off the coast of California is managed by the California Fish and Game Commission. NMFS, in coordination with the Pacific Fishery Management Council (PFMC), manages Chinook salmon fisheries in the Federal Exclusive Economic Zone (EEZ; 3 to 200 nautical miles offshore of California). State and federal fishing regulations are coordinated and harvest of Chinook salmon is permitted subject to seasonal closures, area and gear restrictions, and bag and size limits (78 FR 25865 ; CDFW 2016) .

There are still no quantitative population estimate or exploitation rate for CC Chinook salmon at this time (O'Farrell *et al.* 2015). Harvest of marked and unmarked Chinook salmon is permitted in commercial and recreational fisheries. A portion of hatchery Chinook salmon are marked (*e.g.*, Klamath River Fall-run Chinook and Central Valley Fall-run Chinook) and analyzed following capture to evaluate effectiveness of fishing regulations, however, a large portion of hatchery and wild Chinook salmon are unmarked (including CC Chinook salmon). Without analysis of tissue samples (*e.g.*, Genetic Stock Identification, otolith microchemistry, *etc.*), the origin and composition of unmarked populations are unknown. Thus, the specific level of CC Chinook

salmon caught in commercial and recreational Chinook salmon fisheries remains relatively unknown (O'Farrell *et al.* 2012; O'Farrell *et al.* 2015).

Restriction of Klamath River Fall-run Chinook (KRFC) harvest is used to control Chinook salmon fisheries to a level that allows for persistence of CC Chinook at low abundances. In addition, seasonal and area restrictions are implemented to achieve a preseason-predicted KRFC age-4 ocean harvest rate of no greater than 16 percent (81 FR 26157). The area between Humboldt South Jetty and Horse Mountain has been closed to commercial salmon fishing since the early 1990s, largely for the purpose of protecting CC Chinook populations (O'Farrell *et al.* 2012). These restrictions reduce the catch of CC Chinook salmon that share common ocean ranges with KRFC (O'Farrell *et al.* 2012).

In ocean salmon fisheries, wild CC Chinook salmon are most commonly contacted from the Oregon state border to San Francisco (Weitkamp 2010; Satterthwaite *et al.* 2014). Genetic Stock Identification of Chinook salmon from the Fort Bragg area in 2010 and 2011 indicated catch per unit effort was similar for CC Chinook salmon and KRFC in the early season and higher for CC Chinook salmon than KRFC in July and August (Satterthwaite *et al.* 2014). Although CC Chinook harvest does occur in northern California, mortality levels have likely been reduced through limits to KRFC age-4 ocean harvest rates and commercial fishing area restrictions.

NMFS and CDFW met in 2014 to discuss an abundance-based fishery management (ABM) approach and to evaluate the feasibility of collecting that level of information needed for the CC-Chinook ESU (O'Farrell *et. al* 2015). It was determined that the collection of sufficient data to enable ABM will be difficult to achieve in the CC-Chinook salmon ESU (O'Farrell *et. al* 2015). The level of data needed for ABM is greater than the level of data currently collected, and is greater than the level of data that would be generated with full implementation of the California Coastal Monitoring Plan (CMP) (O'Farrell *et. al* 2015). There are substantial technical difficulties associated with spawner surveys in the ESU and new programs would need to be developed to obtain ocean harvest data (O'Farrell *et. al* 2015). Looking toward the future, important steps

would include (1) addressing the technical challenges associated with implementation of the CMP and moving toward full implementation, (2) giving consideration to a pilot study aimed at assessing the feasibility of marking and tagging programs that would provide sufficient information for estimation of ocean harvest and enable cohort reconstruction assessments, and (3) identification of stable funding for this monitoring work (O'Farrell *et. al* 2015).

Indirect mortality from catch and release of undersized Chinook salmon

Ocean harvest of any undersized Chinook salmon is not permitted in California, however, indirect mortality may occur from the catch and release of undersized CC Chinook salmon. Estimated mortality of released Chinook salmon in ocean fisheries (*e.g.*, KRFC) ranges from approximately 12 to 42 percent depending on fish size, fishery, method, and location (Grover *et al.* 2002; PFMC 2007). Undersized Chinook salmon are routinely encountered in commercial and recreational fisheries and some degree of CC Chinook salmon mortality is inevitable. It is difficult to quantify the mortality of undersized CC Chinook salmon from catch and release methods because unmarked Chinook salmon that are caught could be either CC or KRFC Chinook salmon.

In addition to causing mortality to CC Chinook salmon, fisheries can indirectly reduce diversity of life history strategies and alter the population structure, especially in small populations. There is a minimum size limit for harvest of Chinook salmon off the California coast and older Chinook salmon can be removed from the population at a disproportionately higher rate. Over time this selective pressure can lead to a predominance of Chinook salmon spawning at a younger age, which could reduce the resiliency of a population to environmental variability. This population structure and life history effect is somewhat reduced for CC Chinook salmon because the exploitation rate is presumably lower than targeted stocks such as KRFC.

Bycatch in federal non-salmon fisheries

The PFMC manages three fisheries in Federal waters potentially affecting CC Chinook salmon and CCC and NC steelhead through fishery bycatch: Groundfish, Coastal Pelagic Species (CPS), and Highly Migratory Species (HMS). The highest level of Chinook salmon bycatch occurs in the

Groundfish fishery, however, NMFS evaluated the Groundfish Fishery Management Plan (FMP) in their 1999 Biological Opinion and determined Groundfish fishery activities and implementing regulations were not likely to jeopardize the continued existence of listed salmon and steelhead (NMFS 1999).

Chinook salmon are incidentally captured in fisheries targeting CPS but at relatively low levels (PFMC 2005). Furthermore, NMFS evaluated the CPS FMP in their 2010 Biological Opinion and determined fishery activities and implementing regulations were not likely to jeopardize any endangered or threatened species under their jurisdiction. The HMS fishery targets various species of tunas, sharks, and billfishes as well as mahi-mahi. Although all listed salmonid ESUs and DPS could occur in the area where HMS fishing occurs, there are no records indicating any instance of take of listed salmonids in any HMS fisheries (NMFS 2005).

Freshwater Fishing

The 2016-2017 California state sport fishing regulations allow retention of hatchery steelhead in streams critical for CC Chinook salmon recovery. For Chinook salmon the regulations call for a catch and release fishery in the Eel River; however, mortality or reductions to spawning success associated with catch and release are relatively unknown. Many streams where fishing is allowed do not have a hatchery and the watershed has a very low likelihood of supporting hatchery-origin steelhead. Recreational fishing on the Eel River and Russian River are particularly high and anglers are likely to intercept Chinook salmon on a regular basis. Poaching and illegal retention is likely a threat in some populations. CDFW and the California Fish and Game Commission have made an effort to lessen this threat by implementing low flow fishing closures. CDFW has closed some waters to fishing in order to protect native salmon and steelhead from low water flows in California streams and rivers that have been significantly impacted by drought. CDFW has the authority under Title 14, California Code of Regulations, Section 8.00 to close select streams to fishing during specific months (depending on the area) when it determines that stream flows are below specific minimum flows or are inadequate to provide fish passage for migrating steelhead trout and salmon (depending on the area). Although fishing is prohibited in many

areas and fines for violations are high, protection of summer steelhead populations requires special enforcement efforts (Moyle *et al.* 2008). Species identification and proper handling and release techniques, when incidental capture of CC Chinook salmon occurs, is critical to reduce likelihood of mortality and ensure CC Chinook salmon adult survival. Releasing CC Chinook salmon unharmed requires specific handling, hook removal, revival efforts and minimal air exposure time (*i.e.*, time out of the water). An outreach campaign in the Russian River has been implemented and is underway to raise angler awareness with informational press releases, fliers, and species identification signs at popular angling access points (Figure 2).

Figure 2: Signage to inform recreational fishermen of differences between salmonid species found in the Russian River.

Scientific Collecting

Since the listing of this ESU the take of fish for scientific research and other purposes has been closely controlled by CDFW and NMFS through the issuance and conditioning of collection permits via a Biological Opinion (NMFS 2012) and NMFS' approval of the CDFW Research Program under 50 CFR 223.203 (promulgated by NMFS under ESA section 4(d), this regulation includes an exception to take prohibitions for a state research program approved by NMFS). Tracking of authorized take began in 2004. Beginning in 2009, project applications were submitted online at the NMFS online application website Authorizations and Permits for Protected Species (APPS). APPS has allowed for improved annual tracking of lethal and non-lethal take requested, approved, and reported for natural and listed hatchery-origin adults, smolts and juveniles. APPS data are analyzed annually to determine level of take for the ESU. Between 2004 and 2010, the actual reported percent mortality of CC Chinook juveniles and smolts for each year was at, or less than, 1 percent. The conclusion in the Biological Opinion (NMFS 2012) is that take associated with the CDFW Research Program is not likely to jeopardize the continued existence of CC Chinook salmon.

Artificial production, supplementation, and broodstock collection activities have also been terminated since the last review, and therefore, no fish are being collected for these purposes at present.

Please see the CC Chinook salmon 2016 ESA 5-Year Status Review (NMFS 2016; Williams *et al.* 2016) for more details on the current status of Listing Factor B.

Factor C: Disease or Predation

Factor C At Listing:

Disease, freshwater predation and marine predation were threats identified for Factor C at the time of listing. Diseases associated with diminished water quantity and quality, introduced non-native fish, and hatchery programs, such as bacterial kidney disease (BKD), were considered a threat. Freshwater predation was considered a threat mostly in circumstances with introduced

non-natives, low populations, and habitat conditions concentrating Chinook salmon in small areas or where avoidance habitats such as deep pools, undercut banks, or quality estuarine areas were compromised or lost. Predators such as smallmouth bass, striped bass, channel catfish and the Sacramento pikeminnow were identified as a significant threat to Chinook salmon at the time of listing. Marine mammal predation was believed to be a minor factor for Chinook salmon decline. Nonetheless, it was acknowledged that the combination of increased predator populations and large-scale modifications to salmon habitat could favor predators and shift the predator-prey balance.

Factor C Since Listing:

Disease, freshwater predation and marine predation continue as threats for some populations. The potential of some disease outbreaks, due to introductions and straying of out-of-basin and other non-native fishes, are less likely than at the time of listing due to implementation of policies by CDFW prohibiting interbasin transfers. BKD treatment protocols at hatcheries have significantly reduced the threat of disease. Habitat conditions, such as low water flows and high temperatures, continue to exacerbate susceptibility to both disease and predation through increased physiological stress and physical injury. Salmonids appear to be a minor component of the diet of marine mammals (NMFS 1998). Predation by marine mammals coincidental with salmonid migrations may, in some cases, kill a significant fraction of a run and local depletion might occur (NMFS 1997; Quinn 2005).

Please see the CC Chinook salmon 2016 ESA 5-Year Status Review for a more details on the current status of Listing Factor C (NMFS 2016).

Factor D: Inadequacy of Existing Regulatory Mechanisms

Factor D At Listing:

At the time of listing, a variety of state and Federal regulatory mechanisms were in place to protect CC Chinook and their habitats. However, due to funding and implementation uncertainties and the voluntary nature of many programs, those regulatory mechanisms did not

provide sufficient certainty that combined Federal and non-federal efforts were successfully reducing threats to CC Chinook salmon. The following entities and their associated regulatory mechanisms were discussed under Factor D at the time of listing:

- California Department of Transportation (Caltrans)
- California Fish and Game Commission
    - Rearing programs
    - Steelhead policy
    - Water development and wetlands resources policy
- California Forest Practice Rules
- California Regional Water Quality Control Board
- California Department of Fish and Wildlife
    - Hatchery and Harvest Management
    - State Fishing Regulations
    - California Fish and Game Code Sections 1602/1603, 2786, 6900-6930
    - Keene-Nielsen Fisheries Restoration Act of 1985
    - Bosco-Keene Renewable Resources Investment Fund
    - Salmon and Steelhead Stock Management Policy
    - Steelhead Trout Catch Report-Restoration Card
    - Trout and Steelhead Conservation and Management Planning Act of 1979
    - Steelhead Restoration and Management Plan
    - Fishery Restoration Grant Program (FRGP)
    - California Coastal Salmonid Monitoring Program
- California Water Code 1243
- County Planning Efforts
- EPA/Water Quality
    - Water Quality Programs and TMDLs
    - Coastal Waters Program
    - Comprehensive Conservation and Management Plan for the San Francisco Bay-Delta Estuary

    - Wetland Protection Grants
- Five Counties MOU
- Gravel Mining Plans
- Green Diamond HCP
- NMFS
    - ESA section 7
    - Section 10 and HCPs, including Alameda Creek HCP, Green Diamond HCP, and Pacific Lumber Company (PALCO) HCP
    - Pacific Coastal Salmon Recovery Fund
    - California Coastal Salmonid Monitoring Program
- Northcoast Regional Water Quality Control Board
- Pacific Fisheries Management Council
- Pacific Coast Ocean Salmon Fishery Management Plan and Magnuson-Stevens Act
- RCDs, Watershed Organizations and Private Companies
- US Army Corp of Engineers
    - Dredge, Fill and Inwater Construction Programs
    - Section 404 of the Clean Water Act
- USDA Forest Service: Northwest Forest Plan and PACFISH

Factor D Since Listing:

Since listing, a number of factors outlined in the Federal Register listing CC Chinook salmon persist, have improved or have been identified as not relevant. The primary regulatory mechanisms that protect CC Chinook salmon are not comprehensive and are vastly different across the landscape and land use type. For example: timber operations abide by California's Forest Practice Rules while other land uses have little to no oversight or salmonid protections rely on State regulations or county ordinances when those mechanisms are triggered.

Federal and State Land Management

Timber harvest and associated road building was noted as a limiting factor during listing. Federally, the Northwest Forest Plan (NFP) has generally accomplished the goal of slowing aquatic degradation that had been accelerating under previous forest management programs (Reeves *et al.* 2006). Recent changes to the California Forest Practice Rules have improved riparian habitat protection on private timber lands, which make up the vast majority of timberland in the CC Chinook salmon ESU. Aside from updates to the California Forest Practice Rules, few changes to state land management programs have occurred since the last status review in 2011. Sonoma County adopted their Vineyard Erosion and Sediment Control Ordinance (VESCO) in 2012 that aims to reduce sediment discharge into stream resulting from vineyard and orchard development. While VESCO may minimize potential erosion from these activities (both NMFS and CDFW formally questioned various ordinance underpinnings), the ordinance nevertheless fails to analyze the impact a vineyard's future water use may have on adjacent streams. Mendocino County has no ordinance or effective regulation concerning agricultural grading.

Regulating and managing marijuana cultivation, while not specifically a land management issue, is nevertheless critically important in the effort to minimize environmental damage resulting from illegal marijuana grows. Medical Marijuana Regulation and Safety Act, which was signed into law in October 2015, has strong potential in minimizing marijuana cultivation impacts to the environment. This new law established a state-controlled regulatory and enforcement program that will control the permitting, regulation, and taxing of the medical marijuana industry.

While political efforts may dramatically change the marijuana cultivation landscape in California, the efficacy of any regulatory scheme to minimize grow-related environmental impacts would depend on specific details unknown at this time. Having environmental advocates (*i.e.*, resource agencies or environmental NGOs) included as part of any legislative deliberations on the subject is critical toward crafting strong legalization laws that adequately and effectively minimize grow-related impacts.

The North Coast Regional Water Quality Control Board (NCRWQCB) currently has implemented a waste discharge waiver for state-legal medicinal marijuana cultivation[2]. The waiver program attempts to regulate and manage waste discharge into surface water bodies in a manner similar to other agricultural industries in the state, such as vineyards and grazing, with a tiered approach that places prospective operations into one of four different levels based largely on the areal size of the operation. All growers regulated under the waiver program will be required to implement specific Best Management Practices identified by the NCRWQCB, with program compliance verified either through self-reporting (for the smaller farms) to inspection by state agency personnel for larger operations. While the marijuana cultivation waste discharge waiver shows promise toward minimizing water quality-related impacts resulting from marijuana cultivation, the realized benefit may be smaller than anticipated due to the suspected large number of illegal grows (*i.e.*, not for medicinal uses, but for black market sales) and the low likelihood that criminal operators will voluntarily register with a state agency.

Federal and State Water Management

Groundwater regulation and management should improve in the coming decades following the 2014 passage of the Groundwater Sustainability Management Act; however, surface water throughout the state is heavily over-allocated (Grantham and Viers 2014), and little change to the regulatory status quo concerning surface water rights and permitting is expected in the near future. As the state adapts to future climate variability combined with a period of accelerated population growth, the demands placed upon streams and rivers for surface water supplies will likely grow. Many large rivers and stream in the CC Chinook salmon ESU are listed by the Environmental Protection Agency and State Water Quality Control Board as impaired for temperature and sediment pollution (per Section 303(d) of the Clean Water Act[3]). Many of the waterbodies listed will have Total Maximum Daily Loads identified, and an action plan for

[2] http://www.waterboards.ca.gov/northcoast/water_issues/programs/cannabis/
[3] Information on the 303(d) list can be found at:
http://www.swrcb.ca.gov/water_issues/programs/tmdl/integrated2010.shtml

achieving that load, by 2019, which when implemented will improve salmonid habitat in affected streams.

Dredge, fill and instream construction programs

The U.S. Army Corps of Engineers, through their authority under the Clean Water Act, regulate dredge and fill within the ordinary high water mark of streams, rivers, wetlands, and other waterbodies. Anyone proposing to conduct a project that requires a federal permit or involves dredge or fill activities that may result in a discharge to U.S. surface waters and/or "Waters of the State" is required to obtain a Clean Water Act Section 401 Water Quality Certification and/or Waste Discharge Requirements (Dredge/Fill Projects) from the Regional Water Quality Control Board, verifying that the project activities will comply with state water quality standards. These Water Quality Certifications establish enforceable conditions necessary for compliance with California State water quality standards. In addition, the RWQCBs issue permits for dredge and fill activities outside of the U.S. Army Corps of Engineers' jurisdiction. These permits include the Statewide General Waste Discharge Requirements for Dredged or Fill Discharges to Waters Deemed by the U.S. Army Corps of Engineers to be Outside of Federal Jurisdiction (Order No. 2004-0004-DWQ), and in the North Coast Region the Categorical Waiver for Minor Dredging and Fill Operations, adopted through Resolution No. R1-2012-0099. CDFW performs a similar role through their Streambed Alteration Agreement program (Fish and Game Code section 1602).

Please see the CC Chinook salmon 2016 ESA 5-Year Status Review for a more details on the current status of Listing Factor D (NMFS 2016).

Factor E: Other Natural and Man-made Factors Affecting the Species' Continued Existence

Factor E At Listing:

Man-made factors of artificial propagation and introduction of non-native Chinook and the natural factors of ocean conditions, El Nino events, terrestrial conditions, floods, droughts and fire were identified at the time of listing as contributing to the threatened status of CC Chinook

salmon. The threats associated with the man-made factor of propagation included competition, genetic introgression, disease transmission, non-native introductions and the taking of wild fish for broodstock purposes negatively impacting already small populations.

In conjunction with the status review for the CC Chinook salmon ESU (Good *et al.* 2005), NMFS reviewed available information on hatchery stocks and programs within the range of the ESU. This review and analysis concluded that seven artificially propagated hatchery stocks (Freshwater Creek, Yager Creek/Van Duzen, Redwood Creek, Hollow Tree Creek, Van Arsdale Fish Station, Mattole River, and Mad River) were closely related to naturally spawning populations in the ESU (SSHAG 2003) based on genetic information, the source of the broodstock, and the hatchery management practices. Based on this review and evaluation, these seven hatchery stocks were ultimately included in the listed ESU in 2005 (70 FR 37160).

Marine conditions were identified as the dominant natural factor influencing Chinook salmon population abundance, distribution, migration and survival. Near-shore conditions during the spring and summer months were believed to dramatically affect year-class strength. Freshwater systems were characterized as having lost the natural processes and functions that provide resiliency to systems and the species to withstand natural variations. Furthermore, poor conditions combined with droughts and floods were thought as events causing straying and exacerbating predation, stress and disease. At listing it was hypothesized that changes in upland habitats altering flow and delivery of surface water to streams often caused earlier and higher peak flows, decreased spawning success for Chinook salmon adults and increased the mortality of emerging juveniles. Fire was identified as a threat due to the alteration of habitats.

Factor E Since Listing:

All seven artificial propagation programs that were included in the listed ESU have been terminated. The natural factors of ocean conditions, El Nino events, terrestrial conditions, floods, droughts and fire remain as threats contributing to the threatened status of CC Chinook salmon. Many populations of CC Chinook salmon have declined in abundance to levels that are well

below low-risk extinction risk abundance targets, and several are, if not extirpated, likely below the high-risk depensation thresholds specified by Spence *et al.* (2008). These populations are at risk from natural stochastic processes, in addition to deterministic threats, that may make recovery of Chinook more difficult. As natural populations get smaller, stochastic processes may cause alterations in genetics, breeding structure, and population dynamics that may interfere with the success of recovery efforts and need to be considered when evaluating how populations respond to recovery actions.

Please see the CC Chinook salmon 2016 ESA 5-Year Status Review for a more details on the current status of Listing Factor E (NMFS 2016).

Protective/Conservation Efforts for CC Chinook Salmon

Protective and conservation efforts have been underway for CC Chinook salmon and these efforts have reduced some of the threats and poor conditions for the species. However, these efforts need to increase in spatially and in intensity to have a measurable positive effect on the species. Please see the CC Chinook salmon 2011 and 2016 ESA 5-Year Status Reviews for a more details on protective efforts (NMFS 2011, NMFS 2016).

ESU RECOVERY GOALS, OBJECTIVES AND CRITERIA

Recovery goals, objectives and criteria provide a means by which the public can measure progress in the efforts at recovery and are used to link listing with status reviews and reclassification determinations. We developed eight categories of recovery criteria for the CC Chinook salmon ESU: biological viability, criteria for each of the five listing factors, degree recovery actions have been implemented, and certainty conservation efforts are ameliorating threats.

The goal for this plan is to remove the CC Chinook salmon ESU from the Federal List of Endangered and Threatened Wildlife (50 CFR 17.11; 50 CFR 223.102) due to their recovery. Our vision is to have restored freshwater and estuarine habitats that are supporting self-sustaining,

well-distributed and naturally spawning salmonid populations that provide ecological, cultural, social and economic benefits to the people of California.

Recovery plan objectives are to:

1. Reduce the present or threatened destruction, modification, or curtailment of habitat or range;
2. Ameliorate utilization for commercial, recreational, scientific, or educational purposes;
3. Abate disease and predation;
4. Establish the adequacy of existing regulatory mechanisms for protecting CC Chinook salmon now and into the future (*i.e.*, post-delisting);
5. Address other natural or manmade factors affecting the continued existence of CC Chinook salmon; and
6. Ensure the status of CC Chinook salmon is at a low risk of extinction based on abundance, growth rate, spatial structure and diversity.

Biological Recovery Criteria

Populations selected for recovery scenarios must achieve the following criteria based on their role in recovery. Populations selected for recovery scenarios in all the diversity strata of the DPS or ESU must meet these criteria in order for the DPS or ESU to meet biological recovery criteria. See Volume 1, Chapter 4 and 5 for more information.

Low Extinction Risk Criteria: For the essential independent populations selected to be viable, the low extinction risk criteria for effective population size, population decline, catastrophic decline, hatchery influence and density-based spawner abundances must be met according to Spence *et al*. (2008) (Table 1) (See Vol. I Chapter 3)

AND

Moderate Extinction Risk Criteria: Spawner density abundance targets have been achieved for Supporting Independent populations

AND

Redundancy and Occupancy Criteria: Spawner density and abundance targets for dependent populations, which are the occupancy goals for each of those populations, have been achieved (See the discussion of Spence *et al*. (2008) in Vol. I, Chapter 3)

The selected populations and associated recovery criteria for the CC Chinook salmon ESU (Also see Table 2. Selected populations in all four Diversity Strata achieving biological recovery criteria;

a. **CC-BR1** 13 Independent Essential populations attaining low extinction risk criteria (*i.e.*, Bear River, Big River, Garcia River, Humboldt Bay tributaries, Lower Eel River (Van Duzen and Larabee), Lower Eel River (South Fork and Lower Eel), Little River, Mad River, Mattole River, Noyo River, Redwood Creek (Humboldt Co.), Russian River, and Upper Eel River);
b. **CC-BR2:** Three Supporting Independent populations attaining moderate extinction risk criteria (*i.e.*, Gualala River, Navarro River and Ten Mile River);
c. **CC-BR3**: One Supporting Dependent population contributing to redundancy and occupancy (*i.e.,* Albion River).

Table 1: Criteria for assessing the level of risk of extinction for CC Chinook salmon populations. Overall risk is determined by the highest risk score for any category. N_a is total abundance of adult spawners in a year. N_e is effective population size per generation. N_g is total number of spawners for the generation.

Population Characteristic	**Extinction Risk**		
	High	**Moderate**	**Low**
Extinction risk from population viability analysis (PVA)	≥ 20% within 20 yrs	≥ 5% within 100 yrs but < 20% within 20 yrs	< 5% within 100 yrs
	- or any ONE of the following -	- or any ONE of the following -	- or ALL of the following -
Effective population size per generation *-or-* Total population size per generation	$N_e \leq 50$ *-or-* $N_g \leq 250$	$50 < N_e < 500$ *-or-* $250 < N_g < 2500$	$N_e \geq 500$ *-or-* $N_g \geq 2500$
Population decline	Precipitous decline[a]	Chronic decline or depression[b]	No decline apparent or probable
Catastrophic decline	Order of magnitude decline within one generation	Smaller but significant decline[c]	Not apparent
Spawner density	$N_a/IPkm$[d] ≤ 1	$1 < N_a/IPkm <$ MRD[e]	$N_a/IPkm \geq$ MRD[e]
Hatchery influence[f]	Evidence of adverse genetic, demographic, or ecological effects of hatcheries on wild population		No evidence of adverse genetic, demographic, or ecological effects of hatchery fish on wild population

[a] Population has declined within the last two generations or is projected to decline within the next two generations (if current trends continue) to annual run size $N_a \leq 500$ spawners (historically small but stable populations not included) *or* $N_a > 500$ but declining at a rate of ≥10% per year over the last two-to-four generations.
[b] Annual run size N_a has declined to ≤ 500 spawners, but is now stable *or* run size $N_a > 500$ but continued downward trend is evident.
[c] Annual run size decline in one generation < 90% but biologically significant (e.g., loss of year class).
[d] *IPkm* = the estimated aggregate intrinsic habitat potential for a population inhabiting a particular watershed (i.e., total accessible km weighted by reach-level estimates of intrinsic potential; see Bjorkstedt et al. [2005] for greater elaboration).
[e] MRD = minimum required spawner density and is dependent on species and the amount of potential habitat available. Figure 5 summarizes the relationship between spawner density and risk for each species.
[f] Risk from hatchery interactions depends on multiple factors related to the level of hatchery influence, the origin of hatchery fish, and the specific hatchery practices employed.

Table 2: CC Chinook Salmon ESU Diversity Strata, Populations, Historical Status, Population's Role in Recovery, Current IP-km, and Spawner Density and Abundance Targets for Delisting. The Diversity Stratum recovery targets are only comprised of the essential populations because these are the populations that are expected to be viable. *The Lower Eel River Chinook population is divided between two diversity strata, and as a result has one recovery target for the North Mountain Interior DS (Van Duzen and Larabee) and one for the North Coastal DS (Lower and South Fork Eel River).

Diversity Strata	CC Chinook salmon Populations	Historical Population Status	Population's Role In Recovery	Current Weighted IP-km	Spawner Density	Spawner Abundance
North Coastal	Bear River	I	Essential	39.4	37.8	1,500
	Humboldt Bay Tributaries	I	Essential	76.6	33.7	2,600
	Little River (Humboldt County)	I	Essential	17.4	40.0	700
	Lower Eel River ~ *Lower Mainstem/ South Fork Eel River**	I	Essential	368.4	20	7,400
	Mad River	I	Essential	94.4	31.7	3,000
	Mattole River	I	Essential	177.5	22.5	4,000
	Redwood Creek (Humboldt Co)	I	Essential	116.1	29.3	3,400
	North Coastal Diversity Stratum Recovery Target					**22,600**
North Mountain Interior	Lower Eel River ~ *Larabee Creek/ Van Duzen River**	I	Essential	144.0	20.0	2,900
	Upper Eel River	I	Essential	528.5	20.0	10,600
	North Mountain Interior Diversity Stratum Recovery Target					**13,500**
North-Central Coastal	Albion River	D	Supporting	17.6	6-12	104-209
	Big River	I	Essential	104.3	30.6	3,200
	Noyo River	I	Essential	62.2	35.3	2,200
	Ten Mile River	I	Supporting	67.2	6-12	401-804

	North-Central Coastal Diversity Stratum Recovery Target					**5,400**
Central Coastal	Garcia River	I	Essential	56.2	36.0	2,000
	Gualala River	I	Supporting	175.6	6-12	1,052-2,105
	Navarro River	I	Supporting	131.5	6-12	787-1,576
	Russian River	I	Essential	465.2	20.0	9,300
	Central Coastal Diversity Stratum Recovery Target					**11,300**
	CC Chinook ESU Recovery Target					**52,800**

ESA § 4(a)(1) Factors Recovery Criteria

The following are the recovery criteria for the section ESA 4(a)(1) listing factors. The primary metrics for assessing whether each of the listing factor criteria have been achieved will be to utilize the CAP analyses to reassess habitat attribute and threat conditions in the future, and track the implementation of identified recovery actions unless otherwise found unnecessary.

All recovery actions were assigned to a specific section 4(a)(1) listing factor in order to track progress of implementation of actions for each factor. Recovery Action Priorities are assigned to each action step in the implementation table in accordance with NMFS' Interim Recovery Planning Guidance (NMFS 2010) and the NMFS Endangered and Threatened Species Listing and Recovery Priority Guidelines (55 FR 24296) (See Chapter 4 for more information).

Factor A: Present or threatened destruction, modification or curtailment of habitat or range

A1 CAP/Rapid Assessment attribute ratings for:

a. **Essential Populations** found Good or better for all attributes in each Stratum.
b. **Supporting Populations** found Good or better for 50 percent[4] and the remaining rated Fair throughout the DPS/ESU.

[4] The role of supporting populations within the recovery scenario is to provide for redundancy and occupancy across Diversity Stratum. Because of their role, we use lower criteria for Factor A (*i.e.*, 50 percent as Good or better and the remaining as Fair). A "Fair" CAP/rapid assessment rating means that habitat conditions, while impaired to some degree, are functioning. Therefore, at least all habitat conditions are

A2 All recovery actions have been implemented under Listing Factor A, or the actions are deemed no longer necessary for recovery.

Listing Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

B1 CAP/Rapid Assessment threat ratings for Fishing and Collecting:

a. Essential and Supporting Populations found Medium or Low.

B2 All recovery actions have been implemented under Listing Factor B, or the actions are deemed no longer necessary for recovery.

Listing Factor C: Disease, Predation and Competition

C1 CAP/Rapid Assessment threat ratings for Disease, Predation and Competition:

a. Essential and Supporting Populations found Medium or Low.

C2 All recovery actions have been implemented under Listing Factor C, or the actions are deemed no longer necessary for recovery.

Listing Factor D: The Inadequacy of Existing Regulatory Mechanisms

D1 CAP/Rapid Assessment threat ratings related to Listing Factor D (see list below):

a. Essential and Supporting Populations found Medium or Low.

Listing Factor D Threats

- Agriculture
- Channel Modification
- Fire, Fuel Management and Fire Suppression
- Livestock Farming and Ranching
- Logging and Wood Harvesting
- Mining
- Residential and Commercial Development

expected to function within these populations, and at least half are expected to be in proper condition (*i.e.*, Good), which NMFS expects will be sufficient for these populations to fulfill their role within the recovery scenario.

- Roads and Railroads
- Water Diversions and Impoundments

D2 All recovery actions have been implemented under Listing Factor D, or the actions are deemed no longer necessary for recovery.

Listing Factor E: Other Natural and Manmade Factors Affecting the Species' Continued Decline

E1 CAP/Rapid Assessment threat ratings for Hatcheries and Aquaculture, Recreational Areas and Activities, and Severe Weather Patterns:

a. Essential and Supporting Populations found Medium or Low.

E2 All recovery actions have been implemented under Listing Factor E, or the actions are deemed no longer necessary for recovery.

Conservation Efforts

CE1 Formalized conservation efforts applicable to the ESU or DPS have been implemented and are effective in ameliorating any remaining threats associated with the five section 4(a)(1) factors.

PRIORITIZATION POPULATIONS FOR RESTORATION AND FOCUS

While immediately working to restore and recover all populations simultaneously would be preferable, the cost to implement such an effort is prohibitive. Instead, initially focusing efforts in fewer watersheds provides the best chance for species recovery. Decisions to focus efforts and funding to specific areas do not imply other areas are less important or not needed for recovery. Rather, decisions to prioritize populations are necessary to ensure efforts are optimizing benefits to fisheries and ecosystem processes across each of the ESU/DPSs. This prioritization protocol was used to identify essential populations, based on a consistent protocol, that are closest to achieving recovery and that are important to the recovery of the overall Diversity Strata.

NOAA Fisheries evaluated all the essential (i.e. must meet low viability criteria) CCC and NC steelhead and CC Chinook salmon populations within the recovery plans using a prioritization framework based on Bradbury et al. (1995). Oregon State Senate President, Bill Bradbury, asked

the Pacific Rivers Council for help in assembling a diverse group to create a prioritization process for effective and scientifically-sound watershed protection and restoration. The framework developed provides a common basis from which diverse groups can develop mutually agreed-upon restoration priorities reflecting a strong scientific basis (Bradbury et al. 1995).

The prioritization framework uses three criteria groupings for ranking populations:

1. biological and ecological resources (Biological Importance);
2. watershed integrity and risk (Integrity and Risk); and
3. potential for restoration (Optimism and Potential).

The following tables are the prioritization results for each species. Please see Appendix H for a more detailed discussion of methods and for the scores and supporting information for each population.

Table 3: CC Chinook Restoration and Focus Prioritization Results

Diversity Strata	California Coastal Chinook Salmon Populations	Biological & Ecological			Integrity & Risk			Optimism & Potential			Total	Priority #
		CAP Biological Viability (Weighted)	Number of Listed Species	High IP-km	CAP Watershed Characterization	CAP Threats	Public Lands	CCC Coho Focus Population	SONCC Core 1 Population	Monitoring (LCM) Priority		
North Coastal	Redwood Creek	4	3	3	3	1	3	0	1	1	19	A
	Little River	2	3	1	1	1	1	0	0	0	9	B
	Mad River	6	3	2	2	1	3	0	0	0	17	A
	Humboldt Bay Tributaries	4	3	2	1	1	2	0	1	1	15	B
	South Fork/ Lower Mainstem Eel River	4	3	3	2	1	2	0	1	1	17	A
	Bear River	6	3	1	1	1	1	0	0	0	13	B
	Mattole River	6	3	3	3	3	3	0	0	0	21	A
North Mountain Interior	Van Duzen River	4	3	2	1	1	2	0	1	1	15	B
	Larabee Creek	4	3	1	1	3	1	0	1	0	14	B
	Upper Eel River	2	3	3	3	3	3	0	0	0	17	A
North-Central Coastal	Ten Mile River											C
	Noyo River	2	3	1	1	3	2	1	0	1	14	B
	Big River	2	3	2	3	3	3	1	0	0	17	A
	Albion River											C
Central Coastal	Navarro River											C
	Garcia River	2	3	1	3	1	1	1	0	1	13	B
	Gualala River											C
	Russian River	2	3	3	2	1	1	1	0	1	14	A

ESU AND DIVERSITY STRATA RESULTS

All CAP viability and threat tables were assembled for the CC Chinook salmon ESU to evaluate patterns in the ESU across Diversity Strata and populations. Attribute and threat results are discussed first for Diversity Strata followed by results across lifestages for the ESU. A subset of CAP indicators and threat results were evaluated under a climate change scenario which is provided in Appendix B.

DIVERSITY STRATA ATTRIBUTE AND THREAT RESULTS

The delineation of the CC Chinook salmon ESU Diversity Strata was based on environmental and ecological similarities and life history differences between fall run and spring run adult populations. Four strata were identified by Bjorkstedt *et al*. (2005): North Coastal, North Mountain Interior, North-Central Coastal and Central Coastal.

Attribute Results

Across strata, the North Mountain Interior stratum had the highest percentage of viability attribute ratings reported as Poor or Fair (74%), followed by the Central Coastal (67%) and North-Central Coastal (62%), and North Coastal (61%). Although the North Coastal Stratum shared the lowest combined ratings reported as Poor or Fair, it received the highest percentage of Poor ratings (31%) overall (Figure 3).

Threat Results

The North Coastal and Central Coastal Diversity Stratum had the highest combined threat ratings of Very High and High (30%) followed by the North Mountain Interior (18%) (Figure 4). All threats in the North-Central Coastal strata were rated as either Medium (33%) or Low (37%), with an additional 30% that were deemed not applicable.

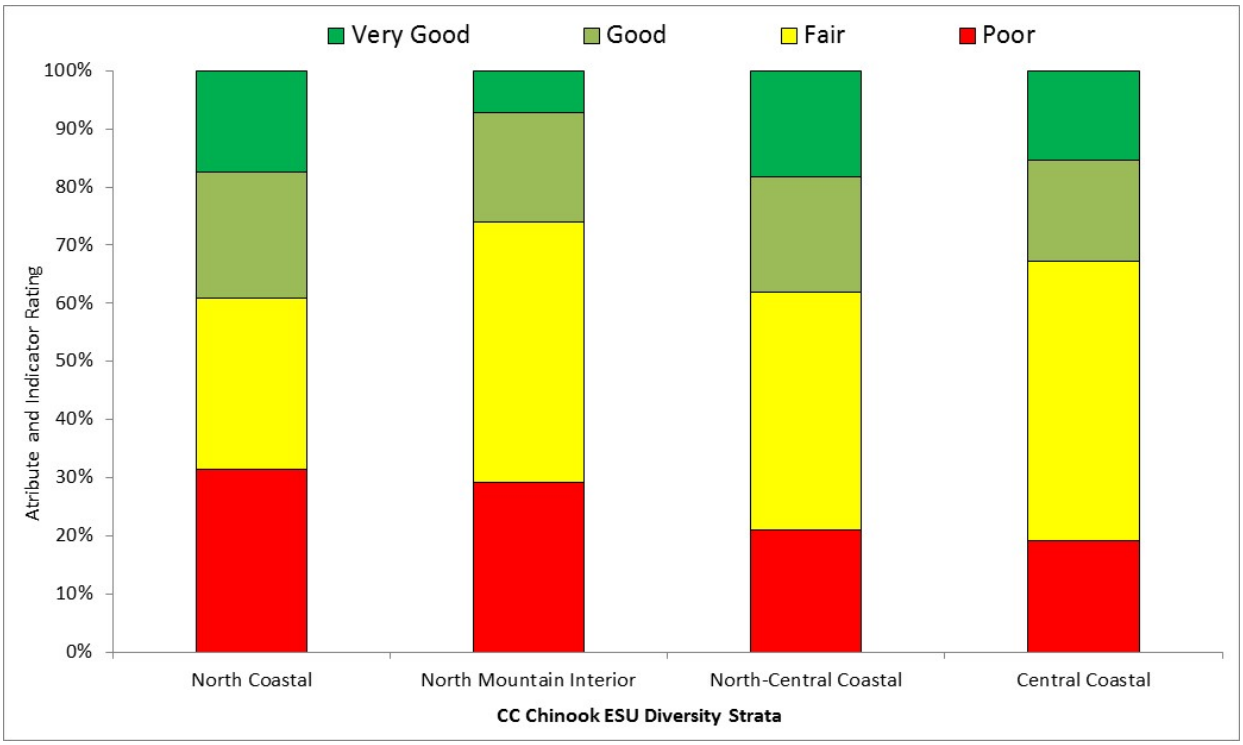

Figure 3: Attribute Indicator ratings for the CC Chinook salmon ESU by Diversity Strata.

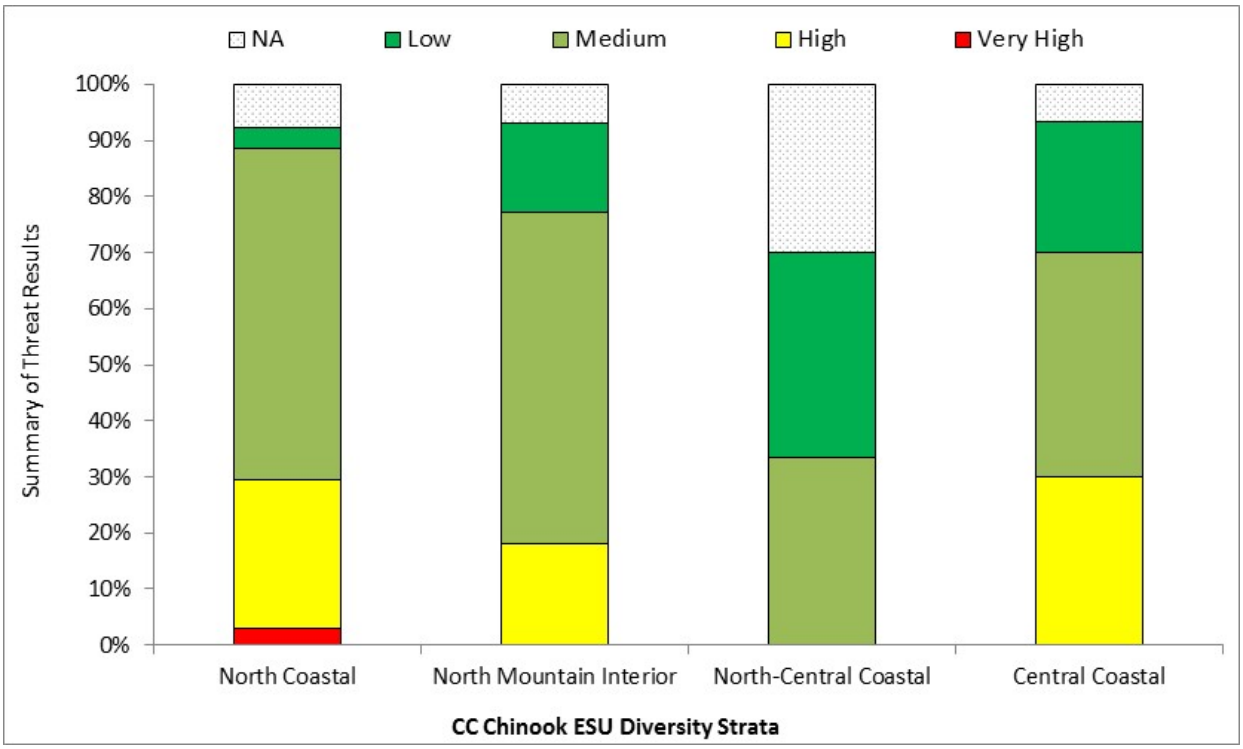

Figure 4: CC Chinook salmon Diversity Strata Threat ratings.

North Coastal Diversity Stratum Results

The North Coastal Diversity Stratum CAP populations include: Redwood Creek (Humboldt County), Little River (Humboldt County), Mad River, Humboldt Bay, South Fork Eel River, Bear River, and the Mattole River. These populations are influenced by coastal climate conditions of northern California.

Attribute Results

Across the stratum, attribute indicators of greatest concern were habitat complexity (LWD, percent staging pools, pool/riffle/flatwater ratio, and shelter), sediment transport (road density and stream side road density), estuary/lagoon (quality and extent) and water quality (turbidity) (Table 4). Attribute indicators of low concern included landscape patterns (agriculture, urbanization), passage/migration (passage at mouth or confluence, physical barriers), and water quality (toxicity).

Life Stage Results

All lifestages are impaired in the North Coastal Diversity Stratum with approximately 45% or more of attribute ratings reported as Poor or Fair for each lifestage (Figure 5). The adult lifestage is the most impaired followed closely by pre smolt with 69% and 63% indicators rated as Poor or Fair, respectively. Watershed Processes are also impaired with nearly 50% of indicators reported as Poor or Fair, of which 35% were rated Poor. Attribute indicators of greatest concern for the adult lifestage included habitat complexity (large woody debris, percent staging pools, pool/riffle/flatwater ratio), riparian vegetation (tree diameter), and water quality (turbidity) (Table 5). Eggs were most impacted by sediment (gravel quantity and quality). Estuary/lagoon, habitat complexity (shelter), velocity refuge (floodplain connectivity), and water quality (turbidity) were the indicators of most concern for the pre smolt and smolt lifestages. Streamside road density was rated Poor for all populations in the stratum and road density was rated Poor for all but one population in the stratum (Mattole River).

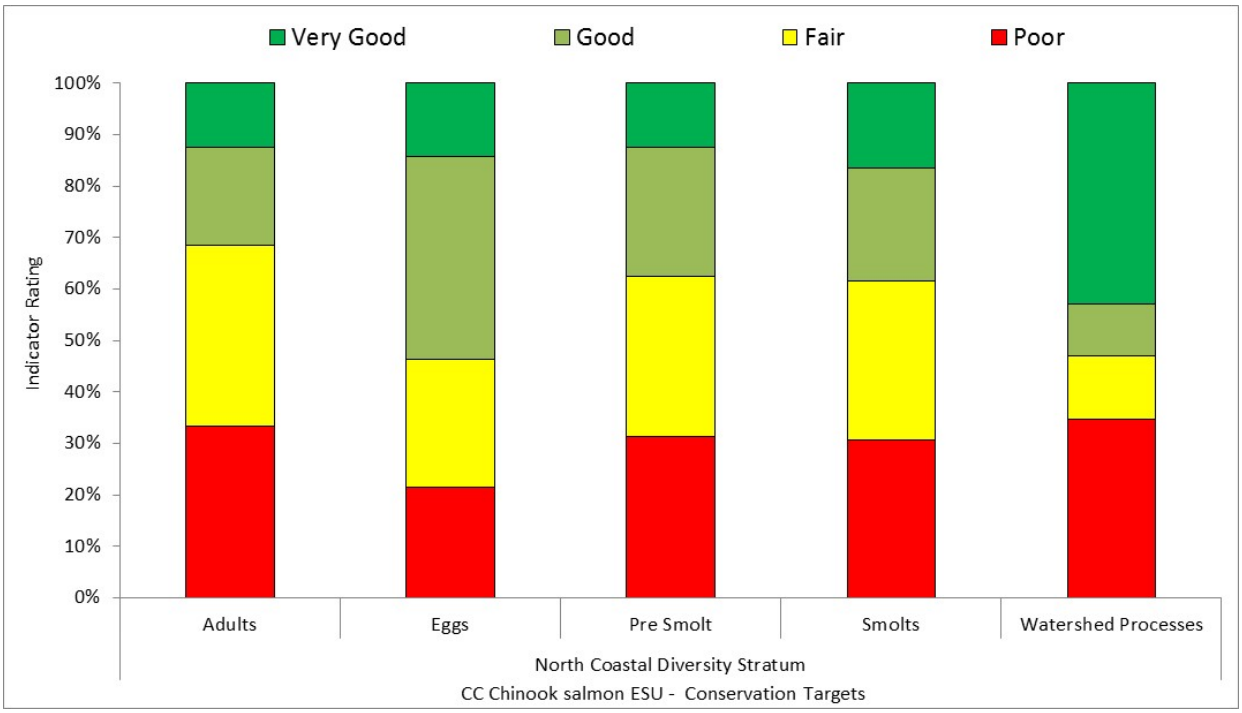

Figure 5: Attribute Indicator Ratings for the North Coastal Diversity Stratum Conservation Targets.

Threat Results

Threats of greatest concern for the North Coastal Diversity Stratum were channel modification, logging and wood harvesting, roads and railroads, and severe weather patterns (Figure 6). Threats of minimal concern included fishing and collecting, hatcheries and aquaculture, recreational areas and activities, and residential and commercial development. Across threats 4% were rated as Low, 63% were rated as Medium, 23% were rated as High, 1% were rated as Very High and an additional 8% (mostly hatcheries and aquaculture) were deemed not applicable within the stratum (Figure 6).

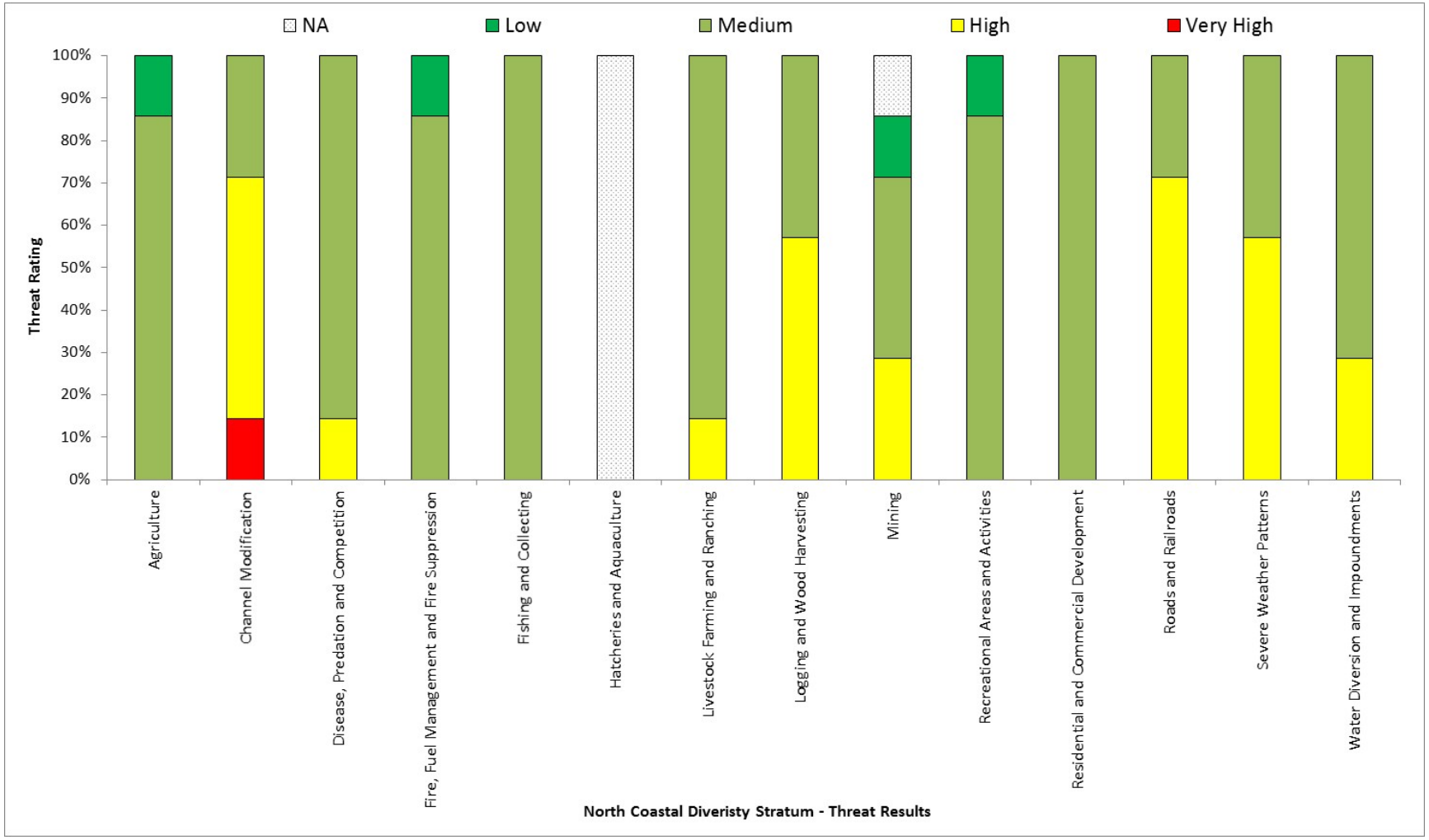

Figure 6: Threat ratings for the North Coastal Diversity Stratum.

North Mountain Interior Diversity Stratum Results

The North Mountain Interior Diversity Stratum CAP populations are the Van Duzen River, Larabee Creek, and Upper Mainstem Eel River populations. These populations are influenced by likely snowmelt events in the Eel River Watershed.

Attribute Results

Of the four Diversity Strata, the North Mountain Interior had the highest percentage (74%) of Poor or Fair indicator ratings (Figure 3). Although the Eel River estuary is not located within the stratum boundaries, all Chinook salmon populations within the Eel River watershed will rely upon the estuary during portions of their life cycle. Estuary/lagoon was rated Poor for all life stages and populations in the North Mountain Interior Diversity Stratum. Across the stratum, other attribute indicators of great concern included habitat complexity (large woody debris, percent primary pools, percent staging pools, pool/riffle/flatwater ratio, shelter), riparian vegetation (tree diameter), sediment (gravel quality), and sediment transport (road density, streamside road density) (Table 4). Attribute indicators of low, or of less concern were hydrology (impervious surfaces), landscape patterns (agriculture, urbanization), passage/migration (physical barriers), and riparian vegetation (species composition).

Life Stage Results

All lifestages in the North Mountain Interior Diversity Stratum are impaired with more than 74% of indicator ratings for each lifestage reported as Poor or Fair (Figure 7). Pre smolt was the most impaired lifestage with 81% of indicator ratings reported as Poor or Fair. For adults, attributes of greatest concern were estuary/lagoon, habitat complexity, riparian vegetation (tree diameter), and water quality (turbidity) (Table 5). Gravel quality and, to a lesser degree, quantity were the indicators of most concern for the egg lifestage. Attribute indicators impacting the pre smolt lifestage were estuary/lagoon, habitat complexity (percent primary pools, shelter rating), flow conditions (baseflow), riparian vegetation (tree diameter), sediment (gravel embeddedness), and turbidity. Many of the same indicators identified as a concern for pre smolts were also identified

for the smolt lifestage (Table 5). Smolts were also rated Poor for smoltification water temperatures. Like the North Coastal stratum, road density and streamside road density are the primary contributors to the degraded conditions in these populations. Timber harvest was also rated Poor in two of the three populations within the stratum.

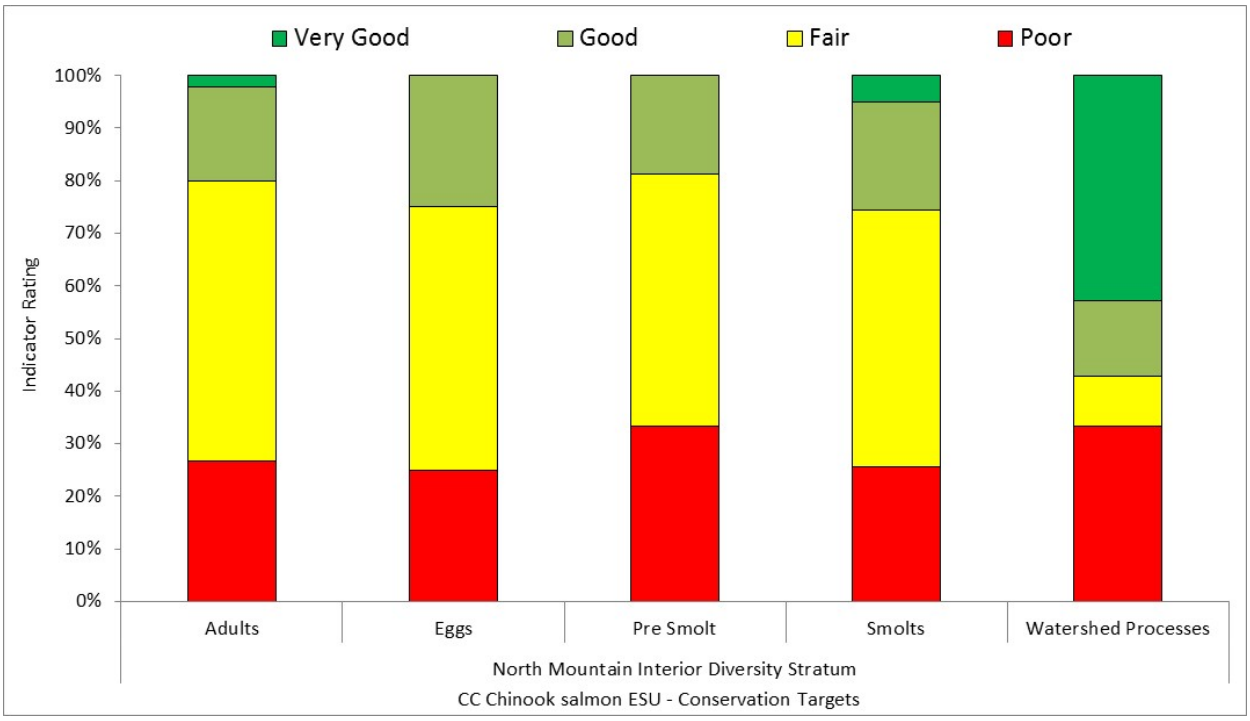

Figure 7: Attribute Indicator Ratings for the North Mountain Interior Diversity Stratum Conservation Targets.

Threat Results

Despite Poor viability ratings throughout the stratum, most threat ratings (79%) were either Low or Medium and there were no Very High ratings (Figure 8). Disease, predation, and competition (*e.g.*, introduced Sacramento pikeminnow in the Eel River) was the most significant threat followed by roads and railroads, water diversions and impoundments, and channel modification. Across all threats, 17% were rated as Low, 62% were rated as Medium, 14% were rated as High, 0% were rated as Very High, and an additional 7% (all hatcheries and aquaculture) were deemed not applicable within the stratum (Figure 8).

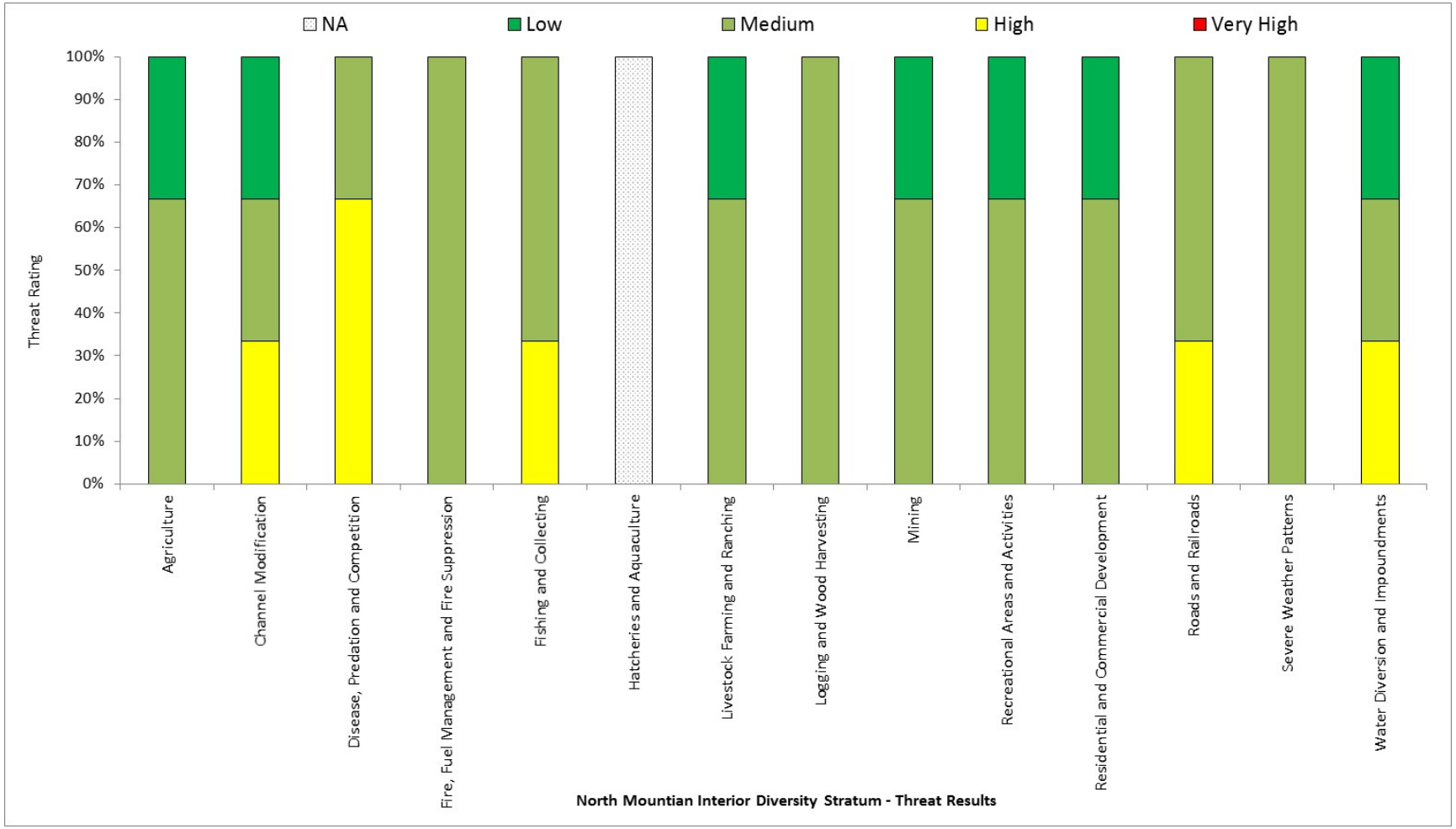

Figure 8: Threat ratings for the North Mountain Interior Diversity Stratum.

North-Central Coastal Diversity Stratum Results

The North-Central Coastal Diversity Stratum CAP populations include the Noyo River and Big River. This stratum is comprised almost entirely of a forested landscape, and timber harvest is the dominant land use. Coastal and rural developments are also present.

Attribute Results

In these two populations, attribute indicators of most concern were those related to reduced habitat complexity (large woody debris, primary and percent staging pools, pool/riffle/flatwater ratio, shelter), sediment transport (streamside road density), and species viability (abundance, density, spatial structure) (Table 4). The two estuaries were rated Fair for all lifestages. Overall, indicators for hydrology and landscape patterns were generally rated as Good or Very Good for both populations indicating that in general, habitat conditions should favor the persistence of Chinook salmon populations. This, however, conflicts with the current depressed population status and Poor viability ratings.

Life Stage Results

All lifestages in the stratum are impaired. Smolts received the most Poor or Fair ratings (76%) followed closely by eggs (75%) and adults (70%). However, adults had the highest percentage of Poor ratings alone (33%), which was nearly twice as much as any other lifestage (pre smolts, 19%) (Figure 9). Adults are most impaired by poor habitat complexity and low viability. As in all strata, eggs are most limited by impaired gravel quality and quantity while reduced habitat complexity (*e.g.,* shelter) and viability (abundance) are the indicators of most concern for the pre smolt and smolt lifestages (Table 5). Streamside road density was rated Poor in both populations.

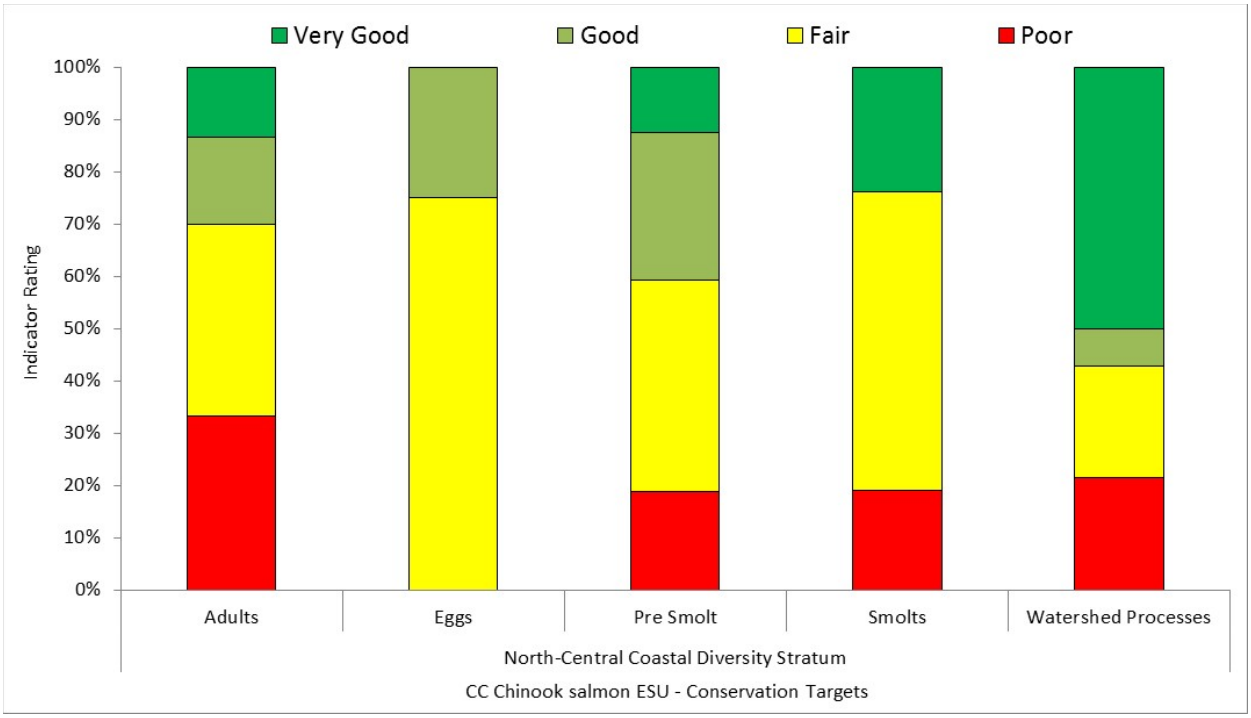

Figure 9: Attribute Indicator Ratings for the North-Central Coastal Diversity Stratum conservation targets.

Threat Results

The North-Central Coastal was the only stratum without High or Very High threats identified, though roads, severe weather, and logging were identified as medium threats in both populations (Table 6 and Figure 10). Many threats (32%) were deemed not applicable for the stratum. Across threats, 39% were rated as Low, 29% were rated as Medium, and 0% were rated as High or Very High (Figure 10).

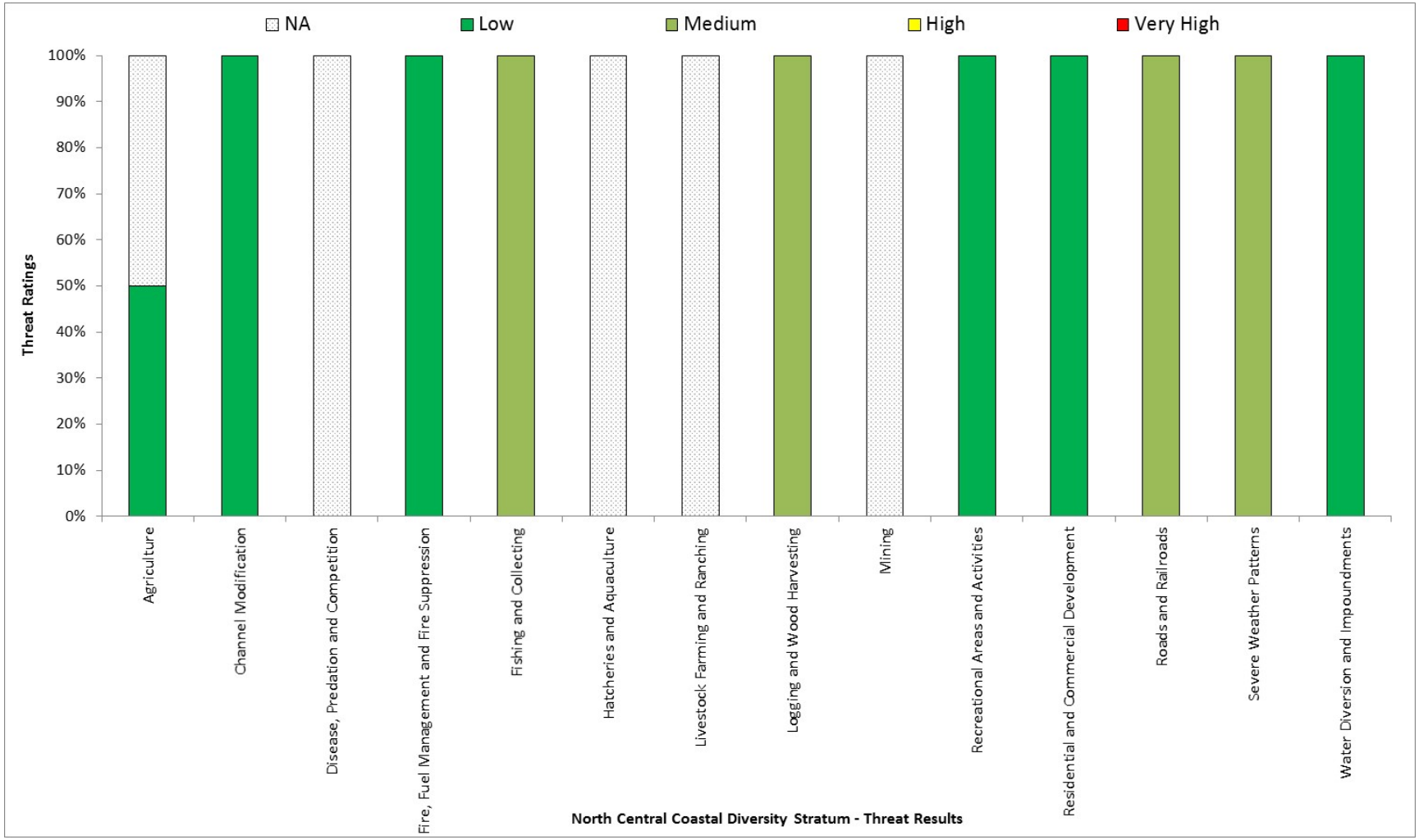

Figure 10: Threat ratings for the North-Central Coastal Diversity Stratum.

Central Coastal Diversity Stratum Results

The Central Coastal Diversity Stratum CAP populations are the Russian River (the most southern and urbanized population in the ESU) and the Garcia River. Chinook salmon have also been observed recently in the Navarro and Gualala rivers, but sightings are uncommon and they are believed to only occur sporadically in these basins.

Attribute Results

Both the Garcia River and Russian River populations were rated Poor for shelter and streamside road density and the Garcia population was rated Poor for floodplain connectivity for all life stages (Table 4). Aside from these indicators, the Garcia population had Poor ratings for viability indicators but the remainder were rated Fair or better with many rated as Good or Very Good. The Russian River population was rated Poor for many other indicators including habitat complexity (large woody debris, pool/riffle/flatwater ratio, and shelter), passage/migration (pre smolt), tree diameter (adult and pre smolt), floodplain connectivity and turbidity (pre smolt). Despite some degraded conditions within the watershed, the Russian River is the only population in the ESU that has recently exhibited a trend toward viability based on increased adult escapement.

Life Stage Results

All lifestages in the stratum are impaired with more than 66% of indicator ratings as either Poor or Fair (Figure 11). Based on the percentage of Poor and Fair indicator ratings, eggs were the most impaired lifestage with 75% of all indicator ratings reported as Fair (although none were rated Poor), followed by smolt (73%), pre smolt (72%), then adult (70%) lifestages. Attribute indicators most limiting for adults included reduced habitat complexity (Russian) and low viability (Garcia). Pre smolt and smolt lifestages were most limited by impaired habitat complexity (large wood frequency and shelter) and estuary/lagoon conditions and reduced floodplain connectivity. In the Russian River, pre smolt and smolt are also impaired by degraded

riparian conditions (tree diameter), passage and migration (passage at mouth or confluence), reduced floodplain connectivity, and elevated turbidity.

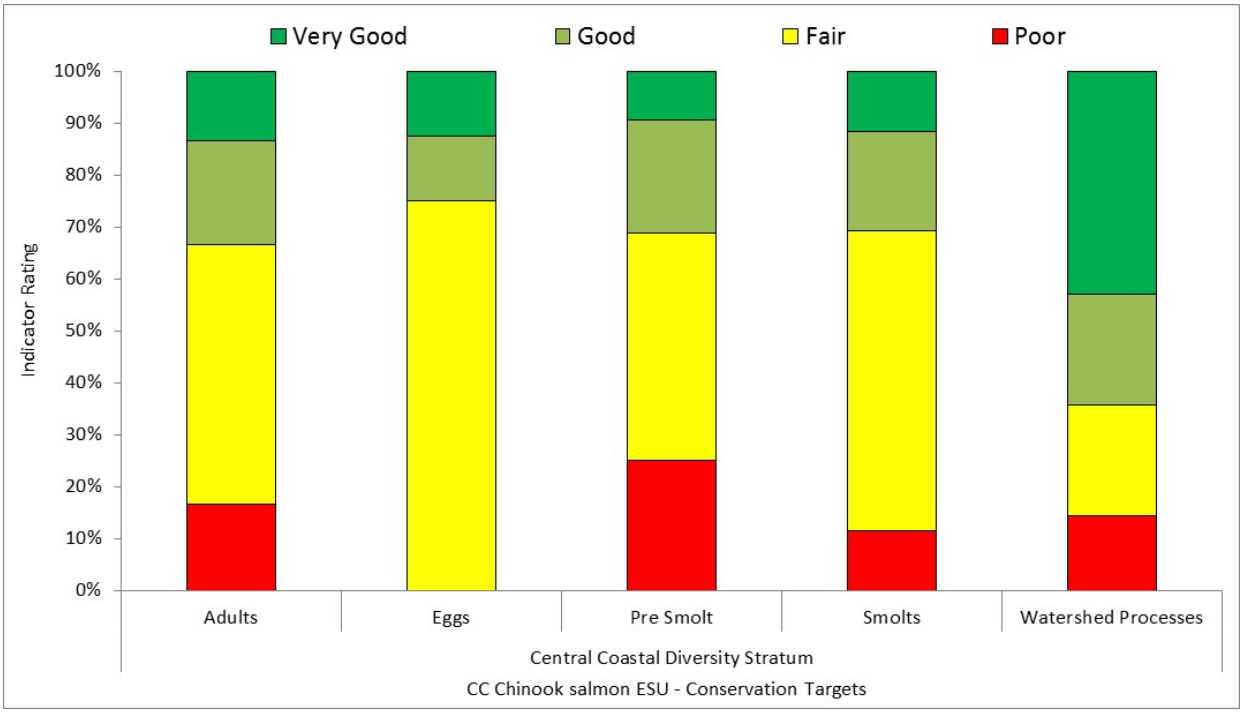

Figure 11: Attribute Indicator Ratings for the Central Coastal Diversity Stratum Conservation Targets.

Threat Results

The most significant threat identified for the Central Coastal Diversity Stratum was roads and railroads (both populations were rated as High) (Table 6 and Figure 12). Channel modification, fishing and collecting, logging and wood harvesting, residential and commercial development, and water diversions and impoundments were also identified as concerns with one of two populations rated as High and the other as medium. Fire, fuel management and fire suppression as well as recreational areas and activities were considered low threats for both populations in the stratum. Across threats, 7% were rated as not applicable (all hatcheries and aquaculture), 25% were rated as Low, 43% were rated as Medium, 25% were rated as High, and 0% were rated as Very High (Figure 10).

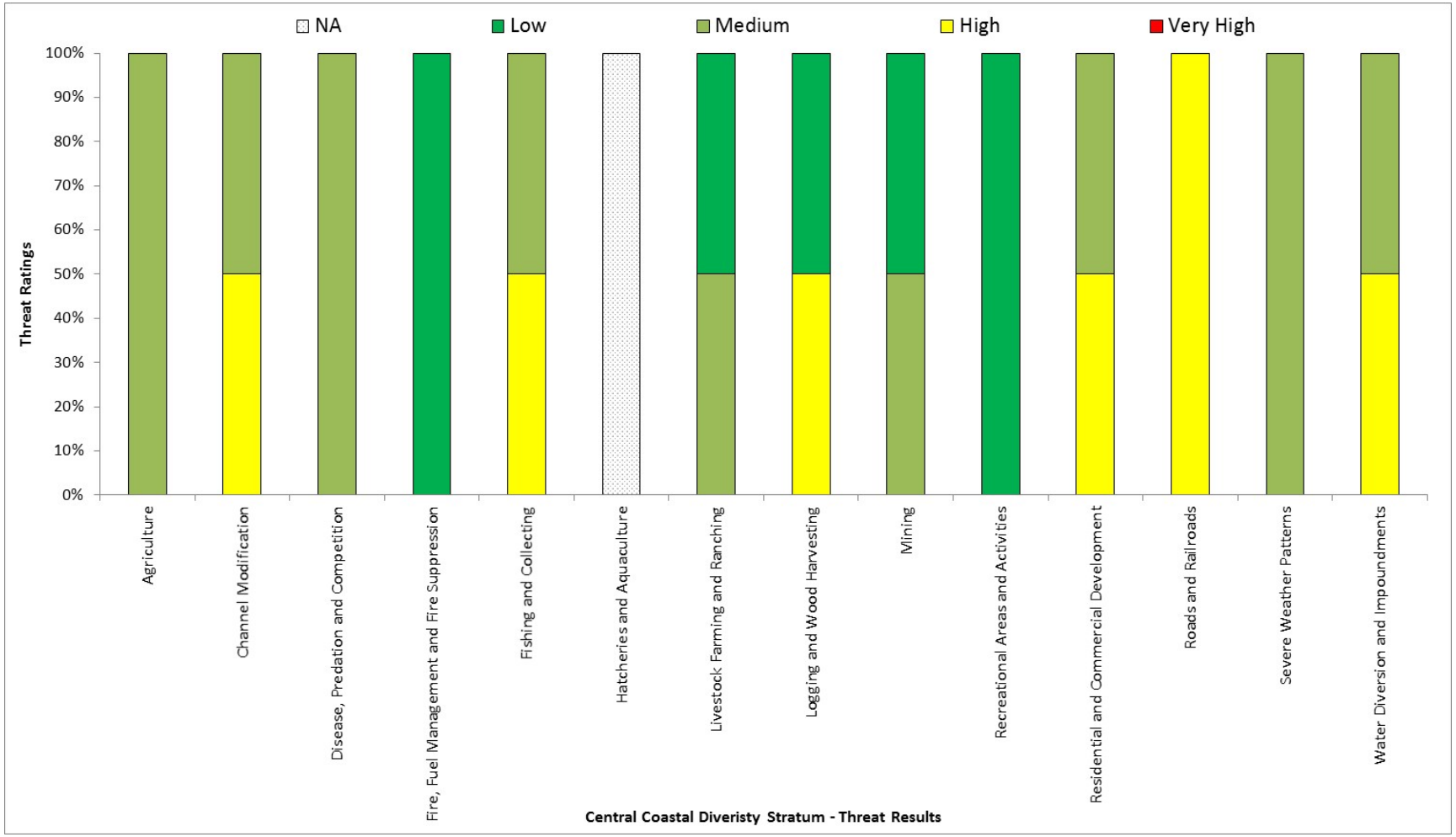

Figure 12: Threat ratings for the Central Coastal Diversity Stratum.

ESU CAP VIABILITY RESULTS

Attributes

Across the ESU and lifestages, viability attribute indicators for habitat complexity (large wood frequency, percent primary pools, pool/riffle/flatwater ratio, and shelter rating) and sediment transport (road density and stream-side road density) were rated Poor (Table 4). In addition, estuary/lagoon (quality and extent) and riparian vegetation (species composition and tree diameter) were rated Poor or Fair for nearly all populations and applicable lifestages.

Attribute indicator ratings that received a high percentage of Good or Very Good ratings throughout the ESU included passage/migration (physical barriers) and watershed processes (impervious surfaces, agriculture, and urbanization (Table 4). These ratings reflect the limited extent of urbanization and agriculture throughout the region.

Table 4: CC Chinook Salmon ESU CAP Viability Summary by Attribute.

CC Chinook Salmon Population Conditions (Sorted By Attribute)			North Coastal							North Mountain Interior			North-Central Coastal		Central Coastal	
Target	Attribute	Indicator	Redwood	Little River	Mad River	Humbold Bay	S. F. Eel River	Bear River	Mattole River	Van Duzen	Larabee Creek	Upper Eel River	Noyo River	Big River	Garcia River	Russian River
Adults	Estuary/Lagoon	Quality & Extent	P	F	G	F	P	F	F	P	P	P	F	F	F	F
Pre Smolt	Estuary/Lagoon	Quality & Extent	P	F	F	F	P	F	F	P	P	P	F	F	G	F
Smolts	Estuary/Lagoon	Quality & Extent	P	F	F	F	P	F	P	P	P	P	F	F	F	F
Adults	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	P	P	F	P	F	P	P	F	F	P	P	F	G	P
Adults	Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	P	P	F	F	P	P	P	F	F	P	P	P	F	P
Pre Smolt	Habitat Complexity	Percent Primary Pools	G	F	P	V	F	G	F	P	F	P	F	P	V	F
Adults	Habitat Complexity	Percent Staging Pools	P	G	P	P	P	P	P	P	F	F	F	P	V	F
Adults	Habitat Complexity	Pool/Riffle/Flatwater Ratio	P	V	P	V	F	P	F	F	F	P	P	P	V	F
Pre Smolt	Habitat Complexity	Pool/Riffle/Flatwater Ratio	P	V	P	V	F	P	F	F	F	F	G	P	V	P
Pre Smolt	Habitat Complexity	Shelter Rating	P	F	P	P	P	P	P	P	P	P	P	P	P	P
Smolts	Habitat Complexity	Shelter Rating	P	F	P	P	P	P	P	P	P	P	P	P	P	P
Pre Smolt	Hydrology	Flow Conditions (Baseflow)	F	G	G	G	P	G	P	P	P	F	G	F	F	F
Eggs	Hydrology	Flow Conditions (Instantaneous Condition)	G	G	V	V	G	G	G	G	G	F	G	G	F	F
Pre Smolt	Hydrology	Flow Conditions (Instantaneous Condition)	F	G	V	V	F	G	P	F	F	G	G	G	F	F
Smolts	Hydrology	Flow Conditions (Instantaneous Condition)	F	G	V	V	F	G	P	F	F	G	G	G	F	F
Watershed Processes	Hydrology	Impervious Surfaces	V	V	V	F	V	V	V	V	V	V	V	V	V	V
Pre Smolt	Hydrology	Number, Condition and/or Magnitude of Diversions	F	G	F	F	P	G	P	P	F	G	V	V	G	F
Smolts	Hydrology	Number, Condition and/or Magnitude of Diversions	F	G	F	F	P	G	P	P	F	G	V	V	G	F
Adults	Hydrology	Passage Flows	F	V	G	G	F	G	F	P	F	G	V	G	F	G
Pre Smolt	Hydrology	Passage Flows	F	V	V	V	F	G	P	F	F	G	G	G	F	G
Smolts	Hydrology	Passage Flows	F	V	V	V	F	G	P	F	F	G	G	G	F	G
Eggs	Hydrology	Redd Scour	P	V	G	P	F	G	F	F	F	F	F	F	F	F
Watershed Processes	Landscape Patterns	Agriculture	V	V	V	V	V	V	V	F	G	V	V	V	V	V
Watershed Processes	Landscape Patterns	Timber Harvest	V	P	G	P	G	G	V	P	P	V	F	V	G	V
Watershed Processes	Landscape Patterns	Urbanization	V	V	V	P	V	V	V	V	V	V	V	V	V	F
Adults	Passage/Migration	Passage at Mouth or Confluence	F	G	G	G	P	V	F	P	G	F	V	G	F	F
Pre Smolt	Passage/Migration	Passage at Mouth or Confluence	G	G	G	G	F	V	P	F	G	F	V	G	F	P
Smolts	Passage/Migration	Passage at Mouth or Confluence	G	G	G	G	F	V	P	F	G	G	V	G	F	F
Adults	Passage/Migration	Physical Barriers	V	V	V	G	V	V	V	G	V	F	V	V	V	V
Smolts	Passage/Migration	Physical Barriers	V	V	V	V	V	V	V	G	V	V	V	V	V	V
Watershed Processes	Riparian Vegetation	Species Composition	G	F	F	G	F	P	F	V	G	F	F	F	G	F
Adults	Riparian Vegetation	Tree Diameter (North of SF Bay)	F	F	F	F	P	P	F	F	P	P	F	F	F	P
Pre Smolt	Riparian Vegetation	Tree Diameter (North of SF Bay)	P	F	F	F	P	P	F	F	P	P	F	F	F	P
Eggs	Sediment	Gravel Quality (Bulk)	F	F	V	G	P	F	P	P	G	F	F	F	F	G
Eggs	Sediment	Gravel Quality (Embeddedness)	G	P	F	G	F	G	P	P	F	P	F	F	V	F
Adults	Sediment	Quantity & Distribution of Spawning Gravels	F	F	G	F	G	P	F	F	F	G	G	G	F	G
Pre Smolt	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	G	P	V	G	F	G	P	P	F	P	F	F	V	F
Smolts	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	G	P	V	G	F	G	P	P	F	P	F	F	V	F
Watershed Processes	Sediment Transport	Road Density	P	P	P	P	P	P	F	P	P	G	P	G	G	F
Watershed Processes	Sediment Transport	Streamside Road Density (100 m)	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Smolts	Smoltification	Temperature	P	V	F	G	P	F	P	F	F	F	F	F	F	F
Adults	Velocity Refuge	Floodplain Connectivity	P	G	G	P	F	F	P	F	G	F	F	F	P	F
Pre Smolt	Velocity Refuge	Floodplain Connectivity	P	G	G	P	P	F	P	F	G	F	F	F	P	P
Smolts	Velocity Refuge	Floodplain Connectivity	P	G	G	P	P	F	P	F	G	F	F	F	P	F
Smolts	Viability	Abundance	F	P	G	F	F	F	F	F	F	F	P	P	P	F
Adults	Viability	Density	F	P	F	P	F	F	F	F	F	F	P	P	P	F
Adults	Viability	Spatial Structure	G	F	V	G	G	V	V	G	G	F	P	P	P	F
Pre Smolt	Viability	Spatial Structure	G	F	V	G	G	V	V	G	G	F	P	P	P	F
Pre Smolt	Water Quality	Temperature (MWMT)	P	V	F	G	F	F	P	F	G	F	G	G	G	F
Adults	Water Quality	Toxicity	F	G	G	F	F	G	G	F	G	F	G	F	G	F
Pre Smolt	Water Quality	Toxicity	F	G	G	F	F	G	G	F	G	F	F	F	G	F
Smolts	Water Quality	Toxicity	F	G	G	F	F	G	G	F	G	F	F	F	G	F
Adults	Water Quality	Turbidity	P	P	F	P	P	F	P	P	F	F	F	F	G	F
Pre Smolt	Water Quality	Turbidity	P	P	P	P	F	F	P	P	F	F	F	V	G	P
Smolts	Water Quality	Turbidity	P	P	F	F	P	F	P	P	F	F	F	F	G	F

Table 5: CC Chinook Salmon ESU CAP Viability Summary by Conservation Target.

CC Chinook Salmon Population Conditions (Sorted By Conservation Target)			North Coastal							North Mountain Interior			North-Central Coastal		Central Coastal	
Target	Attribute	Indicator	Redwood	Little River	Mad River	Humbold Bay	Lower-S. F. Eel River	Bear River	Mattole River	Van Duzen	Larabee Creek	Upper Eel River	Noyo River	Big River	Garcia River	Russian River
Adults	Estuary/Lagoon	Quality & Extent	P	F	G	F	P	F	F	P	P	P	F	F	F	F
Adults	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	P	P	F	P	F	P	P	F	F	P	P	F	G	P
Adults	Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	P	P	F	F	P	P	P	F	F	P	P	P	F	P
Adults	Habitat Complexity	Percent Staging Pools	P	G	P	P	P	P	P	P	F	F	F	P	V	F
Adults	Habitat Complexity	Pool/Riffle/Flatwater Ratio	P	V	P	V	F	P	F	F	F	P	P	P	V	F
Adults	Hydrology	Passage Flows	F	V	G	G	F	G	F	P	F	G	V	G	F	G
Adults	Passage/Migration	Passage at Mouth or Confluence	F	G	G	G	P	V	F	P	G	F	V	G	F	F
Adults	Passage/Migration	Physical Barriers	V	V	V	G	V	V	V	G	V	F	V	V	V	V
Adults	Riparian Vegetation	Tree Diameter (North of SF Bay)	F	F	F	F	P	P	F	F	P	P	F	F	F	P
Adults	Sediment	Quantity & Distribution of Spawning Gravels	F	F	G	F	G	P	F	F	F	G	G	G	F	G
Adults	Velocity Refuge	Floodplain Connectivity	P	G	G	P	F	F	P	F	G	F	F	F	P	F
Adults	Water Quality	Toxicity	F	G	G	F	F	G	G	F	G	F	G	F	G	F
Adults	Water Quality	Turbidity	P	P	F	P	P	F	P	P	F	F	F	F	G	F
Adults	Viability	Density	F	P	F	P	F	F	F	F	F	F	P	P	P	F
Adults	Viability	Spatial Structure	G	F	V	G	G	V	V	G	G	F	P	P	P	F
Eggs	Hydrology	Flow Conditions (Instantaneous Condition)	G	G	V	V	G	G	G	G	G	F	G	G	F	F
Eggs	Hydrology	Redd Scour	P	V	G	P	F	G	F	F	F	F	F	F	F	F
Eggs	Sediment	Gravel Quality (Bulk)	F	F	V	G	P	F	P	P	G	F	F	F	F	G
Eggs	Sediment	Gravel Quality (Embeddedness)	G	P	F	G	F	G	P	P	F	P	F	F	V	F
Pre Smolt	Estuary/Lagoon	Quality & Extent	P	F	F	F	P	F	F	P	P	P	F	F	G	F
Pre Smolt	Habitat Complexity	Percent Primary Pools	G	F	P	V	F	G	F	P	F	P	F	P	V	F
Pre Smolt	Habitat Complexity	Pool/Riffle/Flatwater Ratio	P	V	P	V	F	P	F	F	F	F	G	P	V	P
Pre Smolt	Habitat Complexity	Shelter Rating	P	F	P	P	P	P	P	P	P	P	P	P	P	P
Pre Smolt	Hydrology	Flow Conditions (Baseflow)	F	G	G	G	P	G	P	P	P	F	G	F	F	F
Pre Smolt	Hydrology	Flow Conditions (Instantaneous Condition)	F	G	V	V	F	G	P	F	F	G	G	G	F	F
Pre Smolt	Hydrology	Number, Condition and/or Magnitude of Diversions	F	G	F	F	P	G	P	P	F	G	V	V	G	F
Pre Smolt	Hydrology	Passage Flows	F	V	V	V	F	G	P	F	F	G	G	G	F	G
Pre Smolt	Passage/Migration	Passage at Mouth or Confluence	G	G	G	G	F	V	P	F	G	F	V	G	F	P
Pre Smolt	Riparian Vegetation	Tree Diameter (North of SF Bay)	P	F	F	F	P	P	F	F	P	P	F	F	F	P
Pre Smolt	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	G	P	V	G	F	G	P	P	F	P	F	F	V	F
Pre Smolt	Velocity Refuge	Floodplain Connectivity	P	G	G	P	P	F	P	F	G	F	F	F	P	P
Pre Smolt	Water Quality	Temperature (MWMT)	P	V	F	G	F	F	P	F	G	F	G	G	G	F
Pre Smolt	Water Quality	Toxicity	F	G	G	F	F	G	G	F	G	F	F	F	G	F
Pre Smolt	Water Quality	Turbidity	P	P	P	P	F	F	P	P	F	F	F	V	G	P
Pre Smolt	Viability	Spatial Structure	G	F	V	G	G	V	V	G	G	F	P	P	P	F
Smolts	Estuary/Lagoon	Quality & Extent	P	F	F	F	P	F	P	P	P	P	F	F	F	F
Smolts	Habitat Complexity	Shelter Rating	P	F	P	P	P	P	P	P	P	P	P	P	P	P
Smolts	Hydrology	Flow Conditions (Instantaneous Condition)	F	G	V	V	F	G	P	F	F	G	G	G	F	F
Smolts	Hydrology	Number, Condition and/or Magnitude of Diversions	F	G	F	F	P	G	P	P	F	G	V	V	G	F
Smolts	Hydrology	Passage Flows	F	V	V	V	F	G	P	F	F	G	G	G	F	G
Smolts	Passage/Migration	Passage at Mouth or Confluence	G	G	G	G	F	V	P	F	G	G	V	G	F	F
Smolts	Passage/Migration	Physical Barriers	V	V	V	V	V	V	V	G	V	V	V	V	V	V
Smolts	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	G	P	V	G	F	G	P	P	F	P	F	F	V	F
Smolts	Smoltification	Temperature	P	V	F	G	P	F	P	F	F	F	F	F	F	F
Smolts	Velocity Refuge	Floodplain Connectivity	P	G	G	P	P	F	P	F	G	F	F	F	P	F
Smolts	Water Quality	Toxicity	F	G	G	F	F	G	G	F	G	F	F	F	G	F
Smolts	Water Quality	Turbidity	P	P	F	F	P	F	P	P	F	F	F	F	G	F
Smolts	Viability	Abundance	F	P	G	F	F	F	F	F	F	F	P	P	P	F
Watershed Processes	Hydrology	Impervious Surfaces	V	V	V	F	V	V	V	V	V	V	V	V	V	V
Watershed Processes	Landscape Patterns	Agriculture	V	V	V	V	V	V	V	F	G	V	V	V	V	V
Watershed Processes	Landscape Patterns	Timber Harvest	V	P	G	P	G	G	V	P	P	V	F	V	G	V
Watershed Processes	Landscape Patterns	Urbanization	V	V	V	P	V	V	V	V	V	V	V	V	V	F
Watershed Processes	Riparian Vegetation	Species Composition	G	F	F	G	F	P	F	V	G	F	F	F	G	F
Watershed Processes	Sediment Transport	Road Density	P	P	P	P	P	P	F	P	P	G	P	G	G	F
Watershed Processes	Sediment Transport	Streamside Road Density (100 m)	P	P	P	P	P	P	P	P	P	P	P	P	P	P

Life Stages

The viability attribute results indicate all lifestages of CC Chinook salmon are impaired in each Diversity Strata (Table 5 and Figure 13). Adults are the most impaired lifestage across the ESU with 71% of all indicator ratings reported as Poor or Fair, followed by the pre smolt (67%), smolt (66%), and egg (61%) lifestages (Figure 13). The adult lifestage had the highest percentage of Poor ratings overall (30%), followed closely by pre smolt (29%). Watershed processes, on an ESU level, had a combined 44% of attribute indicators reported as Poor or Fair (Figure 13), of which 30% were rated as Poor.

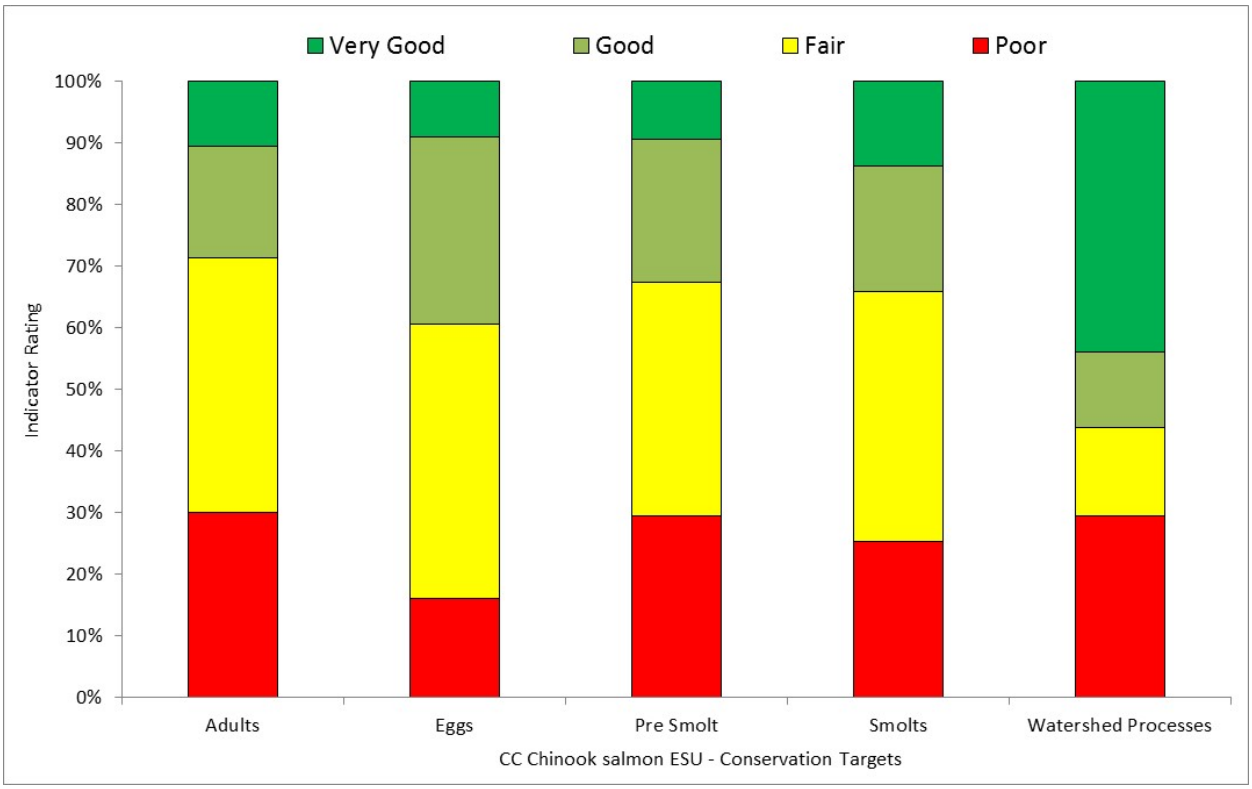

Figure 13: Attribute Indicator ratings for the CC Chinook salmon ESU by lifestage.

<u>Adults Attribute Results</u>*:* Across the ESU, most indicators for the adult lifestage had a high percentage (> 70%) of Poor or Fair ratings with the exceptions being passage flows, passage at mouth or confluence, physical barriers, quality and distribution of spawning gravels, and toxicity (Figure 14). The indicators of greatest concern, based on the percentage of Poor ratings alone

were large wood frequency (BFW 0-10m and BFW 10-100m), percent staging pools, pool/riffle/flatwater ratio, and turbidity. Across all attributes, 30% were rated Poor, 41% were rated Fair, 19% were rated Good, and 10% were rated as Very Good (Figure 14).

Eggs Attribute Results*:* Of the four indicators applicable to the egg lifestage, the most concerning were those related to gravel quality (embeddedness) followed by gravel quantity (bulk), and the potential for redd scour, which is related to overall gravel quality (Figure 15). Across all attributes, 16% were rated Poor, 45% were rated Fair, 30% were rated Good and 9% were rated as Very Good (Figure 15).

Pre Smolt Attribute Results*:* Like adults, most indicator ratings for the pre smolt lifestage had a high percentage (>65%) of Poor or Fair ratings (Figure 16) with the exceptions being flow conditions (instantaneous), passage flows, passage flows at mouth or confluence, and toxicity. The indicators of greatest concern were estuary/lagoon quality and extent, shelter rating, turbidity, tree diameter, and viability (spatial structure) in the southern populations (Figure 16). Across all attributes, 29% were rated Poor, 38% were rated Fair, 24% were rated Good and 9% were rated as Very Good (Figure 16).

Smolt Attribute Results*:* More than half of the indicator ratings (7 out of 13) for the smolt lifestage had a high percentage (> 60%) of Poor or Fair ratings (Figure 17) with the exceptions being flow conditions, stream flow diversions, passage flows, passage at mouth or confluence, physical barriers, and toxicity. The indicators of greatest concern for the smolt lifestage were estuary/lagoon quality and extent, shelter rating, gravel quality, viability (abundance), temperature, velocity refuge (floodplain connectivity), and turbidity. Across all attributes, 25% were rated Poor, 41% were rated Fair, 21% were rated Good and 14% were rated as Very Good (Figure 17).

Watershed Processes Results*:* Road density and streamside road density are the greatest overall source of impairment to current watershed conditions followed by timber harvest (Figure 18).

Streamside road density was rated Poor for all populations. The extent of impervious surfaces and agriculture received Very Good ratings throughout the ESU. Across all attributes, 30% were rated Poor, 13% were rated Fair, 13% were rated Good and 44% were rated as Very Good (Figure 18).

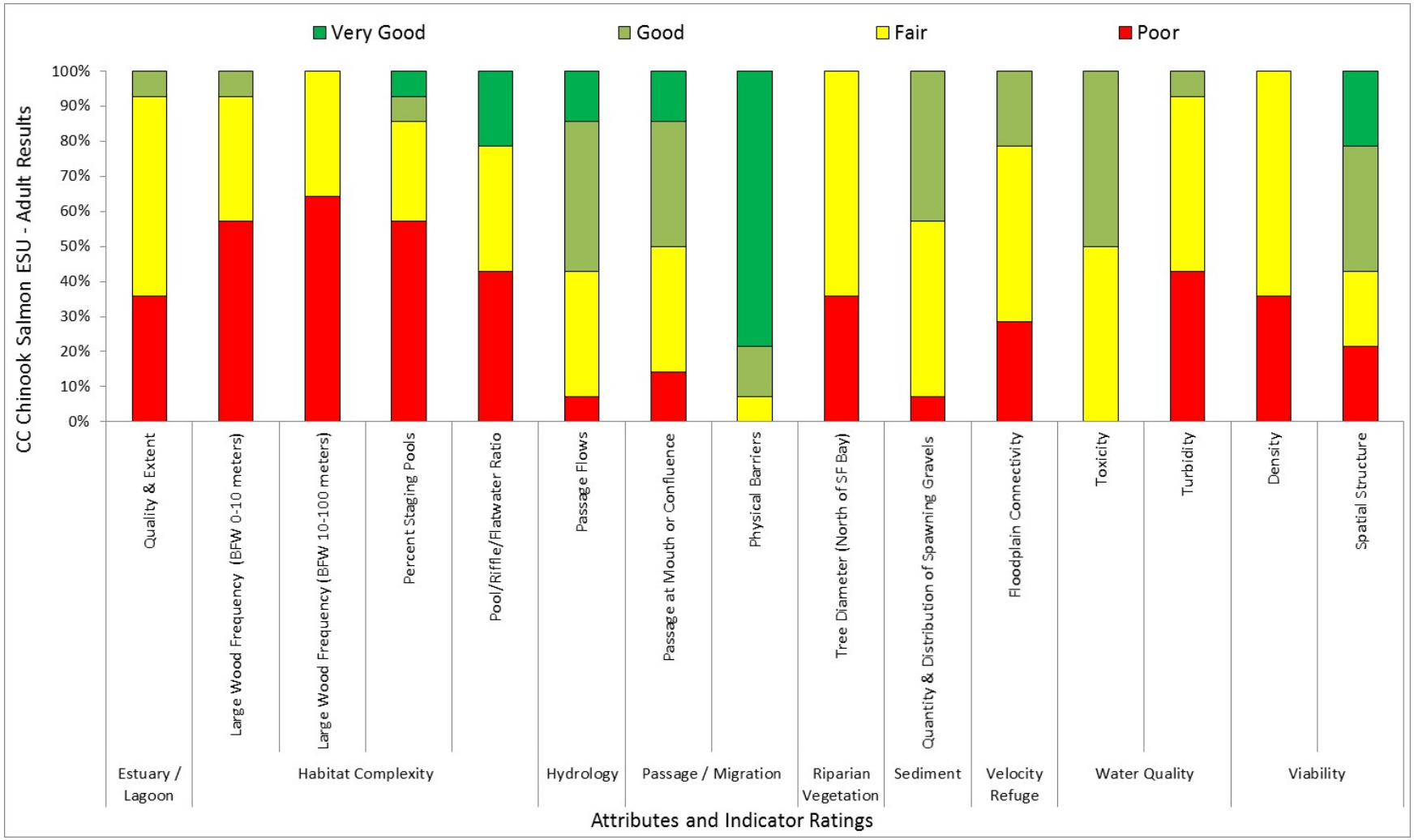

Figure 14: Attribute Indicator ratings for the Adult lifestage.

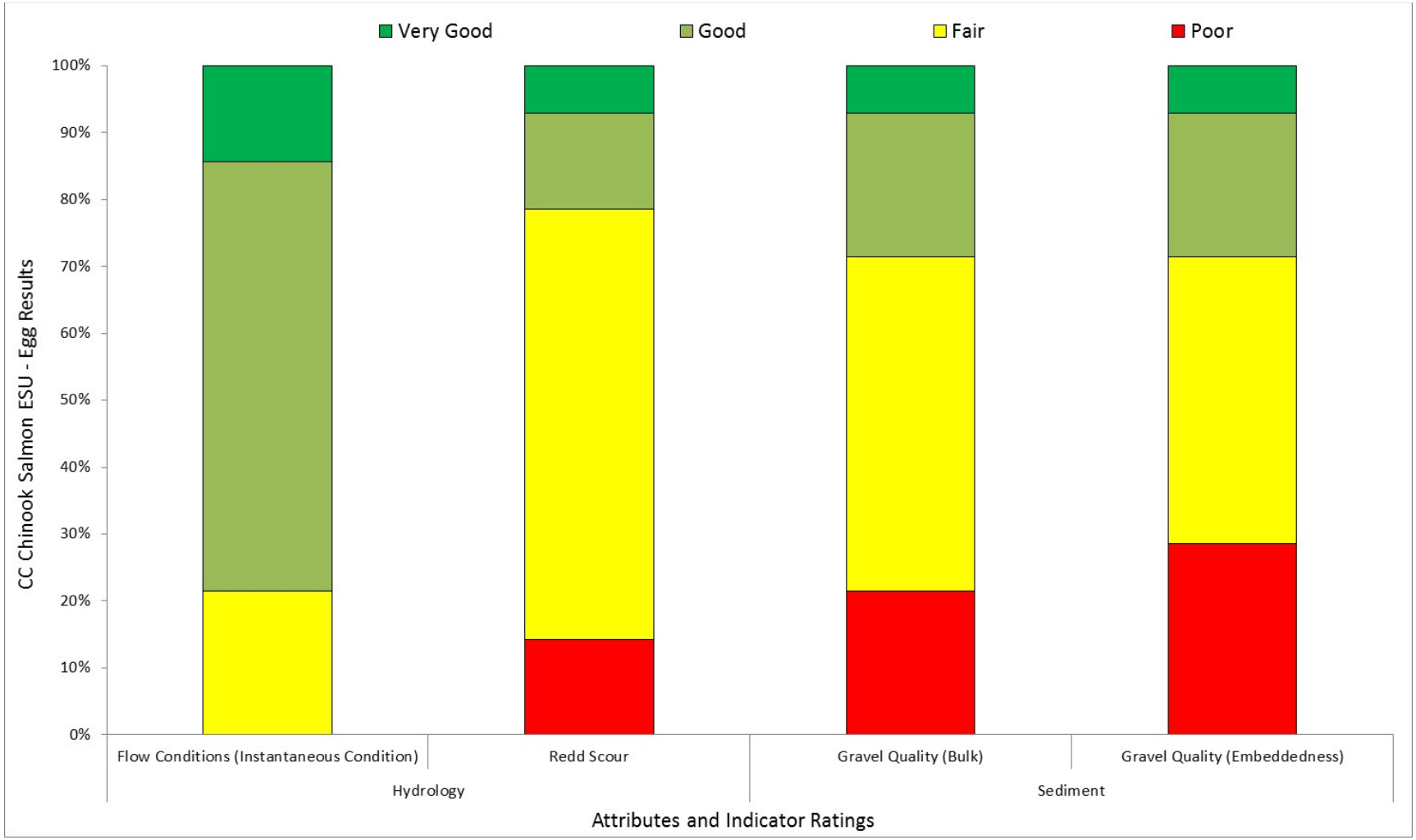

Figure 15: Attribute Indicator ratings for the Egg lifestage.

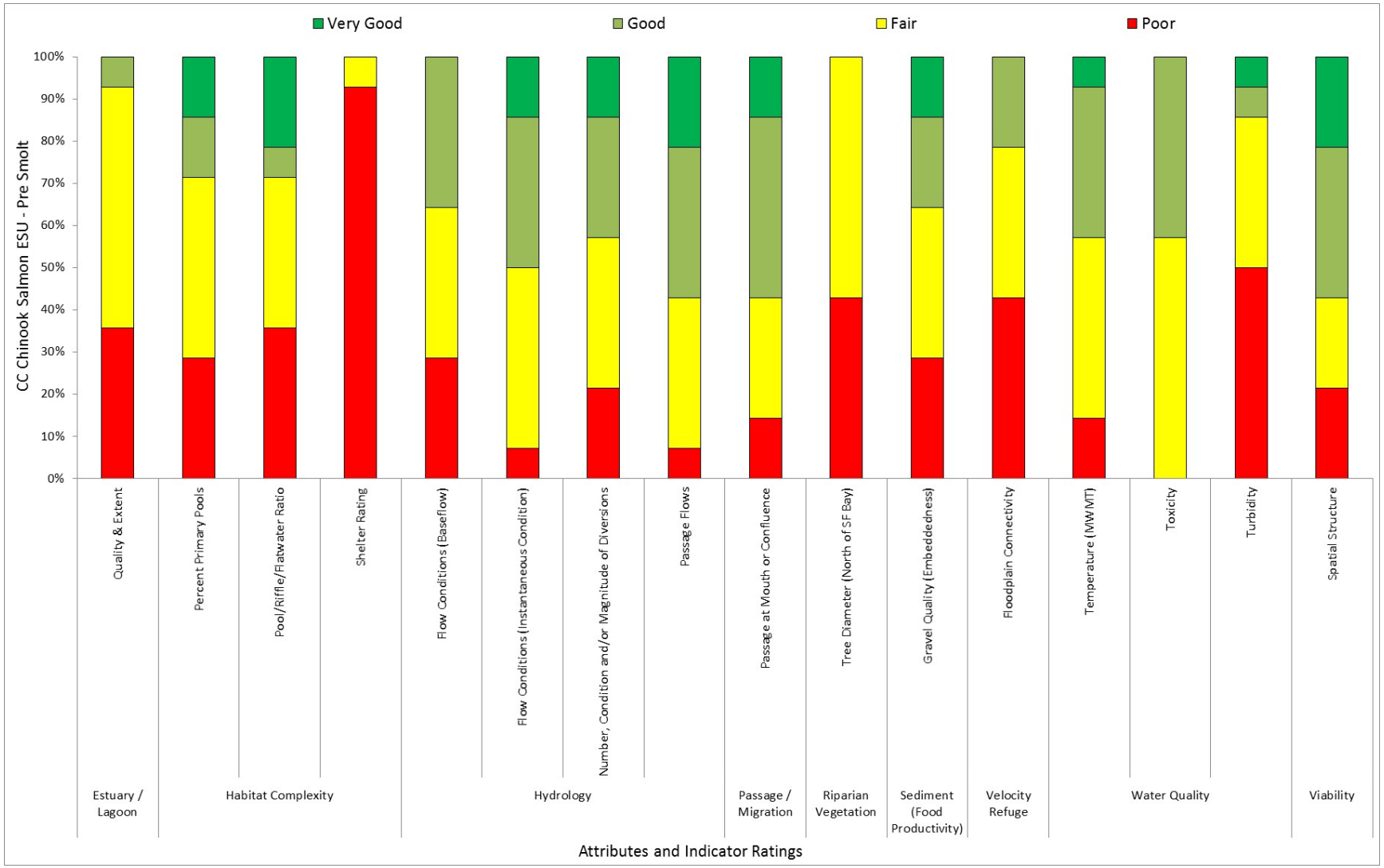

Figure 16: Attribute Indicator ratings for the Pre Smolt lifestage.

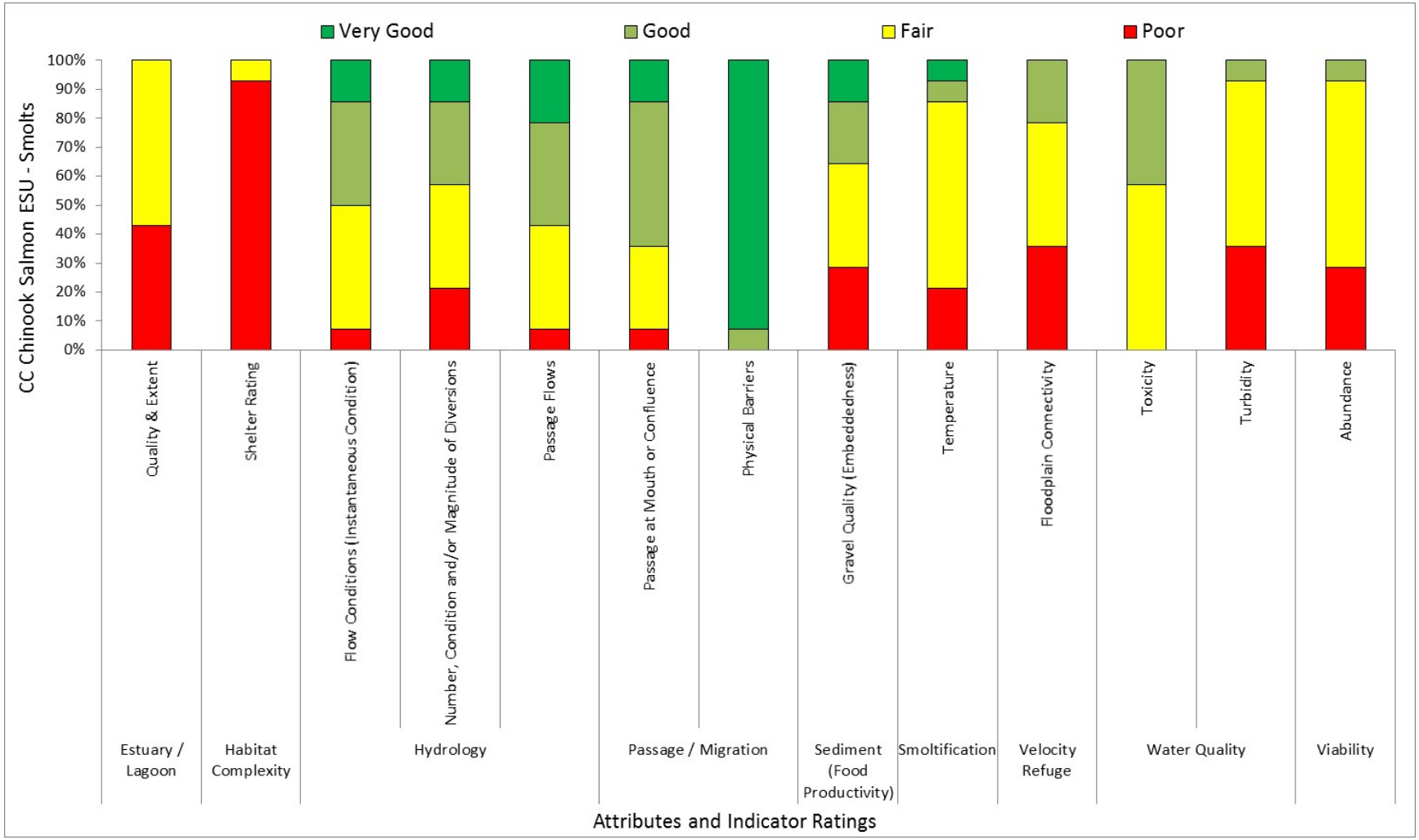

Figure 17: Attribute Indicator ratings for the Smolt lifestage.

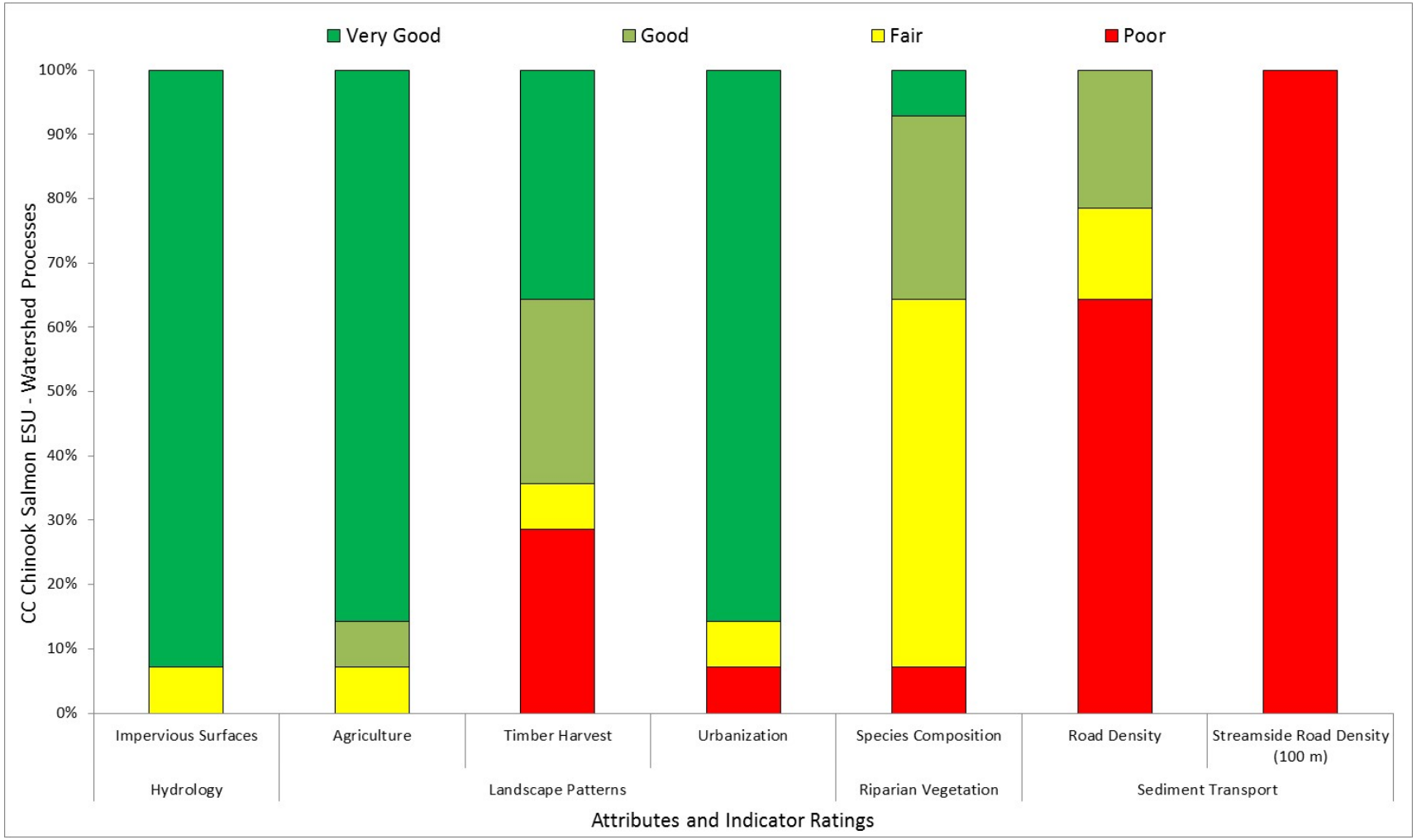

Figure 18: Attribute Indicator ratings for Watershed Processes.

ESU CAP THREAT RESULTS

Table 6 summarizes the CAP threat results across the ESU. Of the 15 identified threats, the four threats of greatest concern throughout the ESU based on the percentage of High and Very High ratings are channel modification (50%), roads and railroads (57%), logging and wood harvesting (36%), and both water diversion and impoundments and severe weather patterns (29%) (Figure 19).

Table 6: CC Chinook salmon ESU Threat Summary Table. Cells with [-] were not rated or not applicable.

Diversity Strata	North Coastal							North Mountain Interior			North-Central Coastal		Central Coastal	
CC Chinook Threat/Population	Redwood Creek	Little River	Mad River	Humbold Bay	Lower - S. F. Eel River	Bear River	Mattole River	Van Duzen River	Larabee Creek	Upper Eel River	Noyo River	Big River	Garcia River	Russian River
Agriculture	M	M	M	M	M	M	L	M	M	L	L	-	M	M
Channel Modification	VH	H	H	H	H	M	M	H	M	L	L	L	M	H
Disease, Predation and Competition	H	M	M	M	M	M	M	H	H	M	-	-	M	M
Fire, Fuel Management and Fire Suppression	M	M	M	L	M	M	M	M	M	M	L	L	L	L
Fishing and Collecting	M	M	M	M	M	M	M	M	M	H	M	M	H	M
Hatcheries and Aquaculture	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Livestock Farming and Ranching	M	M	M	M	M	H	M	M	M	L	-	-	M	L
Logging and Wood Harvesting	H	H	M	H	M	H	M	M	M	M	M	M	H	L
Mining	H	-	H	L	M	M	M	M	M	L	-	-	L	M
Recreational Areas and Activities	M	M	M	L	M	M	M	M	M	L	L	L	L	L
Residential and Commercial Development	M	M	M	M	M	M	M	M	M	L	L	L	M	H
Roads and Railroads	H	H	H	M	H	H	M	M	M	H	M	M	H	H
Severe Weather Patterns	H	M	M	H	H	M	H	M	M	M	M	M	M	M
Water Diversion and Impoundments	M	M	M	M	H	M	H	H	M	L	L	L	M	H

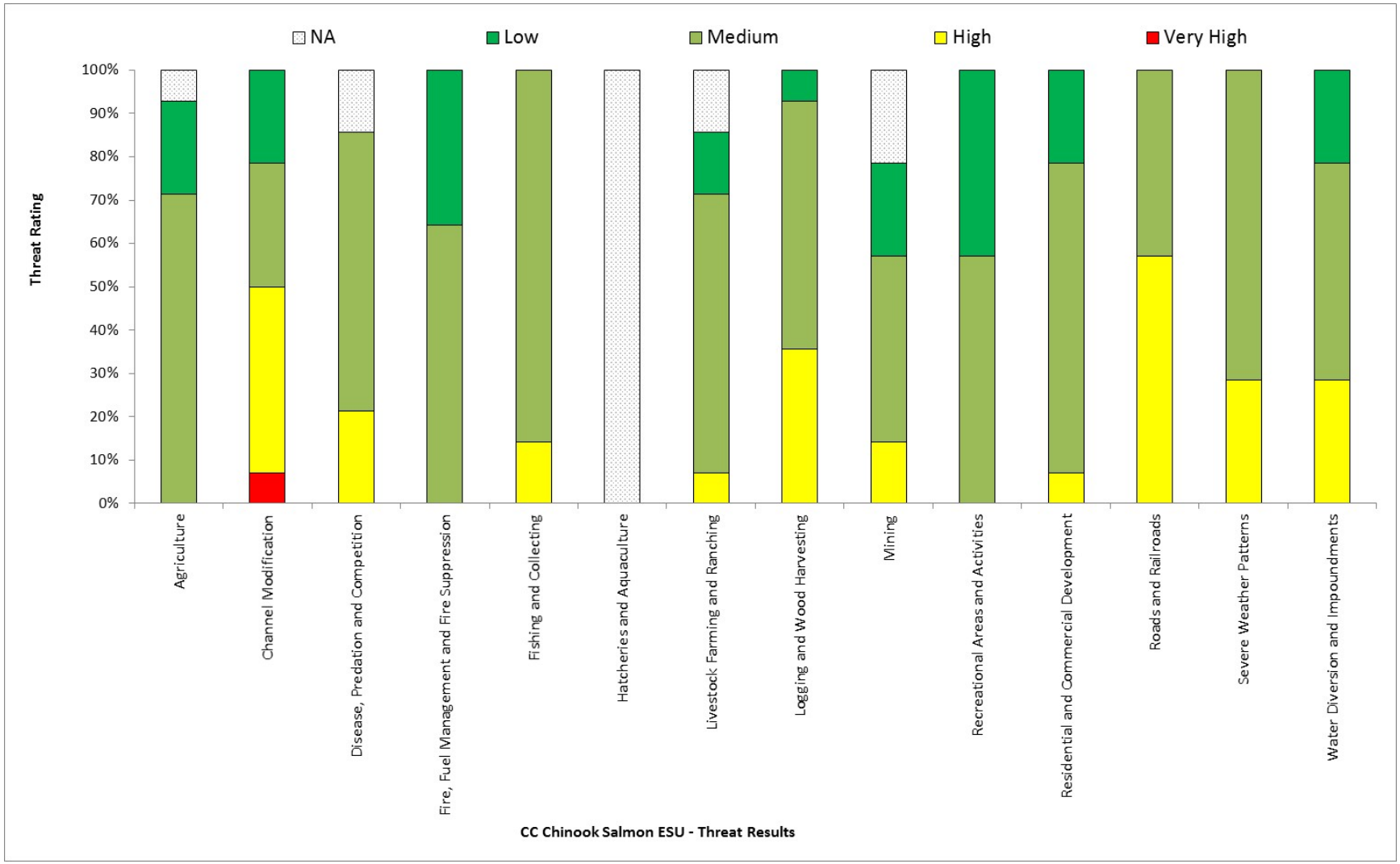

Figure 19: Threat ratings for the CC Chinook salmon ESU.

ESU LEVEL RECOVERY ACTIONS

The following recovery actions are ESU-wide recovery actions. ESU-wide recovery actions are recommendations that are designed to address widespread and often multiple threat sources across the range, such as the inadequate implementation and enforcement of local, state, and federal regulations.

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
ESU-CCCh-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat.				
ESU-CCCh-1.1.1.1	Action Step	Estuary	In estuary/lagoons when applicable, remove problematic infrastructure and fill material to promote the historical seasonal formation and timing of an estuary/lagoon barrier beach	3	20	County, State, NMFS	
ESU-CCCh-1.1.1.2	Action Step	Estuary	Implement patrols by citizens groups, city employees, and law enforcement to ensure seasonal sandbars are not illegally breached.	1	50	City, Citizens, County, CDFW Wardens, NMFS OLE, Non-Profits, Private Landowners,	
ESU-CCCh-1.2	**Objective**	**Estuary**	**Address the inadequacy of existing regulatory mechanisms.**				
ESU-CCCh-1.2.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat.				
ESU-CCCh-1.2.1.1	Action Step	Estuary	Develop and implement Estuary Inflow Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.	2	20	CDFW, NMFS, SWRCB	
ESU-CCCh-1.2.1.2	Action Step	Estuary	Work with local county/city and state organizations to develop alternative methods of flood control to reduce artificial breaching frequency and adverse impacts.	1	10	City, County, NMFS, State	
ESU-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of habitat or range.**				
ESU-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
ESU-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Evaluate opportunities and implement actions for planned retreat of urban development or other incompatible land uses from floodplains, estuaries and alluvial valley streams to recreate natural floodplain processes and complex off-channel habitat and implement such opportunities where appropriate.	1	50	City, County	
ESU-CCCh-2.2	**Objective**	**Floodplain Connectivity**	**Address the inadequacy of existing regulatory mechanisms**				
ESU-CCCh-2.2.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
ESU-CCCh-2.2.1.1	Action Step	Floodplain Connectivity	County zoning should consider the 20-year and 100-year floodprone areas and design protective ordinances and compatible land use designations in these locations.	1	50	County	
ESU-CCCh-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification or curtailment of the species habitat or range**				
ESU-CCCh-3.1.1	Recovery Action	Hydrology	Improve flow conditions				
ESU-CCCh-3.1.1.1	Action Step	Hydrology	Encourage water conservation and the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers.	2	50	EPA, City, County, NGO, Private Landowners, State, RWQCB	
ESU-CCCh-3.1.1.2	Action Step	Hydrology	Work with rural residential communities to develop water conservation strategies protective of salmonids while allowing for domestic water use.	2	20	City, County, NGO, Private Landowners, State, SWRCB	
ESU-CCCh-3.1.1.3	Action Step	Hydrology	Work with partners to reduce stormwater run-off by removing impervious surfaces, and creating or expanding flood retention land and groundwater recharge basins.	3	20	City, County, Private Landowners, State, SWRCB	
ESU-CCCh-3.1.1.4	Action Step	Hydrology	Work with the SWRCB to encourage landowners to increase groundwater recharge, permeable surfaces, and percolation through swales and recharge basins in an effort to reduce the flashiness of hydrographs and increase summer baseflow.	1	20	NMFS, Private Landowners, State, RWQCB	
ESU-CCCh-3.1.1.5	Action Step	Hydrology	Work with partners to expand stream flow gaging networks in streams supporting salmonids and/or their habitat.	3	50	CDFW, City, County, NMFS, Private Landowners, State, SWRCB, USGS	See also Monitoring Chapter.
ESU-CCCh-3.1.1.6	Action Step	Hydrology	Meter water diversions for the purposes of measuring instantaneous demand.	2	5	CDFW, City, County, NMFS, Private Landowners, State, SWRCB	
ESU-CCCh-3.1.1.7	Action Step	Hydrology	Use the best scientifically available technology to keep the public informed on stream flows in real time.	3	5	County, NGO, RWQCB, SWRCB	
ESU-CCCh-3.1.1.8	Action Step	Hydrology	Provide financial and technical support and develop partnerships to characterize watershed hydrology and to assess water availability and create water resource budgets.	1	10	CDFW, City, County, NMFS, State, SWRCB	

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-3.1.1.9	Action Step	Hydrology	Effects of consumptive water uses on both the timing and quantity of flow should be minimized. Water-management technologies promoting restoration of natural runoff patterns and water quality should be encouraged.	1	10	CDFW, City, County, NMFS, State, SWRCB	Patterns of water runoff, including surface and subsurface drainage, should match to the greatest extent possible the natural hydrologic pattern for the region in both quantity and quality.
ESU-CCCh-3.1.1.10	Action Step	Hydrology	Evaluate geological patterns in the ESU to identify areas provide sources of cool water and serve as locations to buffer populations against climate change and on-going water diversions.	3	15	County, NMFS, State, USGS	
ESU-CCCh-3.1.1.11	Action Step	Hydrology	Analyze the impacts of well development on stream flow prior to approval.	2	10	County, DWR, NMFS, RWQCB	
ESU-CCCh-3.1.1.12	Action Step	Hydrology	Encourage groundwater recharge through floodplain inundation.	2	15	CDFW, City, County, DWR, NMFS, State, SWRCB	
ESU-CCCh-3.2	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**				
ESU-CCCh-3.2.1	Recovery Action	Hydrology	Improve flow conditions				
ESU-CCCh-3.2.1.1	Action Step	Hydrology	Encourage local governments to condition new development to minimize adverse impacts to fisheries resources by integrating hydro-modification concerns into development planning.	2	50	CDFW, City, County, NMFS	For example: new homes should have drought-tolerant landscaping, rainwater catchment systems, and permeable surfaces; new vineyards should demonstrate that their water supply development would minimize adverse impacts to fisheries resources.
ESU-CCCh-3.2.1.2	Action Step	Hydrology	SWRCB in coordination with NMFS, CDFW, and other qualified parties, should develop state-wide minimum summer baseflow requirements protective of salmonids and their habitat.	1	5	CDFW, NMFS, SWRCB	Enforcing the minimum baseflow requirement is necessary to ensure salmonid persistence during drought periods and water right curtailment or when watershed surface flow is over-allocated, and when prosecuting illegal diversions.
ESU-CCCh-3.2.1.3	Action Step	Hydrology	Improve coordination between the agencies, particularly with the SWRCB, to effectively identify and address illegal water diverters and out-of-compliance diverters, seasons of diversion, off-stream reservoirs, and bypass flows fully protective of listed salmonids.	1	5	City, County, CDFW, NMFS, Private Landowners, RWQCB, SWRCB	
ESU-CCCh-3.2.1.4	Action Step	Hydrology	Collaborate with and support the DWR and SWRCB and local agencies to increase oversight for regulating groundwater extraction from aquifers hydrologically connected to surface flows. In addition collaborate to develop groundwater surface water management plans and implement groundwater recharge projects in all alluvial basins.	1	5	DWR, City, County, CDFW, NMFS, Private Landowners, RWQCB	
ESU-CCCh-3.2.1.5	Action Step	Hydrology	NMFS should actively participate in Groundwater Management Plan development (per California's Sustainable Groundwater Management Act) where groundwater pumping is impacting hydrologically connected streamflow.	1	5	DWR, City, County, CDFW, NMFS, RWQCB	
ESU-CCCh-3.2.1.6	Action Step	Hydrology	Encourage local governments to integrate meaningful groundwater regulation for land use planning and to increase coordination with State agencies to ensure applicants secure necessary State permits (e.g., water rights) as part of local permitting processes.	1	5	City, County, CDFW, DWR, NMFS, Private Landowners, RWQCB	
ESU-CCCh-3.2.1.7	Action Step	Hydrology	Extend California Water Code Section 1259.4 dealing with instream flows to protect instream beneficial uses, including native fishes, to central and northern California recovery planning areas with appropriate provisions to address regional differences, including but not limited to construction of off-stream storage as alternative to direct diversions during the dry season.	1	5	SWRCB	
ESU-CCCh-3.2.1.8	Action Step	Hydrology	Water conservation projects should be focused on shifting reliance from on-stream storage to offstream storage, resolve frost protection issues (water withdrawals), and ensure necessary flows for all freshwater lifestages in all water years.	2	10	City, County, CDFW, NMFS, Private Landowners, RWQCB, SWRCB	
ESU-CCCh-3.2.1.9	Action Step	Hydrology	Investigate illegal water diversion and well pumping related to marijuana propagation or other agricultural activities and prosecute violations accordingly	1	10	City, County, CDFW, NMFS, Private Landowners, RWQCB, SWRCB	
ESU-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of habitat or range.**				
ESU-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers.				

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-5.1.1.1	Action Step	Passage	All new crossings and upgrades to existing crossings (bridges, culverts, fills, and other crossings) need to accommodate 100-year flood flows and associated bedload and debris.	2	50	City, County, NMFS, State	
ESU-CCCh-5.1.1.2	Action Step	Passage	Monitor and update barriers in the Passage Assessment Database (PAD) (https://nrm.dfg.ca.gov/PAD/)	3	50	City, County, NGO, RCD, State	
ESU-CCCh-6.2	**Objective**	**Habitat Complexity**	**Address the inadequacy of existing regulatory conditions**				
ESU-CCCh-6.2.1	Recovery Action	Habitat Complexity	Improve habitat complexity				
ESU-CCCh-6.2.1.1	Action Step	Habitat Complexity	Work with Federal and State to develop an application of a programmatic permit for restoration work not funded by FRGP. The objectives of the programmatic should be to reduce costs and fast-track the implementation of high priority recovery actions.	2	5	City, County, CDFW, NGO, NMFS, NOAA RC, Private Landowners, RCD	
ESU-CCCh-6.2.1.2	Action Step	Habitat Complexity	Work with California BOF through implementation of California Forest Protection Rules, Section V, CDFW, RWQCB and others to modify the timber harvest permitting process (including CDFW Lake and Streambed Alteration Agreement process) and provide opportunities and incentives for the implementation of LWD placement and other restoration priorities during timber harvest operations.	3	5	BOF, CDFW, NMFS, RWQCB, Timber Landowners	
ESU-CCCh-6.2.1.3	Action Step	Habitat Complexity	Work with CDFW and the California Fish and Game Commission to remove beavers from California Fish and Game Code Section 4181 that provides any owner or tenant of land or property that is being damaged or destroyed or is in danger of being damaged or destroyed by certain mammals, including beaver, may apply to the department for a permit to kill the mammals.	3	10	CDFW, California Fish and Game Commission, NMFS	
ESU-CCCh-6.2.1.4	Action Step	Habitat Complexity	Work with CDFW and the California Fish and Game Commission to modify Title 14 of the California code of Regulations to prohibit recreational hunting/trapping of beavers within all counties within the NCCC Recovery Domain.	3	10	CDFW, California Fish and Game Commission, NMFS	
ESU-CCCh-6.2.1.5	Action Step	Habitat Complexity	Utilize non-lethal methods where feasible to manage beaver depredation issues (e.g. flooding, crop damage) such as flow devices, fencing, and beaver re-location and enhance habitat complexity.	3	10	CDFW, California Fish and Game Commission, NMFS, Private Landowners	
ESU-CCCh-6.2.1.6	Action Step	Habitat Complexity	Where non-lethal methods prove unfeasible to resolve depredation issues, relocate beaver populations to remote streams where habitat enhancement is needed and resource conflict is low.	3	10	CDFW, California Fish and Game Commission, NMFS, Private Landowners	
ESU-CCCh-6.2.1.7	Action Step	Habitat Complexity	Develop and update a Beaver Management Plan for California to benefit salmonids.	3	10	CDFW, California Fish and Game Commission, NMFS	
ESU-CCCh-6.2.1.8	Action Step	Habitat Complexity	Investigate the current conditon of the high IP reaches in each population and assess the status and develop a restoration plan for those areas.	2	10	City, County, CDFW, NGO, NMFS, NOAA RC, Private Landowners, RCD	
ESU-CCCh-7.1	**Objective**	**Riparian**	**Address the inadequacy of existing regulatory conditions**				
ESU-CCCh-7.1.1	Recovery Action	Riparian	Improve riparian conditions				
ESU-CCCh-7.1.1.1	Action Step	Riparian	Develop adequately sized riparian setbacks/buffers to protect salmonids habitat where they do not currently occur, and enforce requirements of local regulations where they do.	1	10	County	
ESU-CCCh-7.1.1.2	Action Step	Riparian	Counties should develop a riparian strategy to grow older larger diameter trees for improved canopy and appropriate natural recruitment to the stream. This could be achieved by creating ordinances (where currently non-existent) that limit or prevent the removal of mature trees during infrastructure upgrades or implementation of restoration projects.	3	10	County	
ESU-CCCh-7.1.1.3	Action Step	Riparian	Coordinate with RWQCB to promote policies and planning for adequate riparian area restoration, conservation and protection.	2	10	NMFS, RWQCB, State	
ESU-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
ESU-CCCh-8.1.1	Recovery Action	Sediment	Improve instream gravel quality				
8.1.1.1	Action Step	Sediment	Fund and implement sediment TMDLs within the range of listed salmonids.	2	10	EPA, RWQCB	
ESU-CCCh-8.1.1.2	Action Step	Sediment	Evaluate stream crossings for their potential to impair natural geomorphic processes. Replace or retrofit crossings to achieve more natural conditions that meet sediment transport goals.	2	10	BOF, CalFire, Caltrans, County, CDFW, NMFS	
ESU-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-10.1.1	Recovery Action	Water Quality	Reduce toxicity and pollutants.				
ESU-CCCh-10.1.1.1	Action Step	Water Quality	Work with EPA, RWQCBs and CDFW to identify and prioritize potential contaminants of concern and develop protective standards and programs for issues that directly or indirectly adversely affect the continued existence of listed salmonids.	2	5	EPA, CDFW, RWQCB	
ESU-CCCh-10.1.1.2	Action Step	Water Quality	Conduct outreach to increase awareness of the effects of pharmaceuticals, pesticides and contaminants that impact the continued existence and habitat of listed salmonids.	2	5	EPA, CDFW, NGO, NMFS, RWQCB	
ESU-CCCh-10.1.1.3	Action Step	Water Quality	Support the development and implementation of stormwater BMPs in cities, towns and rural areas.	2	5	City, County, Local, Private Landowners, State, RWQCB	
ESU-CCCh-10.1.1.4	Action Step	Water Quality	Implement performance standards in Stormwater Management Plans.	2	5	City, County, Private Landowners, State, RWQCB	
ESU-CCCh-10.1.1.5	Action Step	Water Quality	Work with pesticide users to educate and advocate for an "integrative pest management framework (IPM)" for pesticide control.	2	5	City, County, NMFS, Private Landowners, State, RWQCB	Best management practices within the IPM include biological control, pesticide choices, removal of pest habitat and resources, barriers, optimal fertilization and irrigation, trap plants, intercropping, and cover crops, and synthetic mulches.
ESU-CCCh-10.1.1.6	Action Step	Water Quality	Work with the California Department of Pesticide Regulation (CDPR) to support changes to professional pesticide application methodologies and timing to limit the potential exposure of watercourses to pesticide runoff.	3	5	City, County, NMFS, Private Landowners, State, RWQCB	For example: change building infrastructure applications of pyrethoids on monthly schedules throughout the entire year including the rainy season to seasons of interest.
ESU-CCCh-10.1.1.7	Action Step	Water Quality	Work with the academic, local, government and non-profit entities (Natural Resource Conservation District, etc.) to support funding of research and use of pesticide alternatives.	3	15	Academic, Local, Government, NGO	These alternatives may include technologies that reduce the amount of pesticides that need to be applied or pest management strategies that require very little pesticide use.
ESU-CCCh-10.1.1.8	Action Step	Water Quality	Work with EPA, RWQCBs, and local stakeholders to implement actions under section 303(d)(1)(C) and (D) of the Clean Water Act requiring States to prepare TMDLs for all water bodies targeted in this recovery plan not currently meeting State of California water quality standards.	2	25	EPA, NMFS, RWQCB, State	
ESU-CCCh-10.1.1.9	Action Step	Water Quality	Install bollards at fire hydrants that are in proximity to streams inorder to prevent hydrants from being hit and discharging chlorinated water into thestreams.	3	10	CalFire, City, County, Local Fire Departments	Hit hydrants will discharge very high volumes of chlorinated water that has thepotential to wipe out a steelhead population in a stream. This action could preventcatastrophic loss of steelhead.
ESU-CCCh-10.1.1.10	Action Step	Water Quality	Research into the potential level of impacts from and solutions to environmental estrogens associated with wastewater discharge and domestic septic leakage are needed.	2	10	RWQCB, Cities, Water Agencies	
ESU-CCCh-10.1.2	Recovery Action	Water Quality	Reduce sedimentation				
ESU-CCCh-10.1.2.1	Action Step	Water Quality	Support actions and tasks identified in the Regional Water Board Staff Work Plan to Control Excess Sediment in Sediment-Impaired Watersheds.	2	10	NMFS, RWQCB	http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/sediment_workplan/
10.2	**Objective**	**Water Quality**	**Address Inadequacy of existing regulatory conditions**				
ESU-CCCh-10.2.1	Recovery Action	Water Quality	Reduce toxicity and pollutants.				
ESU-CCCh-10.2.1.1	Action Step	Water Quality	Work with the RWQCB to support and fast track promulgation of methods to detect impacts from pharmaceuticals and pesticides and other CECs under 40 C.F.R. Part 136, followed by adoption of water quality criteria for pollutants covered by these methods.	2	10	NMFS, RWQCB, State	
ESU-CCCh-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
ESU-CCCh-11.1.1	Recovery Action	Viability	Increase abundance, spatial structure and diversity.				
ESU-CCCh-11.1.1.1	Action Step	Viability	Finalize and implement the California Coastal Salmonid Monitoring Plan.	1	50	CDFW, County, NGO, RCD, Watershed Partners, Water Agencies	Implementing the California Coastal Monitoring Plan is essential for evaluating the long-term viability of listed salmonids in California. For specific components of the Coastal Monitoring Plan see Vol.1 Chapter 6.

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-11.1.1.2	Action Step	Viability	Prioritize restoration funds, notably the Pacific Coast Salmon Restoration Fund and California's Fisheries Restoration Grant Program (FRGP), to address issues in critical watersheds identified within this recovery plan.	1	50	CDFW, NMFS	
ESU-CCCh-11.1.1.3	Action Step	Viability	Work with the SWFSC to revise the "Intrinsic Potential" model in areas where the model predictions has a severe or high bias and evaluate current conditions where the model indicates the highest values, in order to direct the prioritization of restoration funds.	2	5	NMFS, SWFSC	
ESU-CCCh-11.1.1.4	Action Step	Viability	Support all educational and outreach conferences, events, workshops, etc. that advance the understanding of anadromous salmonid life history, ecology, history, biology, threats, habitat restoration, recovery, and species viability to include all those with a science, restoration, and policy focus.	2	50	Academic, BOF, CalFire, CDFW, NGO, NMFS, SWFSC	
ESU-CCCh-11.1.1.5	Action Step	Viability	Support studies, assessments, science, research, and monitoring (including associated modeling, data management, data analysis, and reporting) that will improve our understanding of species life history and genetic diversity, historical distribution, habitat relationships, status, trends, viability, and spatial structure including those for drought and climate change	2	50	Academic, BOF, CalFire, CDFW, NGO, NMFS, SWFSC	
ESU-CCCh-11.1.1.6	Action Step	Viability	Develop and implement watershed based restoration plans for essential and supporting populations.	1	100	CDFW, Cites, Counties, NGOs, NMFS, RCDs, Water Agencies	Watershed plans should focuses on restoring processes that form, connect, and sustain habitats and provide watershed-wide and reach-specific, detailed restoration actions. Such a plan should be based on geomorphic and ecosystem principles and scientific assessments that: 1) identify the types and natural rates of habitat-forming processes, 2) determine where processes are altered and the factors responsible, 3) decide how to restore the disrupted processes, and 4) provide watershed-wide and reach-specific restoration actions. Once developed, the watershed plans should fit into an adaptive management process and be used to refine actions described in the recovery plan.
ESU-CCCh-11.1.1.7	Action Step	Viability	Federal and State regulatory agencies should encourage city, county and water agencies to incorporate the Multispecies Recovery Plan into their watershed planning documents and Habitat Conservation Plans.	2	100	CDFW, Cites, Counties, NMFS, Water Agencies	
ESU-CCCh-11.2	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
ESU-CCCh-11.2.1	Recovery Action	Viability	Monitor habitat quality and extent and watershed land use change				
ESU-CCCh-11.2.1.1	Action Step	Viability	Establish at least one Intensively Monitored Watershed (IMW) within each diversity stratum (preferably a population with a LCM station) to assess the habitat conditions and the effectiveness of implemented restoration actions.	2	50	CDFW, Counties, NGO, NOAA SWFSC, NPS, Private Consultants, Private Landowners, Resource Conservation Districts, Water Agencies	IMWs are watersheds that are monitored to the extent that the limiting factors are followed and the impact of management actions on fish or habitat can be demonstrated (see ISEMP at http://www.isemp.org/). Conduct power analysis early in development to determine amount of watershed required to be treated necessary to detect 30-50 percent change in population response. Also, use salmonid response (i.e., presence, abundance, and fitness monitoring) at restoration sites to inform effectiveness over time

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-11.2.1.2	Action Step	Viability	Conduct implementation, effectiveness and validation monitoring for restoration projects where necessary and appropriate.	2	50	CDFW, Cities, Counties, NGO, NOAA SWFSC, NPS, NRCS, Private Consultants, Private Landowners, Resource Conservation Districts, State Parks, USFS, Water Agencies	Monitoring must be in accordance with the following specifications: a). The design and implementation of restoration actions should be reported and correlated with known habitat limiting factors, so cumulative impacts can be tracked across the ESU/DPS. b). Where restoration actions are implemented, effectiveness monitoring should be conducted at both the reach and site-specific scales following the Before After Control Impact (BACI) design; and c) Use salmonid response (i.e., presence, abundance, and fitness monitoring) at restoration sites to inform effectiveness over time.
ESU-CCCh-11.2.1.3	Action Step	Viability	Monitor land use and other non-landscape attributes using GIS. In addition to general land use patterns (i.e. agriculture, timber, and urban), other watershed-specific attributes that should be measured include: the extent of impervious surfaces, landslides, watershed road density, and overall riparian conditions. This should be repeated approximately every 10 years.	1	50	CDFW, Counties, NGO, NMFS, NPS, Private Consultants, Private Landowners, Resource Conservation Districts, US EPA, USFS, Water Agencies	
ESU-CCCh-11.2.1.4	Action Step	Viability	Monitor storm-water and agricultural runoff to assess status/trends of turbidity and concentrations of other identified toxins and identify their sources. Where necessary, expand monitoring beyond those already implemented and required by other agencies or laws.	2	50	Cities, Counties, Farm Bureau, NGO, NPS, Private Consultants, Private Landowners, Resource Conservation Districts, State Parks, State Water Resources Control Board, Trout Unlimited, USEPA, USFS	Where necessary, expand monitoring beyond to other areas or increased frequency than those already required of by other agencies or laws.
ESU-CCCh-11.2.1.5	Action Step	Viability	Monitor water temperature throughout individual populations using arrays of automated data loggers (Isaak et al. 2011), particularly within populations with an LCM station or in populations where water temperature has been identified as a potential limiting factor.	1	50	California Coastal Conservancy, CDFW, Counties, NGO, NOAA SWFSC, NPS, Private Consultants, Private Landowners, Resource Conservation Districts, Trout Unlimited, USEPA, USFS, USGS, Water Agencies	Temperature data loggers (e.g., Onset HOBO v2 Data Loggers) cost approximately $130 per unit. Cost estimates per population would depend on the size of the watershed and number of units needed within each watershed. Also, cost for data management and analysis would need to be considered.
ESU-CCCh-11.2.1.6	Action Step	Viability	Monitor the status and spatial pattern of stream flows, particularly for populations where impaired stream flow was identified as a potential limiting factor.	2	50	CDFW, Cities, Counties, NGO, NOAA SWFSC, NPS, PG&E, Private Consultants, Private Landowners, Resource Conservation Districts, State Parks, State Water Resources Control Board, USEPA, USFS, USGS, Water Agencies	Where necessary, coordinate with USGS and/or local governments, non-governmental organizations and water agencies to install additional stream flow gages to assist with stream flow tracking. Seek funding to maintain existing facilities, particularly long-term monitoring gages that may be discontinued due to funding shortages.
ESU-CCCh-11.2.1.7	Action Step	Viability	In accordance with the Coastal Monitoring Plan, develop and implement a water-quality and habitat-condition monitoring program for estuaries and seasonal bar-built lagoons	2	50	CDFW, Counties, NGO, NOAA/NMFS, NPS, Resource Conservation Districts, State Parks	As of Fall 2016, protocols and methods for monitoring water quality and habitat conditions in the estuaries/lagoons have not been developed for the CMP. At a minimum, lagoon water quality monitoring should be conducted for populations where the quality and extent of estuarine/lagoon habitat was identified as a current stress. This should include diurnal, seasonal, and event-based (i.e., a sudden change in weather, inflow, or management actions) monitoring of water temperature, dissolved oxygen, salinity profiles as well as an analysis of seasonal changes in freshwater inflow, depths, and invertebrate abundance and community composition. In addition, monitor the frequency, timing, and associated impacts (see above) of sand bar breaching for all lagoons where authorized and unauthorized manual breaching occurs.

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-11.2.1.8	Action Step	Viability	As part of the Coastal Monitoring Plan, develop and implement a GRTS-based habitat status and trend monitoring program coordinated with the juvenile spatial structure evaluations	1	50	CDFW, Counties, NGO, SWFSC, Resource Conservation Districts, State Parks	The general methods for assessing habitat attributes will follow established programs such as the Columbia River Habitat Monitoring Program (CHaMP)
ESU-CCCh-11.3	**Objective**	**Viability**	**Address the overutilization for commercial, recreational, scientific or educational purposes**				
ESU-CCCh-11.3.1	Recovery Action	Viability	Monitor density, abundance, spatial structure and diversity				
ESU-CCCh-11.3.1.1	Action Step	Viability	In accordance with the Coastal Monitoring Plan, implement an unbiased GRTS-based monitoring program to assess CC Chinook salmon adult spawner abundance estimates at the ESU, diversity stratum, and, population level.	1	50	CDFW, Counties, NGO, NOAA SWFSC, NPS, Private Consultants, Private Landowners, Resource Conservation Districts, State Parks, Trout Unlimited, USACE, USGS, Water Agencies	See the Monitoring and Adaptive Management Chapter in Volume 1 for more information on adult spawner abundance cost estimates.
ESU-CCCh-11.3.1.2	Action Step	Viability	In accordance with the Coastal Monitoring Plan, establish a minimum of one (or preferably two) Life Cycle Monitoring stations within each diversity stratum to estimate spawner : redd ratios, conduct annual smolt abundance/trends, calibrate regional redd counts, and estimate smolt/adult ratios for marine/freshwater survival.	1	50	CDFW, Counties, NGO, NOAA SWFSC, NPS, Private Consultants, Private Landowners, Resource Conservation Districts, State Parks, USACE, USGS, Water Agencies	Strive to have abundance estimates at the LCM stations with a CV on average of 15 percent or less.
ESU-CCCh-11.3.1.3	Action Step	Viability	In accordance with the Coastal Monitoring Plan, implement GRTS-based summer and fall sampling to assess the abundance, distribution and diversity of juvenile steelhead and Chinook salmon.	1	50	CDFW, Counties, NGO, NOAA SWFSC, NPS, Private Consultants, Private Landowners, Resource Conservation Districts, State Parks, Trout Unlimited, USACE, USGS, Water Agencies	Juvenile Chinook salmon are generally not present in freshwater during late summer and fall and their rare presence during this period would be observed while conducting spatially balanced surveys for juvenile steelhead. See DPS-NCSW-11.3.1.3 and DPS-CCCS-11.3.1.3
ESU-CCCh-11.3.1.4	Action Step	Viability	In accordance with the Coastal Monitoring Plan, develop a biological monitoring program for estuaries and seasonal, bar-built lagoons (particularly in LCM populations) that will track salmonid abundance and use of these habitats over time.	1	50	CDFW, Counties, NOAA SWFSC, NPS, Private Consultants, Resource Conservation Districts, State Parks, Trout Unlimited, USACE, USFWS, Water Agencies	These data can be used to document potential limiting factors (e.g., stresses) affecting salmonid rearing in these habitats and highlight emerging threats over time. The estuary/lagoon monitoring protocol for the CMP has not been developed yet.
ESU-CCCh-11.3.1.5	Action Step	Viability	Monitor incidental capture and mortality rates of CC Chinook salmon, NC steelhead, and CCC steelhead in the recreational freshwater fisheries reported from Steelhead Fishing Report-Restoration Cards and creel surveys conducted by CDFW	2	50	CDFW	
ESU-CCCh-11.3.1.6	Action Step	Viability	Continue to annually monitor and assess intentional and incidental capture and mortality rates of CC Chinook salmon, NC steelhead, and CCC steelhead resulting from permitted research to ensure established take limits are adequate to protect these species.	2	50	CDFW, NMFS PRD	
ESU-CCCh-11.3.2	Recovery Action	Viability	Prevent reduced density, abundance, and diversity				
ESU-CCCh-11.3.2.1	Action Step	Viability	Develop Fisheries Monitoring and Evaluation Plans (FMEP) that incorporate delisting criteria, does not limit attainment of population-specific criteria and are specifically designed to monitor and track catch and mortality of wild and hatchery salmon and steelhead stemming from recreational fishing in freshwater and the marine habitats	2	20	CDFW, NMFS	
ESU-CCCh-11.3.2.2	Action Step	Viability	Develop and implement an expanded Genetic Stock Index (GSI) monitoring program for Pacific salmonids. This will help track ocean migrations of Chinook salmon, their origin, and an index of incidental capture and mortality rates in the commercial and recreational fisheries.	3	50	CDFW, NMFS, NOAA SWFSC	
ESU-CCCh-11.3.2.3	Action Step	Viability	Encourage continued scientific research on the effects of Chinook salmon and steelhead population declines on reduced marine-derived nutrients in freshwater habitats (Hill et al. 2010; Moore et al. 2011)	2	50	CDFW, NMFS, NOAA SWFSC	
ESU-CCCh-11.3.2.4	Action Step	Viability	Continue coordination between NMFS and CDFW on revisions to freshwater sport fishing regulations to ensure impacts do no preclude CC Chinook salmon, NC steelhead, and CCC steelhead recovery and impacts to their populations during migrations are minimized	2	50	CDFW, NMFS	
11.4	**Objective**	**Viability**	**Address disease or predation**				

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-11.4.1	Recovery Action	Viability	Increase density, abundance, spatial structure and diversity				
ESU-CCCh-11.4.1.1	Action Step	Viability	Annually, estimate the infection and mortality rates of juvenile Chinook salmon and steelhead from pathogens in populations where diseases are identified as a High or Very High threat	3	50	CDFW, Counties, NGO, NOAA SWFSC, NPS, Private Consultants, Private Landowners, State Parks, USGS, Water Agencies	Infection rates may be determined during spatial sampling throughout the ESU/DPS.
ESU-CCCh-11.4.1.2	Action Step	Viability	Annually monitor the status and trends of non-native predators in populations where predation is identified as a High or Very High threat.	3	50	CDFW, Counties, NGO, NOAA SWFSC, NPS, Private Consultants, Private Landowners, Resource Conservation Districts, State Parks, Water Agencies	General status and trends of non-native predators would partially be assessed during the spatially balanced GRTS sampling for juvenile distribution and abundance. Additional monitoring/funding may be necessary for populations with large or fluctuating populations of these species.
ESU-CCCh-11.4.1.3	Action Step	Viability	Coordinate with CDFW to develop and implement plans to assess the impacts of non-native predators on Chinook salmon and steelhead populations, and where necessary, reduce populations of these species	2	50	CDFW, NMFS	
ESU-CCCh-11.4.1.4	Action Step	Viability	During the 5-year status reviews, re-assessing the status of non-native predatory species in populations where predation was not originally identified as a High or Very High threat to ensure expansion of non-native predatory species or the introduction of new predatory species has not occurred	3	50	CDFW, NMFS	
ESU-CCCh-11.4.1.5	Action Step	Viability	Compile information on predation rates of juvenile steelhead and Chinook salmon by birds (freshwater and marine), pinnipeds, and introduced fish species (e.g., striped, largemouth, and smallmouth bass) and encourage additional research and monitoring to further evaluate their impacts and potential strategies for predation reduction	2	50	CDFW, NMFS	
ESU-CCCh-11.4.1.6	Action Step	Viability	Where applicable encourage implementation of Conservation Hatchery programs for severely depressed populations that follow criteria outlined in Spence et al. (2008) an d CDFG (2004)	2	50	CDFW, NMFS, SWFSC	
11.5	**Objective**	**Viability**	**Address the inadequacy of existing regulatory mechanisms**				
ESU-CCCh-11.5.1	Recovery Action	Viability	Increase density, abundance, spatial structure and diversity				
ESU-CCCh-11.5.1.1	Action Step	Viability	Develop a recovery plan tracking system to track the implementation status of specific recovery actions identified in this recovery plan	1	20	NMFS	
ESU-CCCh-11.5.1.2	Action Step	Viability	Monitoring the implementation and effectiveness of Best Management Practices (BMPs)	3	50	BLM, CDFW, Counties, NGO, NMFS, NRCS, Private Consultants, Resource Conservation Districts, State Parks, State Water Resources Control Board, USGS, Water Agencies	With the assistance of other Federal, State, and local resource agencies, track voluntary and required implementation of best management practices (BMPs) within each diversity stratum, compile any post-implementation data that may indicate the effectiveness of the implemented BMPs, and where necessary, conduct effectiveness monitoring of BMPs
ESU-CCCh-11.5.1.3	Action Step	Viability	Develop and implement a randomized sampling program to determine whether permitees are in compliance with permits issued under local and State regulatory actions designed to protect riparian and instream habitat and applicable agencies are enforcing permit requirements.	2	50	CDFW, NMFS, SWRCB, USACE, USEPA, USFWS	
ESU-CCCh-11.5.1.4	Action Step	Viability	Work with CDFW to develop a revised protocol for implementing fish rescue for threatened species under NMFS' ESA section 4(d) rule (50 C.F.R. 223.203(b)(3)) that will enhance rescue response and efficiency, tracking relevant fisheries data obtained during the rescues (e.g., number/densities of fish per area rescued, age classes of rescued fish, and sex ratios of rescued adults), and developing criteria for estimating population-level benefits from the rescues.	1	50	CDFW, NMFS	
ESU-CCCh-11.6	**Objective**	**Viability**	**Address other natural or manmade factors affecting the species' continued existence**				
ESU-CCCh-11.6.1	Recovery Action	Viability	Increase density, abundance, spatial structure and diversity				
ESU-CCCh-11.6.1.1	Action Step	Viability	Develop and implement Hatchery and Genetic Management Plans (HGMPs). This will rely on the development of a consistent and timely approval process between CDFW and NMFS	2	20	CDFW, NMFS	

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-11.6.1.2	Action Step	Viability	Conduct annual assessments of the percent of hatchery origin spawners (pHOS) where applicable	1	50	CDFW, NGO, NMFS, NOAA SWFSC, NPS, Pacific States Marine Fisheries Commission, Private Consultants, Private Landowners, Resource Conservation Districts, State Parks, Water Agencies	To achieve broad sense recovery, pHOS should not exceed 10 percent in any population. Estimates of percent hatchery origin would developed using data obtained from spawning ground surveys and from both LCMs and hatcheries.
ESU-CCCh-11.6.1.3	Action Step	Viability	Encourage funding for the continuation and expansion of the SWFSC's ocean net surveys conducted as part of their California Current Salmon Ocean Survey	2	50	CDFW, NMFS, NOAA SWFSC, Pacific States Marine Fisheries Commission	
ESU-CCCh-12.1	**Objective**	**Agriculture**	**Address the present of threatened destruction, modification, or curtailment of the species habitat or range.**				
ESU-CCCh-12.1.1	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance.				
ESU-CCCh-12.1.1.1	Action Step	Agriculture	Continue existing cooperative conservation programs (such as Fish Friendly Farming or Fish Friendly Ranching, farming organically/biodynamically) in order to minimize the impacts of agricultural operations on habitat quality.	2	20	NMFS, NRCS, Private Landowners, RCD, RWQCB, State	
ESU-CCCh-12.1.1.2	Action Step	Agriculture	Encourage and assist the NRCS and RCDs to increase the number of landowners participating in sediment reduction planning and implementation.	2	20	NMFS, NRCS, Private Landowners, RCD, RWQCB, State	
ESU-CCCh-12.1.1.3	Action Step	Agriculture	Develop incentive programs and incentive-based approaches for landowners who conduct operations in a manner compatible with salmonid recovery requirements.	3	20	NMFS, NRCS, Private Landowners, RCD, RWQCB, State	
ESU-CCCh-12.1.1.4	Action Step	Agriculture	Continue and expand the use of cover crops in agriculture fields to reduce sediment runoff.	3	10	Private Landowners	
ESU-CCCh-12.1.2	Recovery Action	Agriculture	Prevent or minimize impairment to watershed hydrology				
ESU-CCCh-12.1.2.1	Action Step	Agriculture	Support projects that build agricultural ponds as an alternative to summer riparian diversions.	2	15	NMFS, NRCS, Private Landowners, RCD, RWQCB, State, SWRCB	
ESU-CCCh-12.1.2.2	Action Step	Agriculture	If water is used for frost protection measures, encourage SWRCB to require the use of flow metering in such circumstances to ensure flows are maintained for other beneficial uses.	2	5	NMFS, Private Landowners, RWQCB, State, SWRCB	
ESU-CCCh-12.1.2.3	Action Step	Agriculture	Utilize BMP's for irrigation (cover crop, drip) and frost protection (wind machines, cold air drains, heaters, or micro-sprayers) which eliminate or minimize water use.	2	10	NMFS, NRCS, Private Landowners, RCD, RWQCB, State	
ESU-CCCh-12.1.2.4	Action Step	Agriculture	Re-design levee systems to back-flood alluvial basin recharge zones in flood tolerant agricultural areas.	3	20	Corps, County, NMFS	
12.2	**Objective**	**Agriculture**	**Address the inadequacies of existing regulatory mechanisms.**				
ESU-CCCh-12.2.1	Recovery Action	Agriculture	Prevent or minimize impairment to watershed hydrology				
ESU-CCCh-12.2.1.1	Action Step	Agriculture	NMFS and CDFW should request to be included as technical experts in ongoing legislative efforts to craft marijuana cultivation regulations.	2	5	CDFW, NMFS	
ESU-CCCh-12.2.1.2	Action Step	Agriculture	Counties should condition approval of new developments (e.g. vineyards) in order to require developers to demonstrate that water is available, without adversely affecting public trust resources.	2	10	County, Private, SWRCB	
ESU-CCCh-12.2.1.3	Action Step	Agriculture	Promote the use of reclaimed waste water for agricultural, landscape and other appropriate applications.	2	10	City, County, Private, NMFS, State, RWQCB, SWRCB	
ESU-CCCh-12.2.1.4	Action Step	Agriculture	Encourage the use of low-flow alternatives such as micro-sprinklers, and encourage alternative forms of frost protection that do not use water, such as wind machines.	2	10	City, County, Private Landowners, NMFS, State	
ESU-CCCh-12.2.1.5	Action Step	Agriculture	NMFS and CDFW should work with state/federal attorneys and the Counties District Attorney's office to coordinate prosecutorial strategies for environmental crimes arising from marijuana cultivation.	2	5	CDFW, County, NMFS, State	
ESU-CCCh-12.2.2	Recovery Action	Agriculture	Prevent or minimize impairment to watershed hydrology				
ESU-CCCh-12.2.2.1	Action Step	Agriculture	Minimize impacts from new vineyard development by enforcement of land use zoning appropriate to the site to protect floodplain and riparian processes.	2	20	County, CDFW, NMFS	
ESU-CCCh-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
ESU-CCCh-13.1.1	Recovery Action	Channel Modification	Prevent or minimize increased landscape disturbance.				

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-13.1.1.1	Action Step	Channel Modification	Collaborate with local, state, and federal agencies and non-governmental organizations to acquire fee-title to parcels or conservation easements over strategically-selected stream and riparian corridors to protect salmon and steelhead migratory, spawning, and rearing habitats.	3	50	City, County, Federal, Local, NGO, State	
ESU-CCCh-13.1.1.2	Action Step	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel. Where riprap and other bank hardening is necessary, integrate other habitat-forming features – including large woody debris and riparian plantings and other methodologies to minimize habitat alteration effects.	2	10	City, County, Private Landowner, State, Water Agencies	
ESU-CCCh-13.1.1.3	Action Step	Channel Modification	When bank stabilization projects are required to protect existing infrastructure require bio-engineering methods including use of vegetated soil lifts, log crib walls, willow matresses and planted rock embankments where rip rap is required.	2	10	City, County, Private Landowner, State, Water Agencies	
ESU-CCCh-13.1.1.4	Action Step	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Focus on ensuring minimal disruption to watershed processes.	2	10	City, County, Private Landowner, State, Water Agencies	
ESU-CCCh-13.2	**Objective**	**Channel Modification**	**Address the inadequacy of existing regulatory mechanisms.**				
ESU-CCCh-13.2.1	Recovery Action	Channel Modification	Prevent or minimize increased landscape disturbance.				
ESU-CCCh-13.2.1.1	Action Step	Channel Modification	Encourage Counties and municipalities to adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	15	County, County Municipalities, NMFS	
ESU-CCCh-13.2.1.2	Action Step	Channel Modification	Encourage FEMA to set regulatory standards in its Flood Insurance Program to explicitly address the protection of natural fluvial processes essential for the maintenance of naturally functioning riverine and riparian habitats.	2	15	FEMA, NMFS	
ESU-CCCh-14.1	**Objective**	**Disease/Predation/Competition**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
ESU-CCCh-14.1.1	Recovery Action	Disease/Predation/Competition	Prevent or minimize reduced density, abundance, and diversity based on biological viability criteria				
ESU-CCCh-14.1.1.1	Action Step	Disease/Predation/Competition	Provide funding to investigate and remediate impacts of disease and predation to overall viability.	3	20	Academic, CDFW, NMFS, SWFSC	
ESU-CCCh-14.1.1.2	Action Step	Disease/Predation/Competition	Evaluate impacts of striped bass predation in coastal estuaries to juvenile and smolt salmonids and implement abatement strategies where appropriate.	2	10	CDFW, NMFS	See Monitoring Chapter
ESU-CCCh-14.1.1.3	Action Step	Disease/Predation/Competition	Support CDFW, and other resource agencies to control and contain invasive species in California.	2	10	CDFW, NMFS	
ESU-CCCh-14.1.1.4	Action Step	Disease/Predation/Competition	Provide support to the Invasive Species Council of California (ISCC), and the California Invasive Species Advisory Committee (CISAC) in their efforts to effectively control invasive species.	2	10	CISAC, ISCC, NMFS	
ESU-CCCh-14.1.1.5	Action Step	Disease/Predation/Competition	Work with Counties to modify existing tree ordinances (e.g., Heritage Tree Ordinance) to exclude protection of non-native trees (e.g., *Eucalyptus* sp.) and waive any associated fees for non-native tree removal, particularly when part of a restoration project or on pubic lands.	3	10	County, NMFS, CDFW	
ESU-CCCh-14.1.1.6	Action Step	Disease/Predation/Competition	Promote the practice of Clean, Drain, and Dry for watercraft and equipment used in aquatic environments. Additional information can be found at https://www.wildlife.ca.gov/Conservation/Invasives	2	5	Citizens, CDFW, NMFS	
ESU-CCCh-14.1.1.7	Action Step	Disease/Predation/Competition	Minimize channel modifications that create bare rock walls along migration routes to avoid creating predation habitat for bass. Where feasible modify existing sites that currently act as predation habitat hotspots.	2	19	County, NMFS, CDFW	
ESU-CCCh-15.1	**Objective**	**Fire/Fuel Management**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
ESU-CCCh-15.1.1	Recovery Action	Fire/Fuel Management	Prevent or minimize increased landscape disturbance.				
ESU-CCCh-15.1.1.1	Action Step	Fire/Fuel Management	Review prescribed fire plans to ensure they provide adequate protection for riparian corridors.	2	10	CalFire, CDFW, Local Fire Districts, NMFS	
ESU-CCCh-15.1.1.2	Action Step	Fire/Fuel Management	Identify historical fire frequency, intensities and durations and manage fuel loads in a manner consistent with historical parameters.	2	10	CalFire, CDFW, Local Fire Districts, NMFS	

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-15.1.1.3	Action Step	Fire/Fuel Management	Include CDFW and NMFS participation on rehabilitation planning teams. During rehabilitation, consider leaving felled trees in streams as LWD source. Re-contour massively modified areas. Storm-proof roads immediately after use. Dispose of suitable organic materials by dispersing them on disturbed soils on the contour. Where larger organic material is available, place in severely burned-out watercourses (assure CDFW/NMFS is a part of this design and decision). Seeding, preferably with local seed-stock, at high hazard/risk areas should be done whenever feasible.	2	10	CalFire, CDFW, Local Fire Districts, NMFS	
ESU-CCCh-15.1.1.4	Action Step	Fire/Fuel Management	Establish fire contingency plans that involve CalFire, local fire districts and regulatory agencies with expertise in fisheries issues.	2	10	CalFire, CDFW, Local Fire Districts, NMFS	
ESU-CCCh-15.1.1.5	Action Step	Fire/Fuel Management	Use controlled, low severity fire to dampen fuel loading and crowding of forest vegetation.	2	10	CalFire, CDFW, Local Fire Districts, NMFS	
ESU-CCCh-15.1.2	Recovery Action	Fire/Fuel Management	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
ESU-CCCh-15.1.2.1	Action Step	Fire/Fuel Management	Disseminate recommendations from NMFS' October 9, 2007, jeopardy biological opinion on the use of fire retardants and its impacts to salmonids, to local firefighting agencies and CalFire.	2	5	CalFire, CDFW, Local Fire Districts, NMFS	
ESU-CCCh-15.1.2.2	Action Step	Fire/Fuel Management	Locate chemicals, petroleum products, latrines, camp sites, etc., out of riparian buffer and place on flat ground.	2	5	CalFire, CDFW, Local Fire Districts, NMFS	
ESU-CCCh-15.1.3	Recovery Action	Fire/Fuel Management	Prevent or minimize impairment to watershed hydrology				
ESU-CCCh-15.1.3.1	Action Step	Fire/Fuel Management	Obtain water from lakes and reservoirs not occupied by listed salmonids when possible. Require all water trucks/tenders be fitted with CDFW and NMFS approved fish screens when water is acquired at fish bearing streams. Put up a silt fence or other erosion controls around the water extraction locations. Avoid significantly lower stream flows during water drafting.	2	100	CalFire, CDFW, Local Fire Districts, NMFS	NMFS anticipates that it will take up to 5 years for this to be implemented but should continue in perpetuity
ESU-CCCh-16.1	**Objective**	**Fishing/Collecting**	**Address the overutilization for commercial, recreational, scientific or educational purposes.**				
ESU-CCCh-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity based on biological viability criteria				
ESU-CCCh-16.1.1.1	Action Step	Fishing/Collecting	Fishery managers should work with NMFS to develop Fishery Management and Evaluation Plans to prevent extinction and ensure fishery management is consistent with recovery of the species, and cover incidental take of federally listed salmonids.	1	5	CDFW, CA Fish and Game Commission, NMFS SFD, SWFSC	
ESU-CCCh-16.1.1.2	Action Step	Fishing/Collecting	Collaborate with CDFW to develop appropriate fisheries data in select indicator watersheds that will support Fishery Management and Evaluation Plans (FMEPs).	1	5	CDFW, CA Fish and Game Commission, NMFS	
ESU-CCCh-16.1.1.3	Action Step	Fishing/Collecting	Work with CDFW and Fish and Game Commission to refine freshwater sport fishing regulations to minimize unintentional and unauthorized take, and incidental mortality, of listed species by anglers during the migration period. This effort could include development of specific emergency regulations during adult migration periods between September and January, low-flow closures (much like Washington State) and angler outreach programs.	1	5	CDFW, CA Fish and Game Commission, NMFS	
ESU-CCCh-16.1.1.4	Action Step	Fishing/Collecting	Work with CDFW to develop protective regulations and seek funds for additional Game Wardens to minimize impacts from fishing during the migratory period (e.g., until sandbars open naturally) within one mile of the river mouths of watersheds with essential or supporting populations.	1	5	CDFW, CA Fish and Game Commission, NMFS	
ESU-CCCh-16.1.1.5	Action Step	Fishing/Collecting	Improve CDFW's Freshwater Sport Fishing Regulations by considering prohibiting removal of wild salmonids from the water in catch-and-release fisheries.	2	5	CDFW, CA Fish and Game Commission, NMFS	
ESU-CCCh-16.1.1.6	Action Step	Fishing/Collecting	Consider additional data/information requirements on the Steelhead Report Card. Consider the recording of Chinook and coho salmon incidental catch and if they are of wild or hatchery origin (adipose clipped).	2	5	CDFW, CA Fish and Game Commission, NMFS	
ESU-CCCh-16.1.1.7	Action Step	Fishing/Collecting	Utilizing the "reminder postcard" in efforts to increase Steelhead Report Card (SRC) return rates has worked well and is applauded by fisheries managers. Work with CDFW to consider providing, additional incentives to return SRCs by the January 31 deadline to save time and money while gaining more angler participation, which will provide more accurate information for agency evaluation.	2	5	CDFW, CA Fish and Game Commission, NMFS	Example: Oregon DFW holds a drawing each year for anglers that return their salmon/steelhead/sturgeon/halibut harvest cards before the pre-determined date. Prizes are substantial, typically including a drift boat etc.

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-16.1.1.8	Action Step	Fishing/Collecting	Work with CDFW to bring more awareness to special salmonid conservation propagation programs and improve salmonid identification outreach; especially in areas where a mixed stock fishery occurs (example: Russian River).	2	5	CDFW, CA Fish and Game Commission, NMFS	
ESU-CCCh-16.1.1.9	Action Step	Fishing/Collecting	Consider banning felt sole wading boots in California waters in efforts to minimize or eliminate the spread of aquatic diseases and invasive species (example: didymo, New Zealand mud snails, whirling disease, etc.).	2	5	CDFW, CA Fish and Game Commission, NMFS	
ESU-CCCh-16.1.1.10	Action Step	Fishing/Collecting	Consider other incentives for greater angler participation in fisheries restoration efforts.	2	10	CDFW, CA Fish and Game Commission, NMFS	For example, the Game Warden Stamp is an excellent way to gain more angler and hunter participation and support. Other stamp, sponsorships, and/or lottery fundraising programs that support recovery objectives should be discussed and developed.
ESU-CCCh-16.1.1.11	Action Step	Fishing/Collecting	Collaborate with NOAA OLE, CDFW, Tribes and stakeholders groups to enhance anti-poaching efforts in essential and supporting populations.	2	5	CDFW, Local Citizens, NOAA OLE, Tribes	
ESU-CCCh-16.1.1.12	Action Step	Fishing/Collecting	Determine impacts of ocean fisheries management on CC Chinook salmon in terms of VSP parameters. Identify level of ocean fishing impacts that would not limit attainment of population-specific viability criteria.	1	10	CDFW, CA Fish and Game Commission, NMFS, NMFS SFD, SWFSC	
ESU-CCCh-16.1.1.13	Action Step	Fishing/Collecting	If actual ocean fishing impacts limit attainment of population-specific viability criteria, modify management so that ocean fishing impacts do not limit attainment of population-specific viability criteria.	1	10	CDFW, CA Fish and Game Commission, NMFS, NMFS SFD	
ESU-CCCh-17.1	**Objective**	**Hatcheries**	**Address other natural or manmade factors affecting the species' continued existence.**				
ESU-CCCh-17.1.1	Recovery Action	Hatcheries	Prevent or minimize reduced density, abundance, and diversity based on biological viability criteria				
ESU-CCCh-17.1.1.1	Action Step	Hatcheries	For all hatchery operations, develop and implement HGMPs consistent with 50 CFR 223.203(b)(5) and hatchery criteria identified in Spence et al. (2008).	1	10	CDFW, Hatchery Managers, NMFS	Ensure the threat of hatcheries remains low for listed salmonids for current, and all future, hatchery programs.
ESU-CCCh-17.1.1.2	Action Step	Hatcheries	Hatchery managers need to implement the recommendations in the California Hatchery Scientific Review Group report (California HSRG 2012), where appropriate.	2	10	CDFW, Hatchery Managers, NMFS	
ESU-CCCh-17.1.1.3	Action Step	Hatcheries	Where applicable, for severely depressed populations investigate the implementation of Conservation Hatchery programs that follow criteria outlined in Spence et al. (2008) and CDFG (2004).	2	20	CDFW, Hatchery Managers, NMFS, SWFSC	
ESU-CCCh-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification or curtailment of the species habitat or range.**				
ESU-CCCh-18.1.1	Recovery Action	Livestock	Prevent or minimize increased landscape disturbance.				
ESU-CCCh-18.1.1.1	Action Step	Livestock	Aid and encourage willing landowners to fence livestock from the stream channel, municipal water sources and riparian zones and develop offstream alternative water sources.	2	15	NRCS, RCD, Private Landowners	
ESU-CCCh-18.1.1.2	Action Step	Livestock	Encourage Livestock and Ranch Managers to utilize Groundwork: A Handbook for Small-Scale Erosion Control in Coastal California (MRCD, 2007), and Management Tips to Enhance Land & Water Quality for Small Acreage Properties (Sotoyome RCD, 2007), and The Grazing Handbook (Sotoyome RCD, 2007).	3	15	NRCS, RCD, Private Landowners	
ESU-CCCh-18.1.1.3	Action Step	Livestock	Establish conservative residual dry matter (RDM) targets per acre to ensure areas are not overgrazed at the end of grazing season. Remove cattle from pasture before soils dry out.	3	15	NRCS, RCD, Private Landowners	
ESU-CCCh-18.1.1.4	Action Step	Livestock	Substitute continuous season-long use of pastures in favor of rotational grazing strategies to reduce runoff, improve soil conditions, minimize noxious weeds, and encourage native revegetation.	3	15	NRCS, RCD, Private Landowners	
ESU-CCCh-18.1.1.5	Action Step	Livestock	Work with existing cooperative conservation programs (such as Fish Friendly Farming or Fish Friendly Ranching) in order to minimize the impacts of Livestock operations on habitat quality.	3	15	NRCS, NMFS, RCD, Private Landowners	
ESU-CCCh-18.1.2	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
ESU-CCCh-18.1.2.1	Action Step	Livestock	Implement practices as outlined in the University of California guidelines for water quality protection (Ristow 2006)	2	10	NRCS, RCD, Private Landowners	
ESU-CCCh-18.1.2.2	Action Step	Livestock	Implement recommendations of the California Rangeland Water Quality Management Program.	2	10	NRCS, RCD, Private Landowners	

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of habitat or range.**				
ESU-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance.				
ESU-CCCh-19.1.1.1	Action Step	Logging	Encourage development of a GCP/HCP/Natural Community Conservation Plan (NCCP), conservation easements, conservation banks, or safe harbor agreements with industrial or non-industrial forestland owners.	2	50	County, Private Landowners, NMFS, State, Timber Landowners	
ESU-CCCh-19.1.1.2	Action Step	Logging	Investigate opportunities to programmatically permit the forest certification program to authorize incidental take for landowners through ESA Section 10(a)(1)(B).	3	15	NMFS, Private Landowners, Timber Landowners	
ESU-CCCh-19.1.1.3	Action Step	Logging	Consider assigning NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004) and work to implement recommendations as a result of these reviews	3	5	NMFS	
ESU-CCCh-19.1.1.4	Action Step	Logging	The State should consider a Salmonid Watershed Database (similar to the CDFW Northern Spotted Owl database) for RPFs to acquire standardized information on populations and habitat conditions in the watersheds associated with their harvest plan.	3	15	BOF, CDFW, Timber Landowners	
19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms.**				
ESU-CCCh-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance.				
ESU-CCCh-19.2.1.1	Action Step	Logging	Discourage Counties from rezoning forestlands or identified TPZ areas to rural residential or other land uses (e.g., vineyards).	3	50	County, NMFS	
ESU-CCCh-19.2.1.2	Action Step	Logging	Increase THP inspections by CalFire especially during winter months.	3	50	BOF, CalFire, CDFW, NMFS, Private Landowners, Timber Landowners	
ESU-CCCh-19.2.1.3	Action Step	Logging	Encourage to CalFire and BOF to explore a statewide Forestry HCP (similar to that developed in Washington State), GCP, safe harbor agreements, and seek funding opportunities to support the effort.	2	20	BOF, CalFire, CDFW, NMFS, Private Landowners, Timber Landowners	
ESU-CCCh-19.2.1.4	Action Step	Logging	Work with the BOF through implementation of California Forest Practice Rules, Section V, CalFire, CDFW, professional organizations and landowners to modify the timber harvest permitting process to provide opportunities and incentives for LWD recruitment during timber harvest operations.	1	25	BOF, CalFire, CDFW, NMFS, Private Landowners, Timber Landowners	
ESU-CCCh-19.2.1.5	Action Step	Logging	California BOF should consider requiring (1) EIRs for all forestland conversions, (2) adopting a forestland Conversion THP, (3) elimination of the subdivision exemption, (4) raising forestland conversion permit fees, (5) developing requirements to offset loss of timberland, (6) incentivize restoration of unproductive timberlands, (7) investigate conservation banking programs and (8) coordinate with the other agencies involved for more CalFire oversight on forestland conversions.	1	10	BOF, CDFW, NMFS, Private Landowners, Timber Landowners	
ESU-CCCh-20.1	**Objective**	**Mining**	**Address the present or threatened destruction, modification, or curtailment of habitat or range.**				
ESU-CCCh-20.1.1	Recovery Action	Mining	Prevent or minimize increased landscape disturbance.				
ESU-CCCh-20.1.1.1	Action Step	Mining	In sites with legacy terrace gravel mining pits, remove, setback, or breach levees and re-contour mining pits to an elevation inundated by frequent winter river/stream flows; Restore the inset floodplain at elevation appropriate for modern channel and regulated winter/spring base flows.	2	20	County, EPA, NMFS, Private, State	
ESU-CCCh-20.1.1.2	Action Step	Mining	Where economically and geomorphically feasible use gravel mining to create seasonal off-channel wetland, pond, alcove and secondary channel floodplain habuitats to increase winter refuge and rearing habitat.	2	10	County, EPA, NMFS, Private, State	
20.2	**Objective**	**Mining**	**Address the inadequacy of existing regulations**				
ESU-CCCh-20.2.1	Recovery Action	Mining	Prevent or minimize increased landscape disturbance.				
ESU-CCCh-20.2.1.1	Action Step	Mining	NMFS National Gravel Extraction Guidance (2005, 2014) and NMFS Southwest Region (2004) should be followed for all existing and proposed projects.	2	20	County, EPA, NMFS, Private, State	
ESU-CCCh-20.2.1.2	Action Step	Mining	Given the need for enormous amounts of water during fracking, oil companies and state/federal regulators should consult with NMFS/CDFW to ensure adequate water resources exist prior to developing the well. Avoid fracking operations that obtain water from underground aquifers hydrologically connected with surface streamflow.	2	10	County, EPA, NMFS, Private, State	

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Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-20.2.1.3	Action Step	Mining	Evaluate the potential for fracking to impact surface water quality (and thus impact salmon and steelhead) where hydrologic connectivity between ground and surface water exists.	2	10	EPA, NMFS, RWQCB, State	
ESU-CCCh-21.1	**Objective**	**Recreation**	**Address the present or threatened destruction, modification or curtailment of the species habitat or range.**				
ESU-CCCh-21.1.1	Recovery Action	Recreation	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
ESU-CCCh-21.1.1.1	Action Step	Recreation	Manage or limit mountain bike and equestrian activity on trails within state parks, state forests and on other publically-owned land that cause soil compaction, increased surface erosion, increased storm runoff and increased sediment input to stream channels.	3	10	City, County, Public, State	
ESU-CCCh-22.1	**Objective**	**Residential/Commercial Development**	**Address the present or threatened destruction, modification or curtailment of the species habitat or range.**				
ESU-CCCh-22.1.1	Recovery Action	Residential/Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
ESU-CCCh-22.1.1.1	Action Step	Residential/Commercial Development	Design new developments to avoid or minimize impact to unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to the habitat of listed salmonids.	3	20	City, County, County Planners, Public Works, State	
ESU-CCCh-22.1.2	Recovery Action	Residential/Commercial Development	Prevent or minimize impairment to watershed hydrology				
ESU-CCCh-22.1.2.1	Action Step	Residential/Commercial Development	Educate county and city public works departments, flood control districts, and planning departments, etc., on the critical importance of maintaining a mature and properly functioning riparian zone.	3	5	City, County, County Planners, Public Works, State	
ESU-CCCh-22.1.2.2	Action Step	Residential/Commercial Development	New development in all watersheds with essential and supporting populations should be designed to minimize storm-water runoff and changes in duration or magnitude of peak flow.	3	20	City, County, County Planners, RWQCB, State	
ESU-CCCh-22.2	**Objective**	**Residential/Commercial Development**	**Address the inadequacy of existing regulatory mechanisms.**				
ESU-CCCh-22.2.1	Recovery Action	Residential/Commercial Development	Prevent or minimize impairment to stream hydrology (impaired water flow).				
ESU-CCCh-22.2.1.1	Action Step	Residential/Commercial Development	As mitigation for potential adverse consequences to a watershed's hydrograph, municipalities and counties should develop and implement larger or more effective stormwater detention methods in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.	2	20	CDFW, County, Municipalities, NMFS, SWRCB	
ESU-CCCh-22.2.1.2	Action Step	Residential/Commercial Development	Develop and implement regulations for activities that intercept groundwater recharge.	2	10	CDFW, County, DWR, NMFS	
ESU-CCCh-22.2.1.3	Action Step	Residential/Commercial Development	Work with partners to develop legislation that will fund county planning for environmentally sound growth and water supply development and work in coordination with California Dept. of Housing, and other government associations (CDFG 2004).	2	30	County, NMFS, State	
ESU-CCCh-22.2.2	Recovery Action	Residential/Commercial Development	Prevent or minimize increased landscape disturbance.				
ESU-CCCh-22.2.2.1	Action Step	Residential/Commercial Development	Enforce existing building permit programs to minimize unpermitted construction.	3	50	City, County, County Planner	
ESU-CCCh-22.2.2.2	Action Step	Residential/Commercial Development	Modify Federal, State, city and county regulatory and planning processes to prevent or minimize new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all watersheds with essential and supporting populations.	2	15	City, County, Federal, NMFS, State	
ESU-CCCh-22.2.2.3	Action Step	Residential/Commercial Development	Identify forestlands or oak woodland areas at high risk of conversion, and develop incentives and alternatives for landowners to discourage conversion.	3	15	City, County, County Planner	
ESU-CCCh-22.2.2.4	Action Step	Residential/Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential development.	2	50	City, County, County Planner, NMFS, State	

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Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-22.2.2.5	Action Step	Residential/Commercial Development	Develop legislation that will fund county planning for environmentally sound growth and water supply and work in coordination with California Dept. of Housing, Association of Bay Area Governments, and other government associations (CDFG 2004).	2	15	City, County, County Planner, NMFS, State	
ESU-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
ESU-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
ESU-CCCh-23.1.1.1	Action Step	Roads/Railroads	For all rural (unpaved) and seasonal dirt roads apply, at a minimum, the road standards outlined in the most recent version of the California Forest Practice Rules.	2	50	BOF, Local, RWQCB, Timber Landowners	For roads subject to the California Forest Practices Rules
ESU-CCCh-23.1.1.2	Action Step	Roads/Railroads	Design new roadways to avoid or minimize effects to unstable slopes, wetland, floodplains and other areas of high habitat value.	2	50	BOF, Local, RWQCB, Timber Landowners	This action is consistent with requirements in California Forest Practices Rules at 14 CCR §§ 923 - 923.9.1.
ESU-CCCh-23.1.1.3	Action Step	Roads/Railroads	Conduct annual inspections of roads prior to winter. Correct conditions that are likely to deliver sediment to streams.	2	50	BOF, Local, RWQCB, Timber Landowners	This action is consistent with requirements in California Forest Practices Rules at 14 CCR §§ 923 - 923.9.1.
ESU-CCCh-23.1.1.4	Action Step	Roads/Railroads	Restoration projects that upgrade or decommission high risk roads adjacent to streams supporting listed salmonids should be considered an extremely high priority for funding (e.g., PCSRF).	2	50	BOF, Local, RWQCB, Timber Landowners	
ESU-CCCh-23.1.1.5	Action Step	Roads/Railroads	Conduct outreach and continual education regarding the adverse effects of roads and the types of best management practices protective of salmonids. Education should address watershed process and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	3	50	BOF, CalTrans, CDFW, NMFS, Timber Landowners	
ESU-CCCh-23.1.1.6	Action Step	Roads/Railroads	Evaluate and mitigate (where appropriate) the effects of transportation corridors and infrastructure on estuarine and stream fluvial processes. Mitigating measures may include, elevating existing approach, fill and maximizing clear spanning of upstream active channel(s), floodways, and floodplains to accommodate natural riverine and estuarine fluvial processes.	3	50	CDFW, NMFS, Timber Landowners	
ESU-CCCh-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration.				
ESU-CCCh-23.1.2.1	Action Step	Roads/Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and review appropriate barrier databases when developing new or retrofitting existing road crossings.	2	50	CalTrans, CDFW, City, County, County Planner, Engineers, NMFS, State	
ESU-CCCh-23.1.2.2	Action Step	Roads/Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents (i.e., pilings) feasible in order to minimize drift accumulation and facilitate fish passage.	2	50	CalTrans, CDFW, City, County, County Planner, Engineers, NMFS, State	
ESU-CCCh-23.1.2.3	Action Step	Roads/Railroads	For impact pile driving during construction, develop and implement sound attenuation methods that ensure sound levels are (1) below thresholds for onset of physical injury to fish (see NMFS' 2008 Interim Criteria for Injury to Fish from Pile Driving), (2) avoiding adverse behavioral effects (e.g., during adult migration, etc.), and (3) minimized by a reduction in the sound field (e.g., reduce the size of the area impacted). In situations where sound attenuation is not able to keep sound pressure at sub-injurious levels (i.e., sound levels that will not harm or injure fish), work should be conducted during seasonal work windows to avoid migrating salmonids.	2	50	CalTrans, CDFW, City, County, Engineers, NMFS, State	
ESU-CCCh-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance.				
ESU-CCCh-23.1.3.1	Action Step	Roads/Railroads	Encourage implementation of Vegetation Management Plans for the roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	3	50	CalTrans, CDFW, City, County, NMFS, State	
ESU-CCCh-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms.**				
ESU-CCCh-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to watershed hydrology.				
ESU-CCCh-23.2.1.1	Action Step	Roads/Railroads	Support and engage CalTrans, counties and others with oversight on road practices to reduce sediment delivery to streams from road networks and channelization from poorly situated roads.	2	50	CalTrans, County, NMFS, RWQCB	
ESU-CCCh-23.2.1.2	Action Step	Roads/Railroads	Encourage enforcement of existing regulations regarding grading, riparian and building violations and sediment release from county roads.	2	50	CalTrans, County, NMFS, RWQCB	

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Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-24.1	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species continued existence.**				
ESU-CCCh-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to watershed hydrology				
ESU-CCCh-24.1.1.1	Action Step	Severe Weather Patterns	Actively conduct outreach to stakeholders and the public regarding anticipated effects of climate change to salmonids and increase awareness that human actions can offset these effects. The public, local, state and federal agencies should become familiar with, and implement as necessary through lifestyle and policy changes, recommendations of the Intergovernmental Panel on Climate Change (IPCC).	3	5	Federal, Local, NMFS, Public, State	See the website http://www.ipcc.ch to view a summary of climate change issues for North America and the suite of actions from the IPCC to be considered for ecosystem (and human health) due to climate change.
ESU-CCCh-24.1.1.2	Action Step	Severe Weather Patterns	Develop a climate strategy that addresses simultaneously the reduction of fossil fuels and the protection of forestlands.	3	15	Academic, NWFSC, State, SWFSC,	For example, promote biological carbon sequestration best management practices (BMPs), where feasible, that are consistent with NMFS policies and guidelines. Develop incentives to maintain and rehabilitate forestlands, manage for older forests, discourage conversions or forest changes. Forestlands store carbon and reduce greenhouse gases.
ESU-CCCh-24.1.1.3	Action Step	Severe Weather Patterns	Expand research and monitoring to improve predictions of climate change and its effects on salmon recovery.	2	15	Academic, NWFSC, State, SWFSC,	Tools such as the Regional Climate System Model, Sea Level Rise and Coastal Flooding Impacts Viewer, etc. should be used to improve ecological forecasting of the threat of climate change, human population growth, and their impacts to salmonids and their habitats.
ESU-CCCh-24.1.1.4	Action Step	Severe Weather Patterns	Minimize anthropogenic increases in water temperatures by maintaining well-shaded riparian areas. Work to encourage and incorporate climate change vulnerability assessments and climate change scenarios in consultations, permitting, and restoration projects.	2	50	CDFW, Corps County, NMFS, NOAA RC, State	
ESU-CCCh-24.1.1.5	Action Step	Severe Weather Patterns	Maintain headwater areas in an undisturbed state to ensure a continuous source of cool water downstream.	1	50	CDFW, Corps, County, NMFS, NOAA RC, State	
ESU-CCCh-24.1.1.6	Action Step	Severe Weather Patterns	Maximize connectivity, and increase diversity, of instream habitats to allow a full range of opportunities for salmonids to exploit as environmental conditions shift.	2	100	CDFW, County, NMFS, State	
ESU-CCCh-24.1.1.7	Action Step	Severe Weather Patterns	Evaluate feasibility and benefits of establishing an Emergency Drought Operations Center (similar to the Emergency Drought Operations Center developed in Washington State), comprised of the SWRCB, CDFW, NMFS, and others to develop emergency rules for augmenting water supplies and mitigating the effects of drought and extreme climate listed salmonids and their habitats.	2	5	CDFW, NMFS, SWRCB	
ESU-CCCh-24.1.1.8	Action Step	Severe Weather Patterns	Institute water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.	1	50	CDFW, DWR, Local Government, Private Landowners, NMFS, SWRCB	
ESU-CCCh-24.1.1.9	Action Step	Severe Weather Patterns	Partner with land owners and local governments to explore the use of groundwater sources with high yield, such as Karst formations, and manage them as groundwater storage/banking, particularly during drought periods, or for adverse climate change conditions.	3	50	DWR, Local Government, Private Landowners, NMFS, USGS	
ESU-CCCh-24.1.2	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to estuarine quality and extent				
ESU-CCCh-24.1.2.1	Action Step	Severe Weather Patterns	Investigate the potential impact of sea level rise from climate change on the amount of salinity intrusion into fresh and brackish water habitats.	2	15	Academic, NWFSC, State, SWFSC,	
ESU-CCCh-25.1	**Objective**	**Water Diversion/Impoundments**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
ESU-CCCh-25.1.1	Recovery Action	Water Diversion/Impoundments	Prevent or minimize impairment to watershed hydrology				

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Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-25.1.1.1	Action Step	Water Diversion/Impoundments	Encourage cooperation among water users and coordination of their diversions where they share a common water source to minimize adverse effects of diversions on the species' habitat.	2	50	Private Landowners, NGO, NMFS, SWRCB	
ESU-CCCh-25.1.1.2	Action Step	Water Diversion/Impoundments	Work with partners to promote and build water storage as an alternative to direct diversion during periods of low stream flow.	2	50	Private Landowners, NGO, NMFS, SWRCB	The off-stream storage can also be used to store water for fish and then release it in times of low-flow. See also Hydrology
ESU-CCCh-25.1.1.3	Action Step	Water Diversion/Impoundments	Support projects that provide rainwater catchment systems to rural residential as an alternative to summer riparian diversions.	2	50	Private Landowners, NGO, NMFS	
ESU-CCCh-25.1.1.4	Action Step	Water Diversion/Impoundments	Partner with water rights holders to dedicate water already claimed under existing appropriative right to be used instead for instream benefits under California Water Code Section 1707.	2	50	CDFW, Private Landowners, NMFS, SWRCB	
ESU-CCCh-25.1.1.5	Action Step	Water Diversion/Impoundments	Explore the possibility of using other easement mechanisms to dedicate water to instream uses.	2	50	CDFW, NMFS, SWRCB	
ESU-CCCh-25.1.1.6	Action Step	Water Diversion/Impoundments	Support temporary urgency change petitions by appropriative water right holders during critically dry periods if it will provide a benefit to salmonids.	2	50	CDFW, NMFS, SWRCB	
ESU-CCCh-25.1.1.7	Action Step	Water Diversion/Impoundments	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	3	50	CDFW, NMFS, Private Landowners, SWRCB	
ESU-CCCh-25.1.1.8	Action Step	Water Diversion/Impoundments	Support improvement of major dam/reservoir operations. Evaluate water release schedules and work with partners to modify as needed to improve conditions for salmonids downstream.	1	50	CDFW, NMFS, Public Works, Water Agencies, SWRCB	
ESU-CCCh-25.1.1.9	Action Step	Water Diversion/Impoundments	Support technical solutions to improved short-term precipitation forecasting where such information will facilitate more efficient management of reservoir storage.	3	50	NMFS, NOAA NWS	
ESU-CCCh-25.2	**Objective**	**Water Diversion/Impoundments**	**Address the inadequacy of existing regulatory mechanisms**				
ESU-CCCh-25.2.1	Recovery Action	Water Diversion/Impoundments	Prevent or minimize impairment to watershed hydrology				
ESU-CCCh-25.2.1.1	Action Step	Water Diversion/Impoundments	Encourage the SWRCB to exercise greater regulatory authority over summer water diversions.	1	50	CDFW, NMFS, SWRCB	
ESU-CCCh-25.2.1.2	Action Step	Water Diversion/Impoundments	Work with the SWRCB and explore the feasibility of upgrading bypass flow conditions for water rights developed prior to the establishment of AB 2121.	2	10	NMFS, Private Landowners, Public Works, Water Agencies, SWRCB	
ESU-CCCh-25.2.1.3	Action Step	Water Diversion/Impoundments	Support State agencies in implementing groundwater legislation (AB 1739, SB 1168, and SB 1319) where it may result in improved surface water conditions via groundwater/surface water interaction.	2	10	County, DWR, NMFS, Private Landowners, Public Works, Water Agencies	
ESU-CCCh-25.2.1.4	Action Step	Water Diversion/Impoundments	Improve coordination between the agencies, particularly the SWRCB and county District Attorneys, to effectively identify and address illegal water diverters and out-of-compliance diverters, seasons of diversion, off-stream reservoirs, and bypass flows to protect listed salmonids.	1	5	County, NMFS, Private Landowners, Public Works, Water Agencies, SWRCB	
ESU-CCCh-25.2.1.5	Action Step	Water Diversion/Impoundments	Evaluate the recovery benefits of declaring some watersheds as fully appropriated and petition the SWRCB to formally declare it if appropriate.	2	10	NMFS, SWRCB	
ESU-CCCh-25.2.1.6	Action Step	Water Diversion/Impoundments	Provide technical assistance to the SWRCB in its implementation of the frost protection regulation.	2	10	Agriculture Owners, County, NMFS, Private Landowners, SWRCB	
ESU-CCCh-25.2.1.7	Action Step	Water Diversion/Impoundments	Encourage the SWRCB to conduct interagency consultation with CDFW, and seek technical assistance from NMFS on the issuance of water rights permits.	2	10	CDFW, NMFS, SWRCB	
ESU-CCCh-25.2.1.8	Action Step	Water Diversion/Impoundments	Counties should consider forbearance agreements that eliminate withdrawals during low-flow conditions.	2	5	CDFW, County, NMFS, Private Landowners, SWRCB	
ESU-CCCh-25.2.1.9	Action Step	Water Diversion/Impoundments	Coordinate with CDFW and the SWRCB to ensure the effective implementation of California Fish and Game Code Sections 5935-5937 regarding the provision of fishways and fish flows associated with dams and diversions.	2	5	CDFW, NMFS, SWRCB	

California Coastal Chinook Salmon ESU Level Recovery Actions

Action ID	Targeted Attribute or Threat	Level	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ESU-CCCh-25.2.1.10	Action Step	Water Diversion/Impoundments	Encourage development of a GCP/HCP/Natural Community Conservation Plan (NCCP), conservation banks, or safe harbor agreements for new water diversions in watersheds with essential and supporting populations.	3	5	CDFW, NMFS	
ESU-CCCh-25.2.2	Recovery Action	Water Diversion/Impoundments	Prevent or minimize reduced density, abundance, and diversity based on biological viability criteria				
ESU-CCCh-25.2.2.1	Action Step	Water Diversion/Impoundments	Adequately screen water diversions to prevent juvenile salmonid mortalities.	1	50	CDFW, County, NMFS, Private Landowners	
ESU-CCCh-25.2.2.2	Action Step	Water Diversion/Impoundments	Screen all off stream catchments, ponds, reservoirs with overflows and properly maintain them at all times especially before and after storm events to insure protection of listed species from escaped non-native fish.	2	50	CDFW, County, NMFS, Private Landowners	

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POPULATION-LEVEL RESULTS AND RECOVERY ACTIONS

As described in detail in Volume I, Chapter 4 (Methods) of the Plan, NOAA's National Marine Fisheries Service (NMFS) completed the following steps to develop this recovery plan: (1) selected populations for recovery scenarios using the framework provided by Bjorkstedt et al. (2005) and Spence et al. (2008 and 2012); (2) assessed current watershed habitat conditions; (3) identified ongoing and future stresses and threats to these populations and their habitats; and (4) developed site-specific and range-wide recovery actions. For each population identified as essential or supporting, we summarized the best available information from a variety of sources into a narrative that describes the species abundance and distribution, the history of land use, land management and current resources, and descriptions of the results of our analyses of current conditions and future threats.

Populations were selected using a variety of criteria defined primarily by the Technical Recovery Team (Spence et al. 2008 and 2012), including extinction risk, population size, unique life history traits, connectivity between populations, habitat suitability, etc. Essential populations are those expected to achieve a high probability of persisting over long periods of time (low risk of extinction), while additional supporting populations are expected to either achieve a moderate probability of persisting (moderate risk of extinction) or to provide ESU/DPS stability by providing connectivity and redundancy.

For each population, we estimated the amount of accessible habitat area (in kilometers). Estimates are based on a model that uses stream gradient, channel width, and discharge to define the area with the intrinsic potential (IP-km) to support salmonids (Bjorkstaedt et al. 2005). Where natural barriers, steep gradient changes, or stream flow dynamics were undetected by the model

or where regional experts deemed areas unlikely to support spawning (e.g., ephemeral reaches, reaches inundated by reservoirs or estuaries, or highly modified and irretrievable reaches), we made appropriate changes to modeled IP. Using the Spence et al. (2008 and 2012) criteria and any revisions to IP habitat, spawner targets for each population were calculated using formulas for viable populations.

Current watershed conditions and threats for essential and supporting populations were assessed using a method called Conservation Action Planning (CAP) (TNC 2007). Conditions and threats were analyzed using a detailed set of spatial and ecological parameters described in Appendix D.

The essential populations were analyzed using the full CAP protocol and individual CAP workbooks. These detailed analyses identified an array of watershed habitat conditions, and ranked them using specific indicators developed from literature review. Similarly, future threats were ranked based on available data and knowledge of the watersheds (Appendix D). The supporting populations were analyzed using an abbreviated rapid assessment protocol based on the CAP protocol. These populations were analyzed in groups of ecologically similar Diversity Strata as defined by Spence et al. (2008 and 2012). The rapid assessments utilized a subset of the factors analyzed in the full CAP protocol.

Where we identified poor watershed conditions or high or very high threats, we identified recovery actions to improve conditions and abate/reduce a threats. We organized actions into three levels: Objective, Recovery Action and Action Step. Objectives link the Recovery Actions and Action Steps to the five listing factors. Organizing actions and actions steps to a specific listing factor allows improved and more direct tracking of the listing factors overtime. Recovery Actions were designed in general terms to improve conditions or abate specific threats. If actions were broad in scope (e.g., work with State Water Resources Control Board), they were incorporated into the Stratum or ESU/DPS level actions. Action steps are the most site-specific restoration or threat abatement action needed and are written to address a specific recovery

action. Action steps include additional required information such as cost, priority, etc. For each action step, additional information was included such as the estimated time to implement the action, estimated costs, and likely recovery partners who could contribute to implementing the action.

We present recovery actions in detailed implementation tables for each population and assign each action step as priority 1, 2, or 3. Priority 1 actions must be taken to prevent extinction, or to identify actions needed to prevent extinction (55 FR 24296, June 15, 1990). Priority 2 actions must be taken to prevent significant decline in population numbers, habitat quality, or other significant negative impacts short of extinction. Priority 3 actions include all other actions necessary to provide for full recovery of the species.

Populations are organized by Diversity Strata and then alphabetical within the Diversity Stratum (See Table of Contents).

Eel River Watershed Overview for CC Chinook Salmon

CC Chinook salmon in the Eel River consist entirely of two independent populations (Spence *et al.* 2008). The Lower Eel River population includes fish that spawn in the South Fork Eel River as well as all mainstem and tributaries downstream of the South Fork confluence (*e.g.,* Van Duzen River and Larabee Creek). The Upper Eel River population includes all fish spawning upstream of the South Fork Eel River confluence (excluded), including major tributaries such as the Middle Fork and North Fork Eel River. Spring-run populations in the Eel River watershed are considered extirpated, and are therefore not required to meet viability criteria. Because the Lower Eel River population occupies two diversity strata, it must have two separate density based abundance targets.

Lower Eel River Population

Lower Mainstem/South Fork Eel River

- Role within ESU: A subset with the Lower Eel River Functionally Independent Population
- Diversity Stratum: North Coastal
- Spawner Abundance Target: 7,300 adults
- Current Intrinsic Potential: 364.8 IP-km

Van Duzen River/Larabee Creek

- Role within ESU: Role within ESU: A subset with the Lower Eel River Functionally Independent Population
- Diversity Stratum: North Mountain Interior
- Spawner Abundance Target: 2,900 adults (includes Van Duzen Subset)
- Current Intrinsic Potential: 143.7 IP-km

Upper Eel River Population

- Role within ESU: Functionally Independent Population
- Diversity Stratum: North Mountain Interior
- Spawner Abundance Target: 10,400 adults
- Current Intrinsic Potential: 521.4 IP-km

Although the Van Duzen River and Larabee Creek together have one Recovery Target, each had a separate analysis. There is a profile, map, viablility table, threats table and recovery action

implementation tables for Lower Mainstem/South Fork Eel, Van Duzen River, Larabee Creek and Upper Eel River.

The following sections provide a general overview of the abundance and distribution of CC Chinook salmon, history of land use, current resources and land management, and a brief summary of the CAP viability current condition, and threats results for CC Chinook salmon in the Eel River watershed.

Abundance and Distribution

Information on the historic abundance and distribution of Chinook salmon in the Eel River watershed is limited and poorly understood. Chinook salmon spawned throughout the mainstem and all of its major tributaries. Historically, the Eel River watershed was considered the third largest producer of salmon (and steelhead) among California watersheds (CDFG 1997). Inferences of population abundance in the second half of the 19th and early 20th centuries have been developed based on cannery data (SEC 1998). These represent minimal population estimates which averaged approximately 93,000 fish per year during the period of 1857-1921 with a peak of nearly 600,000 fish in 1877, mostly Chinook salmon (Yoshiyama and Moyle 2010). Using the minimum population estimates, Yoshiyama and Moyle (2010) suggest the historic runs of Chinook salmon could have ranged between 100,000 and 800,000 fish per year depending on environmental/ocean conditions. However, by the 1950s, they estimate the runs had declined to roughly 50,000-100,000 fish per year despite ongoing hatchery propagation in the watershed.

Beginning in the early 1930s, annual counts of returning adult salmonids have been recorded at the Van Arsdale Fisheries Station (VAFS) on the Upper Mainstem Eel River (Figure 1). For Chinook salmon, few counts were available between 1933-34 and the late 1950s, and counts through the 1990s (with the exception of 1986-87 and 1987-88) show relatively few Chinook salmon returned to VAFS. Between 1938-39 and 1975-76, counts of returning adult Chinook salmon were also collected at the Benbow Dam Fish Ladder on the South Fork Eel River (Figure 2). From these data, it is apparent that by the 1960s the Chinook salmon population in the Eel

River watershed had declined substantially from the numbers observed during the late 19th Century (the cannery years). After the significant floods of 1955 and 1964, annual Chinook salmon returns were generally much less than 10,000 fish (Yoshiyama and Moyle 2010). In 1962 and 1987, major modifications were made to the fish ladder at VAFS due to insufficient passage conditions (SEC 1998). Droughts have also impacted returns to the Upper Mainstem where between 1989-90 and 1993-94, fewer than 10 adults returned to the VAFS annually (Figure 1). Following a series of wetter years, improved ocean conditions, and mandated increases in stream flows from Cape Horn Dam (since 2004), adult Chinook salmon returns to Cape Horn Dam improved with three consecutive record counts at VAFS between 2010-11 and 2012-13. During these years, dive counts in the Lower Eel River mainstem and observations throughout the watershed also suggest the run in the Eel River population has improved from lows in previous decades (Higgins 2013). Most recently, adult returns have declined substantially with 168 and 584 adults returning to VAFS in 2013-14 and 2014-15 respectively.

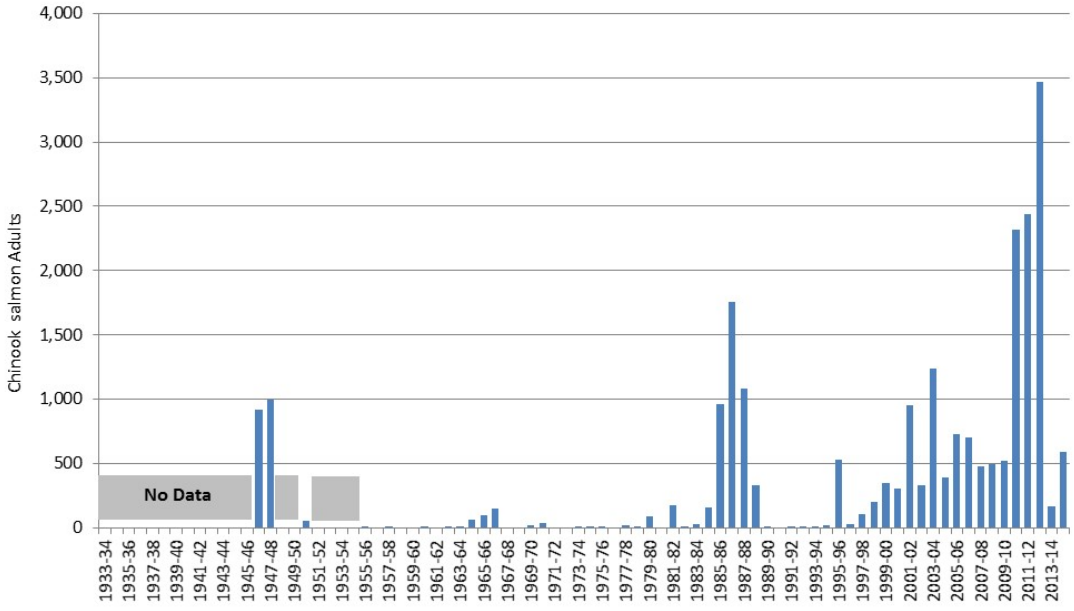

Figure 1: Adult Chinook salmon returns counted at the Van Arsdale Fisheries Station on the Upper Mainstem Eel River, 1933-34 through 2014-2015. Data on Chinook salmon returns were not collected (gray boxes) during the 1933-34 through 1945-46, 1948-49 through 1949-50, and 1951-52 through 1954-55.

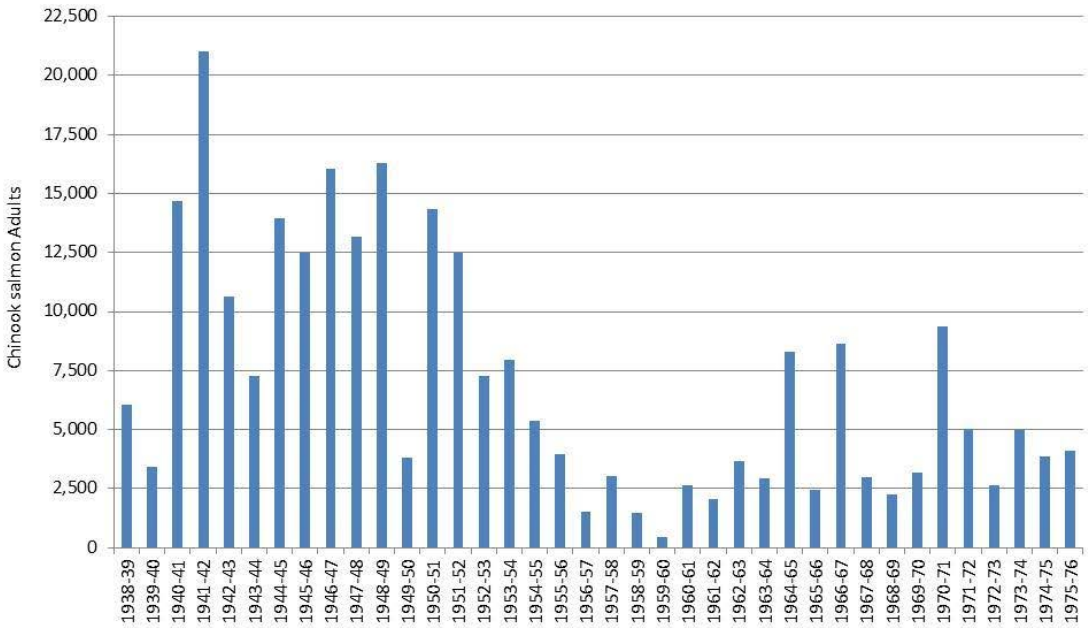

Figure 2: Adult Chinook salmon returns counted at the Benbow Dam Fish Ladder on the South Fork Eel River, 1938-39 through 1975-76. Counts in 1969-70 and 1970-71 are estimates as the station was closed before the end of the run.

History of Land Use

The Eel River watershed is the third largest watershed within California with a drainage area of approximately 3,684 square miles covering four major subbasins (Van Duzen River, South Fork Eel River, North Fork Eel River, and Middle Fork Eel River) and portions of five counties (Figure 3). Due to its size, the topography and climate within the watershed varies. Overall, the climate follows a Mediterranean pattern with cool wet winters, followed by dry and relatively warm summers. In summer, the coastal areas of the watershed typically experience fog while inland areas are dry and much warmer. The watershed is located in a geologically active area and is underlain by the Franciscan Formation which is highly erodible, particularly in steep terrain (Kubicek 1977; Yoshiyama and Moyle 2010).

Prior to Euro-American settlement, the Eel River watershed was inhabited by several native groups including the Wiyot, Sinkyone, Lassik, Nongatl, Yuki and Wailaki peoples. While these groups utilized the natural resources of the Eel River watershed, it is likely their collective impact

on the resources or landscape were relatively minor. Euro-American settlement and exploitation of the watershed's natural resources began in the second half of the 19th Century. During this period, most of the low-elevation forested areas were logged and converted to other uses such as dairies and agriculture. The abundant fish populations in the watershed (primarily Chinook salmon), supported a commercial fishery including cannery operations. The canneries operated until 1912 and the commercial fishery was closed by 1926 as salmon numbers declined despite substantial artificial propagation (Yoshiyama and Moyle 2010).

Figure 3: Eel River watershed overview map

Although logging and fishing continued through the early 20th Century, two of the more significant anthropogenic changes to the watershed during this period were the construction of Cape Horn (1908) and Scott (1922) dams on the Upper Mainstem Eel River (SEC 1998). Unlike Cape Horn, Scott Dam (farther upstream) was constructed without fish passage facilities and therefore blocks a significant amount of potential anadromous salmonid habitat. The dams and impounded reservoirs were built to generate hydro-electric power and provide water south to the Russian River watershed (NMFS 2002).

Following World War II, much of the remaining virgin forest as well as substantial areas of second-growth forest were logged at a rapid pace throughout the watershed. Logging spread to steeper slopes and remote areas which required development of a vast network of mostly poorly constructed roads. The removal of vegetation and road construction increased sediment erosion on an unprecedented scale. The large floods in 1955 and 1964 exacerbated the erosion and caused significant sedimentation within the Eel River, its tributaries, and the estuary. Deep pools that were common in the river channels were mostly filled in and most of the riparian vegetation was eliminated. While some areas have improved since the floods, legacy effects of the logging and floods remains in many areas of the watershed, which contribute to the poor habitat quality evident throughout much of the watershed today.

Throughout the 20th Century, both Chinook salmon and steelhead were propagated and released into the Eel River. For Chinook salmon, most of the eggs and fry were harvested from out-of-basin stocks (Sacramento and Trinity basins) (Yoshiyama and Moyle 2010). After 1981, all Chinook salmon planted in the Eel River watershed were of native origin. The impacts of the hatchery practices on the genetic integrity and population status are unknown or poorly understood due to insufficient information (SEC 1998; Yoshiyama and Moyle 2010).

In 1980, predatory Sacramento pikeminnow were introduced into Lake Pillsbury (CDFG 1997), and are now found throughout the Eel River watershed. Based on recent surveys by the California Department of Fish and Wildlife (CDFW), Sacramento pikeminnow are present in large numbers

in Lake Pillsbury, and many of the larger tributaries that drain into the lake such as the mainstem Eel River, and much of the South Fork system (S. Harris, CDFG, personal communication, 2013).

Current Resources and Land Management

Approximately 67% of the Eel River watershed is privately owned, 30% managed as federal lands, and 3% managed as state lands. A majority of the federally managed lands are within the Six Rivers National Forest and the Yolla Bolly-Middle Eel Wilderness Area. Approximately 60,000 acres of the watershed is managed under the State of California Department of Parks and Recreation, much of which is within Humboldt Redwoods State Park. In 1981, portions of the Eel River and its major tributaries (a total of 398 miles) were designated under the National Wild and Scenic River system.

Nearly 75% of the watershed is forested with Douglas fir (27%), montane hardwood (26%), and Coast redwood (10%) being the most common forest communities. Urban areas represent less than 1% of the watershed area with the largest developments located near the coast and extreme headwaters. In addition to parks and other recreational areas, logging, grazing, and agriculture are the primary land uses in the watershed.

The Eel River Estuary

The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River salmonid populations. Currently, the Eel River estuary is severely impaired due to past diking and filling of tidal wetlands for agriculture and flood protection. Approximately 60 percent of the estuary has been lost through the construction of levees and dikes, and CDFG (2010) estimated only 10 percent of historic salt marsh habitat remains today. The function of the estuary (*e.g.,* rearing, refugia, salt water transition) for Eel River salmonids is particularly important given the degraded habitat conditions and predation and competition from non-native Sacramento pikeminnow in the mainstem Eel River. Juveniles and smolts suffer from the lost opportunity for increased growth, which affects their survival at ocean entry. The quantity and quality of estuary habitat available to salmonids in the Eel River

is expected to expand in the near future due to the Salt River Ecosystem Restoration Project and restoration efforts on the The Wildland Conservancy's Eel River Estuary Preserve and CDFW's Ocean Ranch Unit of the Eel River Wildlife Area.

Salmonid Viability and Habitat Conditions

A summary of attribute indicator ratings for Eel River populations of CC Chinook salmon are presented in Table 1 and Table 2. Across the Eel River watershed, attribute indicators frequently rated Poor for two or more subsets/population and at least one life stage were:

- Estuary: Quality and Extent;
- Habitat Complexity: Large Wood & Shelter
- Habitat Complexity: Percent Primary/Staging Pools & Pool/Riffle/Flatwater Ratios
- Hydrology: Baseflow & Number, Condition, and/or Magnitude of Diversions
- Landscape Patterns: Timber Harvest
- Passage/Migration: Mouth or Confluence
- Riparian Vegetation: Tree Diameter
- Sediment: Gravel Quality (Bulk and Embeddedness)
- Sediment Transport: Road Density and Streamside Road Density
- Water Quality: Turbidity

Throughout the Eel River watershed, all life stages are impaired with 75% or more attribute indicators rated as Poor or Fair and all with at least 25% or more rated as Poor (Figure 4). Pre smolt is the most impaired life stage with 84% of attribute indicators rated Poor or Fair, followed by adults (80%) and smolts (79%). Of the watershed processes, streamside road density was identified as the most significant impact to instream and riparian habitat quality with all populations rated Poor (Table 2). Timber harvest was also rated Poor for the Larabee Creek and Van Duzen River populations. The extent and impact of impervious surfaces, urban development, and agriculture are minimal as all populations were rated Fair or better with most rated Very Good.

The Lower Eel River-South Fork Eel River subset is within the North Coastal Diversity Stratum, and the Van Duzan River/ Larabee Creek subset and Upper Eel River population represents the entirety of the North Mountain Interior Diversity Stratum. The ESU and Diversity Strata results from the CAP viability analysis are described in greater detail in the section above, CC Chinook Salmon CAP results. Subset/population-specific results are described below in the population profiles.

Table 1: CC Chinook salmon CAP Viability Summary by Attribute for Eel River populations

CC Chinook Salmon Population Conditions (Sorted By Attribute)			N.C.	North Mountain Interior		
Target	Attribute	Indicator	S. F. Eel River	Van Duzen	Larabee Creek	Upper Eel River
Adults	Estuary/Lagoon	Quality & Extent	P	P	P	P
Pre Smolt	Estuary/Lagoon	Quality & Extent	P	P	P	P
Smolts	Estuary/Lagoon	Quality & Extent	P	P	P	P
Adults	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	F	F	F	P
Adults	Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	P	F	F	P
Pre Smolt	Habitat Complexity	Percent Primary Pools	F	P	F	P
Adults	Habitat Complexity	Percent Staging Pools	P	P	F	F
Adults	Habitat Complexity	Pool/Riffle/Flatwater Ratio	F	F	F	P
Pre Smolt	Habitat Complexity	Pool/Riffle/Flatwater Ratio	F	F	F	F
Pre Smolt	Habitat Complexity	Shelter Rating	P	P	P	P
Smolts	Habitat Complexity	Shelter Rating	P	P	P	P
Pre Smolt	Hydrology	Flow Conditions (Baseflow)	P	P	P	F
Eggs	Hydrology	Flow Conditions (Instantaneous Condition)	G	G	G	F
Pre Smolt	Hydrology	Flow Conditions (Instantaneous Condition)	F	F	F	G
Smolts	Hydrology	Flow Conditions (Instantaneous Condition)	F	F	F	G
Watershed Processes	Hydrology	Impervious Surfaces	V	V	V	V
Pre Smolt	Hydrology	Number, Condition and/or Magnitude of Diversions	P	P	F	G
Smolts	Hydrology	Number, Condition and/or Magnitude of Diversions	P	P	F	G
Adults	Hydrology	Passage Flows	F	P	F	G
Pre Smolt	Hydrology	Passage Flows	F	F	F	G
Smolts	Hydrology	Passage Flows	F	F	F	G
Eggs	Hydrology	Redd Scour	F	F	F	F
Watershed Processes	Landscape Patterns	Agriculture	V	F	G	V
Watershed Processes	Landscape Patterns	Timber Harvest	G	P	P	V
Watershed Processes	Landscape Patterns	Urbanization	V	V	V	V
Adults	Passage/Migration	Passage at Mouth or Confluence	P	P	G	F
Pre Smolt	Passage/Migration	Passage at Mouth or Confluence	F	F	G	F
Smolts	Passage/Migration	Passage at Mouth or Confluence	F	F	G	G
Adults	Passage/Migration	Physical Barriers	V	G	V	F
Smolts	Passage/Migration	Physical Barriers	V	G	V	V
Watershed Processes	Riparian Vegetation	Species Composition	F	V	G	F
Adults	Riparian Vegetation	Tree Diameter (North of SF Bay)	P	F	P	P
Pre Smolt	Riparian Vegetation	Tree Diameter (North of SF Bay)	P	F	P	P
Eggs	Sediment	Gravel Quality (Bulk)	P	P	G	F
Eggs	Sediment	Gravel Quality (Embeddedness)	F	P	F	P
Adults	Sediment	Quantity & Distribution of Spawning Gravels	G	F	F	G
Pre Smolt	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	F	P	F	P
Smolts	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	F	P	F	P
Watershed Processes	Sediment Transport	Road Density	P	P	P	G
Watershed Processes	Sediment Transport	Streamside Road Density (100 m)	P	P	P	P
Smolts	Smoltification	Temperature	P	F	F	F
Adults	Velocity Refuge	Floodplain Connectivity	F	F	G	F
Pre Smolt	Velocity Refuge	Floodplain Connectivity	P	F	G	F
Smolts	Velocity Refuge	Floodplain Connectivity	P	F	G	F
Smolts	Viability	Abundance	F	F	F	F
Adults	Viability	Density	F	F	F	F
Adults	Viability	Spatial Structure	G	G	G	F
Pre Smolt	Viability	Spatial Structure	G	G	G	F
Pre Smolt	Water Quality	Temperature (MWMT)	F	F	G	F
Adults	Water Quality	Toxicity	F	F	G	F
Pre Smolt	Water Quality	Toxicity	F	F	G	F
Smolts	Water Quality	Toxicity	F	F	G	F
Adults	Water Quality	Turbidity	P	P	F	F
Pre Smolt	Water Quality	Turbidity	F	P	F	F
Smolts	Water Quality	Turbidity	P	P	F	F

Table 2: CC Chinook salmon CAP Viability Summary by Life Stage for Eel River populations.

CC Chinook Salmon Population Conditions (Sorted By Conservation Target)			N.C.	North Mountain Interior		
Target	Attribute	Indicator	S. F. Eel River	Van Duzen	Larabee Creek	Upper Eel River
Adults	Estuary/Lagoon	Quality & Extent	P	P	P	P
Adults	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	F	F	F	P
Adults	Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	P	F	F	P
Adults	Habitat Complexity	Percent Staging Pools	P	P	F	F
Adults	Habitat Complexity	Pool/Riffle/Flatwater Ratio	F	F	F	P
Adults	Hydrology	Passage Flows	F	P	F	G
Adults	Passage/Migration	Passage at Mouth or Confluence	P	P	G	F
Adults	Passage/Migration	Physical Barriers	V	G	V	F
Adults	Riparian Vegetation	Tree Diameter (North of SF Bay)	P	F	P	P
Adults	Sediment	Quantity & Distribution of Spawning Gravels	G	F	F	G
Adults	Velocity Refuge	Floodplain Connectivity	F	F	G	F
Adults	Water Quality	Toxicity	F	F	G	F
Adults	Water Quality	Turbidity	P	P	F	F
Adults	Viability	Density	F	F	F	F
Adults	Viability	Spatial Structure	G	G	G	F
Eggs	Hydrology	Flow Conditions (Instantaneous Condition)	G	G	G	F
Eggs	Hydrology	Redd Scour	F	F	F	F
Eggs	Sediment	Gravel Quality (Bulk)	P	P	G	F
Eggs	Sediment	Gravel Quality (Embeddedness)	F	P	F	P
Pre Smolt	Estuary/Lagoon	Quality & Extent	P	P	P	P
Pre Smolt	Habitat Complexity	Percent Primary Pools	F	P	F	P
Pre Smolt	Habitat Complexity	Pool/Riffle/Flatwater Ratio	F	F	F	F
Pre Smolt	Habitat Complexity	Shelter Rating	P	P	P	P
Pre Smolt	Hydrology	Flow Conditions (Baseflow)	P	P	P	F
Pre Smolt	Hydrology	Flow Conditions (Instantaneous Condition)	F	F	F	G
Pre Smolt	Hydrology	Number, Condition and/or Magnitude of Diversions	P	P	F	G
Pre Smolt	Hydrology	Passage Flows	F	F	F	G
Pre Smolt	Passage/Migration	Passage at Mouth or Confluence	F	F	G	F
Pre Smolt	Riparian Vegetation	Tree Diameter (North of SF Bay)	P	F	P	P
Pre Smolt	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	F	P	F	P
Pre Smolt	Velocity Refuge	Floodplain Connectivity	P	F	G	F
Pre Smolt	Water Quality	Temperature (MWMT)	F	F	G	F
Pre Smolt	Water Quality	Toxicity	F	F	G	F
Pre Smolt	Water Quality	Turbidity	F	P	F	F
Pre Smolt	Viability	Spatial Structure	G	G	G	F
Smolts	Estuary/Lagoon	Quality & Extent	P	P	P	P
Smolts	Habitat Complexity	Shelter Rating	P	P	P	P
Smolts	Hydrology	Flow Conditions (Instantaneous Condition)	F	F	F	G
Smolts	Hydrology	Number, Condition and/or Magnitude of Diversions	P	P	F	G
Smolts	Hydrology	Passage Flows	F	F	F	G
Smolts	Passage/Migration	Passage at Mouth or Confluence	F	F	G	G
Smolts	Passage/Migration	Physical Barriers	V	G	V	V
Smolts	Sediment (Food Productivity)	Gravel Quality (Embeddedness)	F	P	F	P
Smolts	Smoltification	Temperature	P	F	F	F
Smolts	Velocity Refuge	Floodplain Connectivity	P	F	G	F
Smolts	Water Quality	Toxicity	F	F	G	F
Smolts	Water Quality	Turbidity	P	P	F	F
Smolts	Viability	Abundance	F	F	F	F
Watershed Processes	Hydrology	Impervious Surfaces	V	V	V	V
Watershed Processes	Landscape Patterns	Agriculture	V	F	G	V
Watershed Processes	Landscape Patterns	Timber Harvest	G	P	P	V
Watershed Processes	Landscape Patterns	Urbanization	V	V	V	V
Watershed Processes	Riparian Vegetation	Species Composition	F	V	G	F
Watershed Processes	Sediment Transport	Road Density	P	P	P	G
Watershed Processes	Sediment Transport	Streamside Road Density (100 m)	P	P	P	P

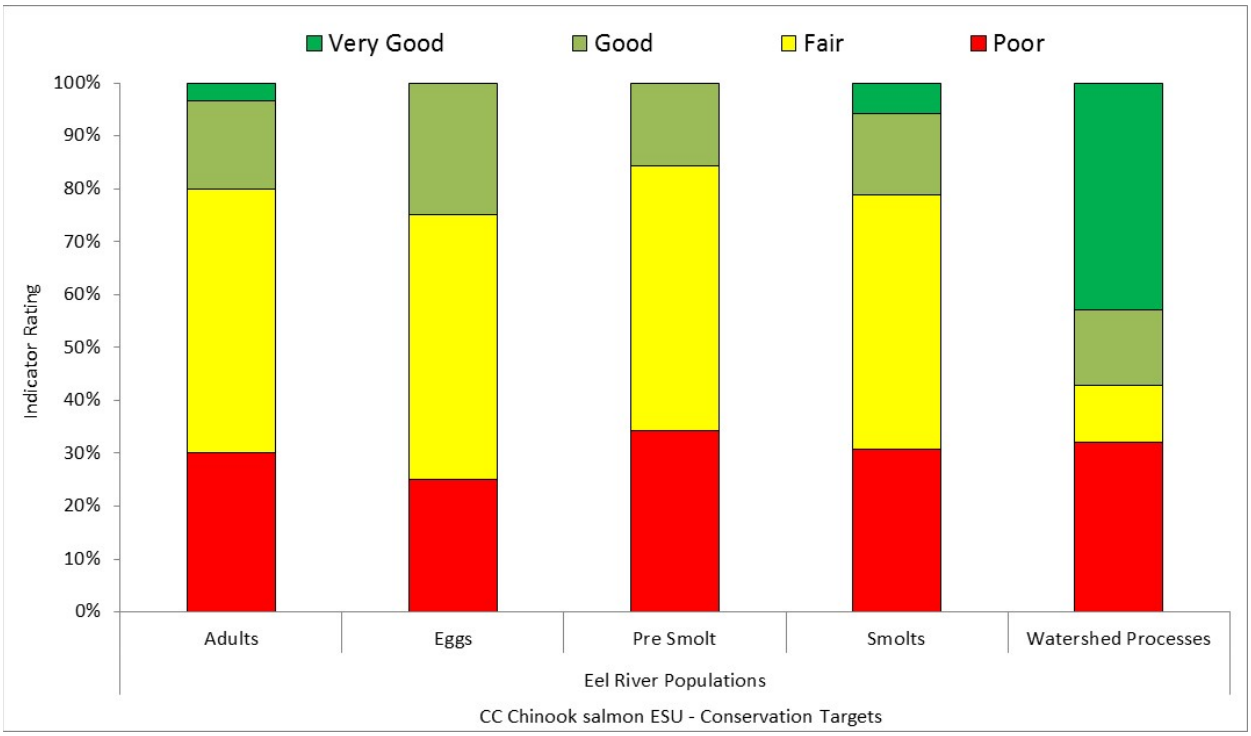

Figure 4: CAP Attribute Indicator ratings for the CC Chinook salmon life stages in the Eel River watershed.

Threats

Table 3 summarizes the CAP threat results across the three subsets of the Lower Eel River population and the Upper Eel population. Based on the occurrence of multiple High or Very High ratings, the threats of greatest concern for CC Chinook salmon in the Eel River watershed were Channel Modification, Disease, Predation and Competition (due to the introduction of Sacramento pikeminnow and other nonnative piscivorous fish), Roads and Railroads, and Water Diversions and Impoundments. Other threats identified as High in the Eel River were Fishing and Collecting (Upper Eel River), and Severe Weather Patterns (Lower-South Fork Eel River). Specific results of threats and actions to ameliorate them are described in greater detail below under each profile.

Table 3: Summary of threat ratings for populations of CC Chinook in the Eel River watershed, where L=Low, M=Medium, H=High, and VH=Very High threat.

Diversity Strata	N.C	North Mountain Interior		
CC Chinook Threat/Population	Lower - S. F. Eel River	Van Duzen River	Larabee Creek	Upper Eel River
Agriculture	M	M	M	L
Channel Modification	H	H	M	L
Disease, Predation and Competition	M	H	H	M
Fire, Fuel Management and Fire Suppression	M	M	M	M
Fishing and Collecting	M	M	M	H
Hatcheries and Aquaculture	-	-	-	-
Livestock Farming and Ranching	M	M	M	L
Logging and Wood Harvesting	M	M	M	M
Mining	M	M	M	L
Recreational Areas and Activities	M	M	M	L
Residential and Commercial Development	M	M	M	L
Roads and Railroads	H	M	M	H
Severe Weather Patterns	H	M	M	M
Water Diversion and Impoundments	H	H	M	L

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North Coastal Diversity Stratum

This stratum includes populations or parts of populations of "short-run" Chinook salmon that spawn in watersheds that are most strongly affected by climate conditions typical of the coast. Lower reaches and tributaries of Redwood Creek (e.g., Prairie Creek), Mad River, and lower Eel River experience these sorts of conditions; however, conditions in these watersheds–especially flow patterns–are also affected by higher, inland areas so that the contribution of Chinook salmon populations to this aspect of ESU diversity may be limited. The South Fork Eel River is in this diversity stratum based on its environmental similarity to coastal basins.

The populations that have been selected for the recovery scenario are listed in the table below and their profiles, maps, results, and recovery actions are in the pages following. Populations are listed by alphabetical order within the diversity stratum.

CC Chinook Salmon North Coastal Diversity Stratum, Populations, Historical Status, Population's Role in Recovery, Current IP-km, and Spawner Density and Abundance Targets for Delisting. The Diversity Stratum recovery targets are only comprised of the essential populations because these are the populations that are expected to be viable (See Vol. 1 Chapter 5). The Chinook salmon Lower Eel River is one population divided between two diversity strata. *The Lower Eel River Chinook population is divided between two diversity strata, and as a result has one recovery target for the North Mountain Interior DS (Van Duzen and Larabee) and one for the North Coastal DS (Lower and South Fork Eel River).

Diversity Stratum	CC Chinook salmon Populations	Historical Population Status	Population's Role In Recovery	Current Weighted IP-km	Spawner Density	Spawner Abundance
North Coastal	Bear River	I	Essential	39.4	37.8	1,500
	Humboldt Bay Tributaries	I	Essential	76.6	33.7	2,600
	Little River (Humboldt County)	I	Essential	17.4	40.0	700
	Lower Eel River ~ *Lower Mainstem/ South Fork Eel River**	I	Essential	368.4	20	7,400
	Mad River	I	Essential	94.4	31.7	3,000
	Mattole River	I	Essential	177.5	22.5	4,000
	Redwood Creek (Humboldt Co)	I	Essential	116.1	29.3	3,400
	North Coastal Diversity Stratum Recovery Target					**22,600**

CC Chinook salmon North Coastal Diversity Stratum Populations selected for the recovery scenario. There are no Supporting populations within this Diversity Stratum.

Bear River Population

Bear River CC Chinook salmon

- Functionally Independent Population
- North Coastal Diversity Stratum
- Spawner Density Target: 1500 adults
- Current Intrinsic Potential: 39.4 IP-km

For information regarding NC steelhead and SONCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the SONCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

Information on the abundance and distribution of Chinook salmon are limited in the Bear River, however they are considered "few in number" and primarily distributed from the mouth of Bear River to the mouth of West Side Creek, including larger tributaries such as the South Fork Bear River (HRC 2008). An outmigrant monitoring effort collected 172 Chinook salmon smolts in the spring of 2001, indicating a successful spawning population (Ricker 2002). Following the 2007 replacement of a culvert road crossing with a bridge in the Happy Valley area, barriers to fish passage on HRC lands are limited to natural waterfalls and high gradient channel conditions (HRC 2008).

History of Land Use

Bear River is a fourth order, coastal stream draining approximately 151.5 square kilometers (53,287 acres) to the Pacific Ocean. The connection between the Bear River and the Pacific Ocean is periodically blocked by a temporary sand bar during summer low flow. The lagoon-type estuary is approximately one-quarter mile in length (HRC 2008). Since settlement, the two primary land uses in the basin have consisted of grazing and timber harvest. The Humboldt Redwood Company (HRC), formerly Pacific Lumber Company (PALCO), owns 16,537 acres of land in the upper third of the watershed. The remainder of the watershed is in private ownership (36,839 acres), with a small portion (161 acres) owned and managed by the California Department of Parks and Recreation.

The headwaters of the watershed have been managed for timber production since 1950. Early logging operations harvested trees from large tracts and burned residual slash. Most of the trees in the riparian areas were harvested. Logs were skidded downhill with tractors, often utilizing watercourses for skid trails. There was little replanting of harvested sites during the 1950's and

1960's, and site regeneration was left to natural seeding or sprouting save for the retention of small Douglas fir groves. The flood of 1964 altered the morphology of the lower river, transporting large amounts of sediment, removing the majority of the remaining riparian vegetation and decreasing the size and depth of the estuary (HRC 2008).

Land use in the lower watershed has remained predominantly rangeland and is grazed by cattle and sheep. No dams exist in the Bear River drainage, however small water diversions exist throughout the basin for domestic use, livestock watering, irrigation, and dust abatement (road watering).

Since 1998, the California Department of Fish and Wildlife (through the Fisheries Restoration Grants Program-SB 271) has funded ten projects in the Bear River watershed. These have included projects for landowner education, road assessments, water temperature monitoring, riparian enhancement and planting, installation of log structures, installation of fencing for livestock exclusion, and gully erosion and stream bank stabilization.

Current Resources and Land Management

As noted above, the upper third of the Bear River watershed is managed for timber harvest while the lower two-thirds are largely managed primarily as private grazing/ranching lands.

PALCO-HRC Habitat Conservation Plan

The PALCO's Habitat Conservation Plan (HCP) was finalized in 1999 and its associated Incidental Take Permit remains effective through 2049. The HCP was adopted by the HRC upon acquisition of the PALCO lands in 2008. Although the goal of the HCP is to maintain or achieve, over time, a properly functioning aquatic habitat condition, the HCP acknowledges that not all essential habitat elements (*e.g.*, large wood recruitment) will be attainable within the 50-year life of the plan (PALCO 1999). Site-specific prescriptions, which are designed to promote a properly functioning aquatic habitat condition, are contained in the Bear River watershed analysis (HRC 2008).

The Bear River Watershed Analysis was completed in October 2006, and the Hillslope Management and Riparian Management Prescriptions were completed in April, 2007. The hillslope management/mass wasting avoidance strategy uses a three-step approach for the identification and avoidance or mitigation of high hazard unstable areas during the planning and implementation of forestry activities. These steps are: slope stability training; site-specific and project-specific "screening" for unstable areas; and enforceable site-specific prescriptions for road

construction, re-construction, or timber harvest on unstable areas designated as "High Hazard." Also required is review and approval of a professional licensed geologist.

In general, no timber harvest will occur within the Channel Migration Zone, defined as the flood-prone area in stream reaches with less than 4 percent gradient, which is generally the 100-year floodplain. In addition, all streams will have a Riparian Management Zone (RMZ). The RMZ for Class I (fish-bearing) streams is 150 feet wide, with no timber harvest permitted within the first 50 feet.

Salmonid Viability and Watershed Conditions

The following habitat indicators were rated Poor through the CAP process: habitat complexity, sediment, estuary/lagoon, sediment transport and water quality. Recovery strategies will typically focus on ameliorating these habitat indicators, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed.

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Bear River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Habitat Complexity: Large Wood & Shelter

Large woody debris (LWD) volume within the mainstem Bear River is generally poor due to the inherently wide bank-full channel width and the high winter flows common to the basin (HRC 2008). Upstream of the Brushy Creek confluence, LWD volume increases as channel dynamics change. Generally speaking, large wood recruitment within the majority of Class I (fish bearing) streams is problematic and will continue to be so for at least the next few decades.

Sediment: Gravel Quality & Distribution of Spawning Gravels

Suitable reaches of the mainstem Bear River, South Fork Bear River, and much of the upper watershed suffer from a high degree of fine sediment embedded within available spawning gravel, which likely reduces salmonid egg and fry survival, impairs invertebrate prey production, and ultimately limits juvenile fish production within the watershed. Both the substrate embeddedness and shallow pool depths common to most low gradient stream reaches are likely caused by upslope erosion from past/current logging practices, failing roads, and poor grazing practices. Juvenile salmonids and eggs are the life stages most impacted by poor gravel quality and excess fine sediment.

Water Quality: Turbidity or Toxicity

The high levels of fine sediment entering the Bear River stream system suggests that elevated turbidity may be an issue following storm events. Highly turbid water can suppress juvenile feeding success and, when severe, physically harm basic physiological processes (*e.g.*, gill respiration).

Habitat Complexity: Percent Primary Pools & Pool/Riffle/Flatwater Ratios

Pool depths in the Bear River mainstem average 3.3 feet or greater. However, in the South Fork Bear River and Nelson and Harmonica Creeks, pool depths are 2 feet or less, which is considered a Poor condition for salmonid habitat function. The poor pool depths provide for a limited number of adequate staging or holding pools for adult Chinook. Pool frequency throughout the watershed is Poor at less than 35 percent by length, caused largely by the lack of instream wood accumulation throughout the mainstem and most larger tributaries. Adults are most impacted by the poor channel complexity because of the lost deep pool holding habitat during spawning migration.

Riparian Vegetation: Composition, Cover & Tree Diameter

Riparian forest condition has an overall Poor rating. High IP-km habitat in lower Bear River, South Fork Bear River, as well as the upper watershed and its tributaries, generally lacks canopy cover, and available riparian habitat is largely dominated by hardwood species that provide poor shading and little channel-forming function. On HRC lands, current riparian conditions are primarily the result of intensive mid-twentieth century logging and two significant flood events of the same time period. Species composition is primarily a mixture of Douglas-fir, tanoak, red alder, willow, California bay-laurel, and big-leaf maple. Structurally, while groups of large trees in excess of 24″ diameter at breast height (dbh) are scattered throughout the Bear River watershed, most stands consist of trees ranging from 11 to 24″ dbh. Very little of the HRC owned property meets established targets indicating high LWD recruitment potential (HRC 2008).

Viability: Density, Abundance & Spatial Structure

Chinook salmon abundance is likely low, and their distribution limited to low-gradient mainstem and tributary reaches. The majority of Chinook salmon spawning likely occurs with the lower 9.5 mile reach between the estuary and West Side Creek (HRC 2008).

Threats

The following discussion focuses on those threats that rank as High or Very High. Recovery strategies will likely focus on ameliorating High ranking threats; however, some strategies may

address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Bear River CAP Results.

Roads and Railroads

High road density (greater than 3 miles of road per square mile of watershed) occurs throughout the majority of the watershed, and ranked as a High threat to all Chinook salmon life stages. Roads accelerate sediment delivery to riparian and aquatic habitat, while also altering stream hydrography by accelerating storm runoff patterns. The majority of the roads in the watershed are associated with industrial timber land and managed under the HRC HCP; as required under their HCP, HRC is required to stormproof roads on their land to minimize erosional processes.

Livestock Farming and Ranching

Grazing in the middle and lower watershed represents an overall High threat to pre-smolt, smolt, and adult Chinook salmon. Poor livestock grazing practices can reduce the riparian corridor, increase upslope erosion, and facilitate nutrient loading of receiving waters through animal waste entering the stream channel. The extent to which current Bear River ranch owners have fenced cattle out of riparian areas is unknown, but analysis of aerial photos suggests little riparian fencing has occurred within the watershed.

Low or Moderate Ranked Threats

Logging is ranked as a Medium threat to all Chinook salmon life stages. Legacy effects of past harvest practices within the upper third of the watershed (HRC property), such as accelerated sediment transport, poor wood recruitment, and impaired riparian function, reduce salmonid habitat quality throughout much of Bear River watershed. Industrial timber harvest impacts may be reduced under the HCP prescriptions, but several decades may pass before riparian and stream habitat recovers. The lower two-thirds of the watershed is privately owned and primarily used for grazing and ranching: appreciable timber harvest does not appear to occur outside of HRC land.

Fire is identified as a Medium threat because of its potential significance if a fire were to occur. No road-crossing barriers have been identified in the Bear River watershed, resulting in a Low threat ranking. Historically, small-scale gravel mining has occurred in the Bear River, and the Humboldt County Public Works is currently permitted to extract 3,000 yards^3 per year and 10,000 yards^3 per three to five year period from their Branstetter Bar sites (RM 1.5). Due to the low level of extraction, mining/gravel extraction is believed to be a Low threat to Chinook salmon. Finally, there are no appropriative water rights in the Bear River watershed according to the NCRWQCB; however, the extent of riparian water rights is unknown. There are no dams in the watershed.

Limiting Stresses, Life Stages, and Habitats

The egg and pre-smolt lifestages are the most limiting to population viability within Bear River, given the high susceptibility to the effects of elevated fine sediment and poor rearing conditions. Poor riparian habitat function likely lowers water quality throughout much of the lower and middle mainstem river and within accessible tributaries.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating stresses and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. The general recovery strategy for the Bear River Chinook salmon population is discussed below with more detailed and site-specific recovery actions provided in the Implementation Schedule for this population.

Reduce Grazing and Road-related Erosion

Failing or improperly maintained roads are significant sources of fine sediment accumulation that is impairing Bear River habitat function. Many tributaries in the upper watershed have high fine sediment concentrations, and recent analysis suggests roads are the primary management-associated source of this type of sediment delivery (141 tons/mi2/yr) (HRC 2008). Although undocumented in the Bear River watershed, poor grazing management could be accelerating streambank erosion within the lower river where cattle grazing is most intensive.

Improve Instream LWD Volume

LWD volume is generally poor within most of the Bear River watershed, especially within the mainstem Bear River reach and the Brushy Creek sub-watershed. Intense historical timber harvesting (pre-1965) effectively depressed natural wood recruitment, while the devastating floods of 1955 and 1964 flushed much of the existing LWD out of the watershed (HRC 2008).

Improve Estuary Habitat

Restore the physical and biological attributes of the estuary. Improve juvenile Chinook salmon rearing habitat by increasing the extent of the estuary and improve in-water structure and overwater cover.

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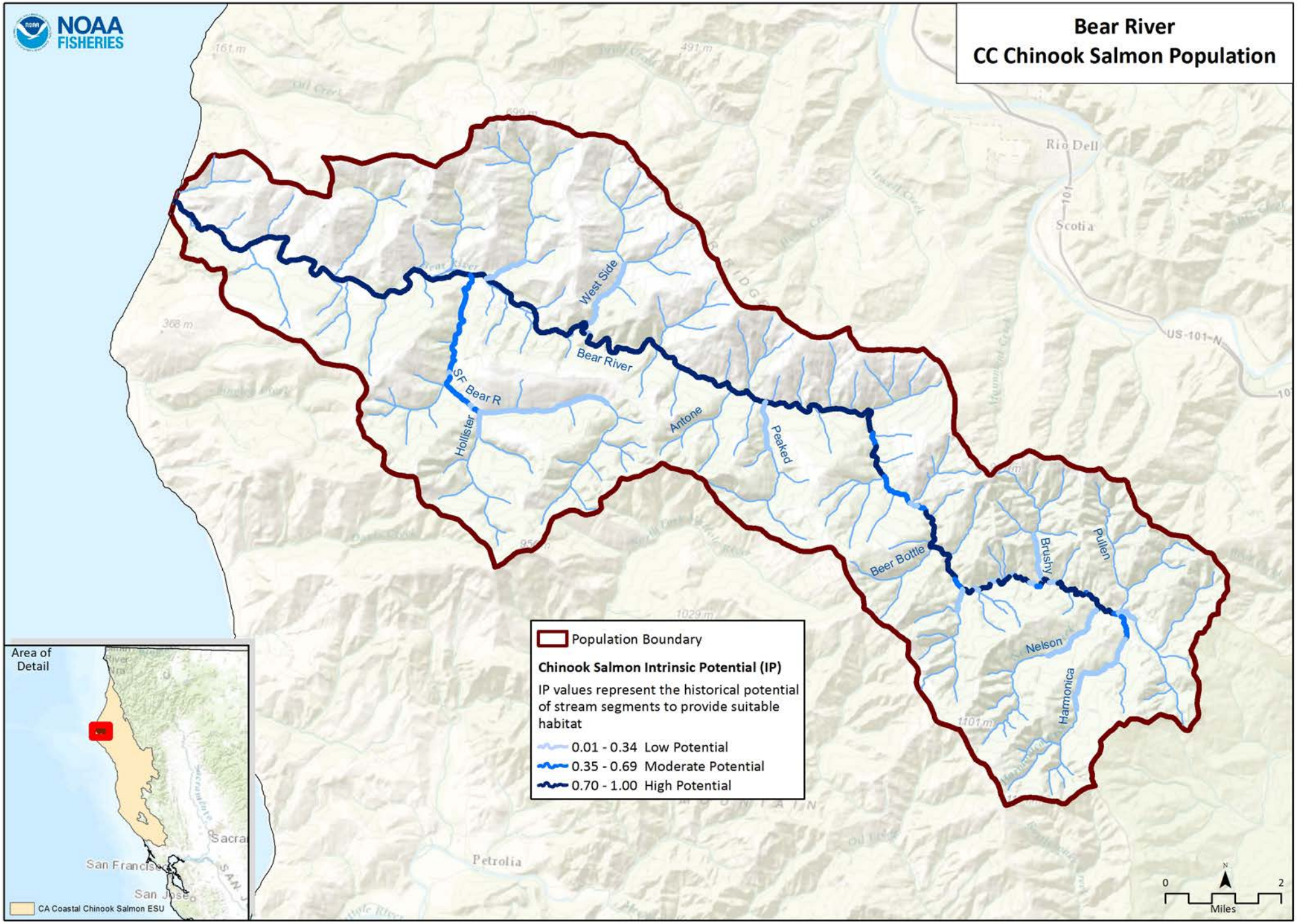
NOAA FISHERIES
Bear River
CC Chinook Salmon Population
West Side
Bear River
SF Bear R
Hollister
Antone
Peaked
Beer Bottle
Brushy
Pullen
Nelson
Harmonica
Rio Dell
Scotia
US-101-N
Petrolia
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Area of Detail
San Francisco
San Jose
CA Coastal Chinook Salmon ESU
0
2
Miles

CC Chinook Salmon Bear River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	50% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	<50% of streams/ IP-km (>49% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	<50% of streams/ IP-km (>30% Pools; >20% Riffles)	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good

			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	35.05% Class 5 & 6 across IP-km	Poor
			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-km accessible*	Poor
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-km: low risk spawner density per Spence (2008)	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		1-20 Spawners per IP-km	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	100% of Historical Range	Very Good
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	14.07% (0.85mm) and <30% (6.4mm)	Fair

			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	50% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-km (>49% average primary pool frequency)	Good
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	<50% of streams/ IP-km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.01 - 1 Diversions/10 IP-km	Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good

			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	35.05% Class 5 & 6 across IP-km	Poor
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	100% of Historical Range	Very Good
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good

			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.01 - 1 Diversions/10 IP-km	Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair

6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.08% of Watershed in Impervious Surfaces	Very Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	0% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	18.12% of Watershed in Timber Harvest	Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	Very Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	<25% Intact Historical Species Composition	Poor
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	4.73 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	2.79 Miles/Square Mile	Poor

CC Chinook Salmon Bear River CAP Threats Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Medium	Low	Medium	Medium	Low	Medium
2	Channel Modification	Medium	Medium	Medium	Medium	Medium	Medium
3	Disease, Predation and Competition	Medium	Low	Medium	Medium	Low	Medium
4	Fire, Fuel Management and Fire Suppression	Medium	Medium	Medium	Medium	Medium	Medium
5	Fishing and Collecting	Medium	Low	Medium	Medium	Low	Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	High	Medium	High	High	Medium	High
8	Logging and Wood Harvesting	Medium	Medium	Medium	High	High	High
9	Mining	Medium	Low	Medium	Medium	Low	Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Low	Medium
11	Residential and Commercial Development	Medium	Low	Medium	Medium	Low	Medium
12	Roads and Railroads	High	High	High	High	Medium	High
13	Severe Weather Patterns	Medium	Medium	Low	Medium	Medium	Medium
14	Water Diversion and Impoundments	Medium	Low	Low	Medium	Low	Medium

Bear River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
BeaR-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BeaR-CCCh-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat				
BeaR-CCCh-1.1.1.1	Action Step	Estuary	Study estuarine habitat suitability and utilization for rearing salmonids.	2	5	CDFW	
BeaR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BeaR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
BeaR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Assess habitat to determine beneficial location for floodplain restoration	2	5	CDFW	
BeaR-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Implement actions recommended by assessment that improve floodplain connectivity and function.	2	10	CDFW, NMFS	
BeaR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BeaR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
BeaR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Assess habitat to determine beneficial locations and amount of instream structure needed.	2	5	Humboldt Redwood Company, NRCS, Private Landowners	
BeaR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Place instream structures, guided by assessment results.	2	20	CDFW, NRCS, Private Landowners	
BeaR-CCCh-6.1.2	Recovery Action	Habitat Complexity	Improve shelter				
BeaR-CCCh-6.1.2.1	Action Step	Habitat Complexity	Develop tributary pool and shelter projects with cooperative landowners to enhance presmolt and smolt survival	3	5	CDFW, Mendocino County RCD, Private Landowners	
BeaR-CCCh-6.2	**Objective**	**Habitat Complexity**	**Address the inadequacy of existing regulatory mechanisms**				
BeaR-CCCh-6.2.1	Recovery Action	Habitat Complexity	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
BeaR-CCCh-6.2.1.1	Action Step	Habitat Complexity	Reduce removal of instream large wood (i.e., wood poaching)	2	10	NPS, CDFW, County	
BeaR-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BeaR-CCCh-7.1.1	Recovery Action	Riparian	Improve riparian conditions				
BeaR-CCCh-7.1.1.1	Action Step	Riparian	Review General Plan and City Ordinances to ensure salmonid habitat needs are accounted for and revise, if necessary.	3	5	CDFW, County, NMFS	
BeaR-CCCh-7.2	**Objective**	**Riparian**	**Address the inadequacy of existing regulatory mechanisms**				
BeaR-CCCh-7.2.1	Recovery Action	Riparian	Improve riparian conditions				
BeaR-CCCh-7.2.1.1	Action Step	Riparian	Reduce detrimental environmental impacts of conversion of TPZ land to other uses.	2	10	NMFS, Calfire, BOF	
BeaR-CCCh-7.2.1.2	Action Step	Riparian	Work with Calfire and BOF to minimize the number of conversions per landowner	2	10	NMFS, Calfire, BOF	
BeaR-CCCh-7.2.1.3	Action Step	Riparian	Institute environmental review as part of TPZ conversions	2	10	Calfire, BOF	
BeaR-CCCh-7.2.1.4	Action Step	Riparian	Work to ensure effects of activities on converted areas are minimized.	2	10	NMFS, Calfire, BOF	
BeaR-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BeaR-CCCh-8.1.1	Recovery Action	Sediment	Improve instream gravel quality				
BeaR-CCCh-8.1.1.1	Action Step	Sediment	Inventory sediment sources, and prioritize for treatment.	2	5	California Conservations Corp	
BeaR-CCCh-8.1.1.2	Action Step	Sediment	Treat priority sediment source sites, guided by plan.	2	5	California Conservations Corp	
BeaR-CCCh-11.1	**Objective**	**Viability**	**Address other natural or manmade factors affecting the species' continued existence**				

Bear River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
BeaR-CCCh-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity				
BeaR-CCCh-11.1.1.1	Action Step	Viability	Conduct comprehensive monitoring to measure indicators for spawning and rearing habitat.	3	25	CDFW	
BeaR-CCCh-16.1	**Objective**	**Fishing/Collecting**	**Address the overutilization for commercial, recreational, scientific or educational purposes**				
BeaR-CCCh-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance and diversity based on the biological viability criteria				
BeaR-CCCh-16.1.1.1	Action Step	Fishing/Collecting	Determine impacts of fisheries management on salmonids in terms of VSP parameters.	3	5	NMFS	
BeaR-CCCh-16.1.1.2	Action Step	Fishing/Collecting	If actual fishing impacts exceed levels consistent with recovery, modify management so that levels are consistent with recovery.	3	25	NMFS	
BeaR-CCCh-16.1.1.3	Action Step	Fishing/Collecting	Determine impacts of scientific collection on salmonids in terms of VSP parameters and determine if scientific collection authorizations exceed impacts consistent with recovery	3	5	NMFS	
BeaR-CCCh-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BeaR-CCCh-18.1.1	Recovery Action	Livestock	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
BeaR-CCCh-18.1.1.1	Action Step	Livestock	Assess grazing impact on sediment delivery and identify opportunities for improvement.	2	5	NRCS, RCD	
BeaR-CCCh-18.1.2	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
BeaR-CCCh-18.1.2.1	Action Step	Livestock	Plant vegetation to stabilize streambank.	2	5	NRCS, RCD	
BeaR-CCCh-18.1.2.2	Action Step	Livestock	Fence livestock out of riparian zones.	2	5	NRCS, RCD	
BeaR-CCCh-18.1.3	Recovery Action	Livestock	Prevent or minimize impairment to water quality (e.g. turbidity, suspended sediment and/or toxicity)				
BeaR-CCCh-18.1.3.1	Action Step	Livestock	Remove instream livestock watering sources.	3	5	NRCS, RCD	
BeaR-CCCh-18.2	**Objective**	**Livestock**	**Address the inadequacy of existing regulatory mechanisms**				
BeaR-CCCh-18.2.1	Recovery Action	Livestock	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
BeaR-CCCh-18.2.1.1	Action Step	Livestock	Develop and implement a grazing management plan to meet objective.	2	5	NRCS, RCD	
BeaR-CCCh-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BeaR-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to habitat complexity				
BeaR-CCCh-19.1.1.1	Action Step	Logging	Encourage coordination of LWD placement projects in streams (as necessary) as part of logging operations.	2	40	CDFW, Humboldt Redwood Company, NMFS	
BeaR-CCCh-19.1.1.2	Action Step	Logging	Encourage low impact timber harvest techniques such as full-suspension cable yarding (to improve canopy cover; reduce sediment input, etc.).	3	40	CDFW, Humboldt Redwood Company, NMFS	
BeaR-CCCh-19.1.1.3	Action Step	Logging	Work with California BOF, CalFire, CDFW, professional organizations and landowners to protect forest lands from conversion, promote sustainable forestry practices and provide landowner incentives for growing late seral forests in riparian areas and conducting restoration actions.	3	40	NMFS	
BeaR-CCCh-19.1.1.4	Action Step	Logging	All roads, landings, and skid trails associated with timber operations should, to the maximum extent practicable, be hydrologically disconnected to prevent sediment runoff and delivery to streams.	3	25	CDFW, Humboldt Redwood Company, NRCS	
BeaR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of habitat or range**				
BeaR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
BeaR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Assess and prioritize road-stream connection, and identify appropriate treatment to reduce delivery of sediment to streams.	3	5	CDFW, Humboldt Redwood Company	
BeaR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Decommission roads, guided by assessment.	3	20	CDFW, Humboldt Redwood Company	
BeaR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Upgrade roads, guided by assessment.	3	15	CDFW, Humboldt Redwood Company	

Bear River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
BeaR-CCCh-23.1.1.4	Action Step	Roads/Railroads	Maintain roads, guided by assessment.	3	20	CDFW, Humboldt Redwood Company	
BeaR-CCCh-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
BeaR-CCCh-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
BeaR-CCCh-23.2.1.1	Action Step	Roads/Railroads	Develop grading ordinance for maintenance and building of private roads that minimizes the effects to salmonids.	3	5	CDFW, County	
BeaR-CCCh-25.1	**Objective**	**Water Diversion/ Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BeaR-CCCh-25.1.1	Recovery Action	Water Diversion/ Impoundment	Improve flow conditions				
BeaR-CCCh-25.1.1.1	Action Step	Water Diversion/ Impoundment	Identify alternative water sources, storage means, or seasonal withdrawal restrictions to increase streamflow during low flow periods.	2	5	CDFW, County, NMFS	
BeaR-CCCh-25.1.1.2	Action Step	Water Diversion/ Impoundment	Reduce diversions.	2	5	NCRWQB	
BeaR-CCCh-25.1.1.3	Action Step	Water Diversion/ Impoundment	Provide education and training on conserving water while diverting.	3	10	NCRWQB	
BeaR-CCCh-25.1.1.4	Action Step	Water Diversion/ Impoundment	Provide incentives to landowners to reduce water consumption during low flow periods.	3	15	NCRWQB	

Humboldt Bay Tributaries Population

Chinook Salmon Fall-Run

- Role within ESU: Potentially Independent Population
- Diversity Stratum: North Coastal
- Spawner Abundance Target: 2,600 adults
- Current Intrinsic Potential: 76.6 IP-km

For information regarding NC steelhead and SONCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the SONCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

The Humboldt Bay watershed drains approximately 433 square kilometers, with a majority of this occurring in the major spawning tributaries of Jacoby Creek, Freshwater Creek, Salmon Creek, and Elk River. Because population data collection in the Humboldt Bay watershed is limited, abundance of the Chinook salmon population is inferred from the trends observed in Freshwater Creek.

Although Chinook salmon have been counted at the Freshwater Creek weir since 1994; these counts are partial counts, as fish can fish pass over the weir during high flows and smaller jacks may pass through the weir. Counts of adults at the Freshwater Creek weir from 1994 through 2014 indicate the wild population has declined (Ricker and Anderson 2014). Ricker and Anderson (2014) characterized the decline in Chinook salmon in Freshwater Creek as dramatic, and raised concerns over depensatory population effects. Once the augmentation of hatchery reared Chinook salmon ceased in 2004, weir captures declined rapidly into the single digits and ultimately reached an all-time low of no returning adults in 2013 (Ricker and Anderson 2014).

History of Land Use

Vegetation in the upper watershed of the Humboldt Bay Tributaries population area was historically (pre-European) coniferous forest, dominated by coast redwood. Douglas-fir and tan oak occur in association with redwood, and other forest trees include grand fir, Sitka spruce, western red cedar, western hemlock, and red alder in riparian areas. Historic riparian canopy cover was likely high, and large wood was abundant in streams. Sediment delivery, storage, and transport processes within the streams were a function of the geology, climate, and channel morphology (Doughty 2003). Prior to the 1800s, the historic salmon habitat in the population area was largely unaffected by anthropogenic land use. After 1800, European settlement, land

use, and resource extraction influenced landscape processes, which resulted in decreased quality, quantity, and accessibility of habitat for salmon adult spawning and juvenile rearing (Beechie *et al.* 2003).

Harvest of old growth trees began in the 1860s with concomitant building of railroads linking the forests to the mills on the Humboldt Bay waterfront. Timber harvest practices that degraded aquatic habitat included: (1) clear cuts that altered the hydrology and increased sediment delivery to the watercourse; (2) loss of riparian floodplain to harvest and road construction; (3) use of tributary stream channels as haul roads; (4) steam donkey dragging of logs within stream channels; and (5) use of larger stream channels for log transport and splash-dams. Several periods of timber harvest have occurred in the Humboldt Bay watershed; initially harvesting the easily accessible timber from 1860 to 1910, and then subsequent harvesting higher in the watershed. In the 1800s, a common road building practice for road-stream crossings was a "Humboldt" log crossing, where organic debris was pushed into the stream and buried with soil. The use of Humboldt crossings, instead of culverts or bridges, continued into the 1970s and created a persistent source of sediment delivery to watercourses (HBWAC 2005).

Current Resources and Land Management

Numerous community-based organizations are engaged in salmonid, watershed, and ecosystem restoration activities, which are distributed across public, private and tribal lands in the Humboldt Bay watershed. The local history of restoration, existing patterns of land ownership and settlement, the presence and engagement of numerous Federal and state public lands management agencies as well as regulatory agencies, and the robust civic culture and community relationships is vital for recovery of salmonid populations (Baker and Quinn-Davidson 2011).

Humboldt Bay is an important commercial and recreational shellfish growing area, as well as deep-water port. Land ownership within the coastal zone, which includes the tidelands and submerged lands of Humboldt Bay to mean higher high water (MHHW) and surrounding lands from MHHW inland to the California Coastal Zone Boundary, is both private and public. Management of the submerged lands and historic tidelands in Humboldt Bay is primarily the responsibility of the Humboldt Bay Harbor, Recreation, and Conservation District (HBHRCD). The HBHRCD was established in 1970 to manage Humboldt Bay for the promotion of commerce, navigation, fisheries, recreation, the protection of natural resources, and to acquire, construct, maintain, operate, develop, and regulate harbor activities. In addition to the HBHRCD, numerous districts, city, county, state and Federal entities have ownership and regulatory jurisdiction over land use activities in the coastal zone (HBHRCD 2007).

Currently in the upper tributary watersheds of Humboldt Bay, the dominant land use is timber production and harvest. The majority of land in the upper Humboldt Bay watershed is privately owned by two commercial timber companies, Humboldt Redwood Company (Freshwater Creek, Elk River, Salmon Creek) and Green Diamond Resource Company (Jacoby Creek, Elk River,Salmon Creek). Approximately 24 square miles (15,400 acres), or 77% of the Freshwater Creek watershed, is owned and managed for timber by Humboldt Redwood Company (Domoni Glass Watershed Professionals Network 2003). The dominant land use in the middle and lower portions of the Humboldt Bay watershed are agriculture, urban, residential, and industrial development. Agricultural land is used primarily for livestock grazing and hay production. Urban, residential, and industrial land use are concentrated in the city of Arcata (population 16,651), the city of Eureka (population 26,128), and in five smaller communities near Humboldt Bay, with a total population of approximately 70,000 (HBWAC 2005). There is currently more residential development in the Jacoby Creek and Freshwater Creek watersheds than in the Elk River or Salmon Creek watersheds.

Outside of incorporated municipalities, there is limited public ownership of land within the Humboldt Bay watershed. The few exceptions are as follows. The City of Arcata owns and manages a 2,100 acre community forest which includes a demonstration forest in the Jacoby Creek watershed; the California Department of Fish and Wildlife (CDFW) manages five wildlife areas (Mad River Slough 587 acres; Fay Slough 484 acres; Elk River 2,131 acres; and South Spit 598 acres); the U.S. Fish and Wildlife Service manages the approximately 4,000 acres of the Humboldt Bay National Wildlife Refuge, with holdings in both the north and south bay areas. Humboldt County manages a small park which includes a seasonal impoundment and associated fish ladder in Freshwater Creek. The Headwaters Forest Reserve, public land managed jointly by the Bureau of Land management and CDFW, includes nearly 7,500 acres of redwood and Douglas-fir forests and protects stream systems that provide habitat for Chinook salmon in South Fork Elk River and Salmon Creek.

Numerous water quality, land use, resource management, and habitat conservation related planning documents specific to Humboldt Bay and its watershed have been prepared (see list below). Local community land use plans (Arcata, Eureka, and Humboldt County) provide direction for future growth and development, express community values and goals, and portray the community's vision of the future. These plans contain measures (*e.g.,* zoning ordinances) designed to protect aquatic habitat by controlling watershed erosion and by maintaining instream flows and enhancing riparian habitat. These plans strive to integrate the incorporated and unincorporated areas within the Humboldt Bay watershed.

- U.S. Bureau of Land Management and California Department of Fish and Game, Headwaters Forest Reserve Resource Management Plan (USBLM and CDFG 2004);
- U.S Fish and Wildlife Service Humboldt Bay National Wildlife Refuge Comprehensive Conservation Plan (USFWS 2009);
- Humboldt Bay Harbor, Recreation and Conservation District Humboldt Bay Management Plan (HBHRCD 2007);
- Humboldt County General Plan Update (ongoing);
- City of Eureka General Land Use Plan (City of Eureka 1997); and
- City of Arcata General Plan 2020 (City of Arcata 2008).

Aside from Federal land management agency and HBHRCD plans, numerous regulatory mechanisms are designed to protect aquatic habitat in the Humboldt Bay watershed. The National Marine Fisheries Service has issued long-term (50-year) section 10(a)(1)(B) Incidental Take Permits for the activities and associated habitat conservation plans for two commercial timber companies in the Humboldt Bay watersheds. Within the State of California, the California Department of Forestry and Fire Protection, the State Board of Forestry and Fire Protection, and the California Environmental Protection Agency have regulatory mechanisms in place or in development to reduce sediment impairment to aquatic habitat from land-based activities in the Humboldt Bay watershed. The North Coast Regional Water Quality Control Board (Regional Water Board) and the U.S. Environmental Protection Agency (EPA) have listed the Freshwater Creek watershed and Elk River watershed under the Clean Water Act Section 303(d) as sediment impaired waterbodies. A program has been developed to recover 303(d) List waterbodies via the establishment of Total Maximum Daily Loads (TMDL). The Regional Water Board staff is in the process of establishing a TMDLs for sediment in the Freshwater Creek and Elk River watersheds. The goal of the TMDL program is to restore and maintain the sediment impaired beneficial uses of water of Freshwater Creek and Elk River and their tributaries. Regulatory mechanisms affecting private lands in the Humboldt Bay watershed include:

- Humboldt Redwood Company Habitat Conservation Plan (HRC 2012);
- Green Diamond Resource Company Habitat Conservation Plan (GDRC 2006);
- California Department of Forestry and Fire Protection and California Department of Fish and Game Anadromous Salmonid Protection Rules (CDFFP and CDFG 2010);
- North Coast Integrated Regional Water Management Plan (NCRP 2007); and
- California State Water Resources Control Board and California Environmental Protection Agency. Water Quality Control Plan for Enclosed Bays and Estuaries. Part 1. Sediment Quality (CSWRCB and CEPA 2009).

Local stakeholders have been proactive in both developing salmonid conservation and habitat restoration plans, strategically coordinating funding and implementation of projects and taking an ecosystem approach to potential effects of sea level rise and climate change:

- Humboldt Bay Watershed Salmon and Steelhead Conservation Plan (HBWAC 2005);
- North Coast Anadromous Salmonid Conservation Assessment (Tussing and Wingo-Tussing 2005);
- Humboldt Bay Ecosystem-Based Management Program (HBHRCD 2007);
- Humboldt Bay Initiative: Adaptive Management in a Changing World (Schlosser *et al.* 2009);
- California Pacific Coast Joint Venture Coastal Northern California Component Strategic Plan (CPCJV 2004); and
- The Humboldt Bay and Eel River Estuary Benthic Habitat Project (Schlosser and Eicher 2012).

Many completed restoration projects have leveraged opportunities on public lands, as well as provided incentives for participation by private landowners. For example, the City of Arcata Baylands and McDaniel Slough Restoration and Enhancement Projects restored and enhanced wetland, riparian and stream habitat adjacent to the Humboldt Bay National Wildlife Refuge, the Arcata Marsh and Wildlife Sanctuary, the Mad River Slough Wildlife Area and Jacoby Creek Land Trust holdings, thereby establishing a continuous, protected habitat area of over 1,300 acres. The Humboldt Bay Initiative (Schlosser *et al.* 2009) identified the need for: (1) a non-profit Coastal Ecosystem Institute of Northern California (CEINC), now established; and (2) a proactive, coordinated response to shoreline and hydrologic changes, and the resulting shifts in land use, human communities, species and habitats due to climate change. In 2013, the CEINC along with the HBHRCD, convened an Adaptation Planning Working Group to begin preparation of a sea level rise adaptation plan for Humboldt Bay.

Salmonid Viability and Watershed Conditions

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Humboldt Bay CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Viability: Density and Abundance

Relative to historic numbers and recovery targets, the numbers of spawning adults are alarmingly low in the Humboldt Bay population leading to an overall rating of Poor. Low numbers of juveniles suggest that the watershed is not functioning properly. Expression of known diverse life history outmigration and rearing strategies of juvenile salmonids are limited by the quantity and quality of both freshwater and estuarine habitat.

Estuary: Quality and Extent

This condition rates Fair for Chinook salmon adults, pre-smolts, and smolts. Chinook salmon adults use estuarine habitat as a staging area prior to their migration to freshwater, and pre-smolts and smolts use estuarine habitat for rearing, as a transitional habitat between the freshwater and marine environments, and as velocity refugia. Chinook salmon pre-smolts rearing in the estuary are almost always found in tidally influenced freshwater habitat while smolts utilize brackish water habitat in the estuary (Wallace, M., CDFW, personal communication, 2011). There is potential for estuarine rearing, although the quality and quantity are reduced compared to historic conditions. The structure and function of the tidally influenced habitat in the drowned river mouths around Humboldt Bay, as well as in the contiguous nearshore and deeper channel habitats in Humboldt Bay have been significantly altered from natural conditions. The quality of rearing habitat for pre-smolts and smolts has been reduced as a result. The physical and biological habitat-forming processes, the light regime, and the spatial extent of the intertidal and subtidal habitats in Humboldt Bay have been directly altered as a result of: (1) upland land use activities that increase sediment transport, reduce floodplain/tidal marsh storage of sediment, and limits large wood recruitment and delivery to the tidally influenced habitats; (2) agricultural practices that diked, drained and eliminated estuarine rearing habitat; (3) construction of roads and railroads that effectively act as dikes, altering hydrology and habit accessibility; (4) port and harbor development and interrelated commercial and recreational activities; and (5) urbanization and development of Arcata and Eureka.

Maintenance dredging of the Federal Navigation Channels and jetty construction to stabilize the mouth of Humboldt Bay; changed the volume of flood and ebb-tidal shoals, modified the tidal prism, and forced a new equilibrium state (Larson *et al.* 2002). Since 1950, from March through May, juvenile salmon present in Humboldt Bay may be exposed to the annual dredging. Overflow of the hopper dredge during annual maintenance dredging of the Federal Navigation Channels, results in water quality that has: (1) been degraded due to increased turbidity; (2) reduced the localized availability of the water column habitat for rearing and migration of juvenile salmon during each daylight dredge cycle; and (3) disoriented fish entrained in the prop wake and turbidity plume, and in turn increased the likelihood of predation by birds during the day.

Over-water structures (piers, piles, docks, and moored boats) in Humboldt Bay, along with associated shading and localized hydraulic effects, cause detrimental effects to salmon habitat. These structures: (1) reduce the amount of nearshore intertidal and subtidal eelgrass habitat, (2) reduce the connectivity of nearshore habitat, (3) alter the type of cover and prey available for juvenile salmonids, and (4) trigger salmonid behavioral habitat avoidance. Because salmon avoid swimming under over-water structures, individuals will occupy the middle to the surface of the water column in deeper water adjacent to structures, as opposed to occupying more shallow water as they would in the absence of the structures (Toft *et al.* 2004). As a result of fragmentation of nearshore habitat, including eelgrass habitat, juvenile salmonids likely increase the amount of time traveling between eelgrass patches, which: (1) results in decreased foraging; and (2) increases their exposure to predators where eelgrass cover is reduced or over-water structures present.

Alteration and loss of salt marsh, intertidal and subtidal habitat in Humboldt Bay adjacent to the Eureka watershed resulted from the construction of the three State Highway 255 Humboldt Bay bridges in 1971 and Woodley Island Marina in 1981. Hardening of the shoreline has reduced the extent of the intertidal habitat, restricted sediment transport, and likely increased nearshore turbulence. Artificial illumination in the nearshore during otherwise normal periods of darkness can provide enough light for visual feeders to see and capture prey (Yurk and Trites 2000; DeVries *et al.* 2003; Longcore and Rich 2004). Harbor seals prey on juvenile salmonids in water at least 2 m deep, and feed actively in the light-shadow boundary produced by halogen bridge lights and residual city lighting (Yurk and Trites 2000).

Landscape Patterns: Agriculture, Timber Harvest and Urbanization

This condition has an overall Poor rating for watershed processes. Clearing of vegetation has increased surface runoff, and over-harvest of riparian vegetation has caused a consequent decrease in both the downed large wood and the amount of future potential large wood. Relative to hydrologic function, reductions in large woody debris decreases in-channel sediment storage, reduces channel roughness, and reduces the ability of the stream to attenuate peak flows. Inboard ditches collect and channelize surface runoff and subsurface flows, then efficiently route sediment and other pollutants present in the water to streams resulting in higher, earlier, and more frequent peak flows. Increased peak flow may increase the frequency of channel bed mobilization; thereby, increasing the probability of redd scour, disturbance of alevins in redds, as well as displacing over-wintering juveniles.

Sediment Transport: Road Condition and Density

This condition has an overall Poor rating for watershed processes. The Humboldt Bay watersheds are comprised of moderately unstable geologic composition. There were very large stressing storms in the late 1990s following a high level of logging operations. These storms, combined with poor landing and stream crossing locations and poor road construction practices caused sediment problems. Specifically, large storms between 1993 and 1997 routed stored sediment from lower order tributary watersheds down to the low gradient storage reaches and caused significant amounts of landsliding associated with old roads and landings, transporting considerable volumes of sediment downstream.

Increased sediment delivery has filled pools, widened channels, and simplified stream habitat throughout the Humboldt Bay watershed, including the tidally influenced habitats and the estuary.

Hydrology: Redd Scour Events and Watershed Processes: Impervious Surfaces

This condition has an overall Poor rating for watershed processes. Although approximately 2.97% of the watershed consists of impervious surfaces, this rating does not recognize the high density of impervious surfaces within the lower floodplain in Eureka and Arcata. Urbanization within these areas has led to increased surface runoff and higher peak flows, both of which negatively affect hydrology and fish habitat. These high peak flows led to a Poor rating for eggs due to redd scour.

Habitat Complexity: Large Wood

This condition has a Poor rating for adults. Large woody debris originating from adjacent riparian forests is a form of cover in many streams, and its importance within pools is widely recognized (Bisson *et al.* 1987; Holtby 1988). Large riparian trees that fall into streams and rivers contribute to a range of habitat types. In particular, large diameter conifer trees support a variety of habitats through their unique ability to enhance channel scouring, improve velocity heterogeneity, and trap coarse sediments. Habitat diversity is essential to Chinook salmon growth and survival because scour pools provide cover from predators and a high flow refugia during winter. In addition, the substrate and velocity enhancements improve spawning and rearing habitat quality.

Habitat Complexity: Percent Primary Pools and Pool/Riffle Ratios/Flatwater Ratios

The Percent Primary/Staging Pools condition has a Poor rating for adults. Jacoby Creek, Freshwater Creek, and Elk River have been listed by the North Coast Regional Water Quality Control Board (NCRWQCB) and the U.S. Environmental Protection Agency (EPA) as sediment impaired under Clean Water Act Section 303(d). Excessive fine sediment can result in poor

spawning habitat for adults. Accelerated delivery of sediment to Humboldt Bay tributaries from roads and historic timber harvest activities have resulted in aggraded channels and shallow pools. This lack of complex overwintering habitat throughout much of the system may be a major factor in the population decline of Chinook salmon.

Velocity Refuge: Floodplain Connectivity

This condition has a Poor rating for pre-smolts and smolts. The primary indicator for this habitat attribute is availability and abundance of velocity refuge during high flows. Velocity refugia are provided by physical features (*e.g.*, pools, large wood) discussed previously, as well as access to and quality of floodplain. Levees and dikes limit connectivity between mainstem slough channels and potential floodplain habitat in valley floor and stream-estuary ecotone sections of most Humboldt Bay tributaries. Tide gates in dikes block fish passage into formerly accessible estuarine rearing habitat and spawning tributaries in the Humboldt Bay watershed (USFWS 2007).

Riparian Vegetation: Composition, Cover & Tree Diameter

This condition has a Fair rating for pre-smolts. Clearing of riparian forests is one factor that alters recruitment of large woody debris to streams (another being harvest of unstable or potentially unstable slopes), subsequently altering sediment transport and storage, deposition and storage of sediment, bed roughness, interaction between the channel and floodplain, channel habitat characteristics including pool habitat (spacing, area, and depth) both in freshwater and tidally influenced habitats. Riparian vegetation also provides: (1) shade, which influences water temperature; (2) nutrients and organic material (leaves, insects); and (3) bank stabilization. The composition of the prey community is a factor in habitat use, for example, a study conducted in the Freshwater Creek watershed in 2004 (Cummins *et al.* 2005) found that greater numbers of juvenile salmon were present where the system was heterotrophic, relying on riparian inputs of energy.

Sediment: Gravel Quality and Distribution of Spawning Gravels

This condition has a Fair rating for adults. Embedded channel gravels reduce permeability of redds, which reduces the amount of oxygen available to salmon eggs, thereby potentially reducing growth and survival of eggs. Further, the success of salmon fry emergence from spawning gravels decreases as channel embeddedness increases. Sediments delivered to the streams and creeks are, over time, transported to tidally influenced habitats in the lower portions of the tributaries and ultimately into Humboldt Bay, as discussed in the subsequent section on impaired function of tidally influenced habitat.

Water Quality: Turbidity or Toxicity

This condition has an overall Fair rating for adults, pre-smolts, and smolts. Increased suspension of sediments, and resultant increased turbidity, can cause avoidance responses, and physical damage to gills of fry, juveniles, smolts and adults, as well as reduced feeding and growth rates of fry, juveniles and smolts. High levels of fine sediment and embeddedness can also reduce the feeding success, and ultimately growth of 0+ and 1+ fish, because extended periods of high turbidity reduce visibility of prey as well as the type of invertebrate prey available. Epibenthic grazer and predator taxa of benthic macroinvertebrates, an important food source for salmonids, are limited or non-existent in channels with high levels of sedimentation. Nutrient loading from septic tank overflow, runoff from grazing lands, and reduced riparian vegetation, contribute to impaired water quality.

Very Good or Good Current Conditions

Viability: Spatial Structure

This condition has an overall Good rating for adults and pre-smolts due to the accessibility of most of their historic habitat. Both adults and pre-smolts are present in 75-90% of their historic range.

Water Quality: Temperature

This condition has a Good rating for smolts. Water temperatures in Freshwater/Eureka Slough between Fay and Ryan sloughs become high (>22 C) during the summer and potentially act as a thermal barrier between Freshwater Creek and Humboldt Bay for Chinook smolts. This likely occurs in other sloughs in the Humboldt Bay watershed.

Passage/Migration: Mouth or Confluence and Physical Barriers

This condition has an overall Good rating for adults, pre-smolts, and smolts. In the tidally-influenced lower region of the watershed, passage barriers (e.g., culverts, tide gates) have limited the accessibility to juvenile and adult salmonids, thereby reducing the quantity and quality of the tidal freshwater and estuarine rearing habitat for anadromous salmonids. Prior to 1988, access to Humboldt Bay tributaries was very limited due to migration barriers. Since the early 2000s, several fish passage projects have been completed using a variety of techniques to enhance and restore fish access.

Hydrology: Baseflow and Passage Flows

This condition has an overall Good rating for adults, pre-smolts, eggs and smolts.

Threats

The following discussion focuses on those threats that rate as High or Very High (see Humboldt Bay CAP results). Recovery strategies will likely focus on ameliorating High rating threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Humboldt Bay CAP results.

Roads and Railroads

Forest roads are a primary causative factor for both altered sediment supply and altered hydrologic function. The density of roads in the Humboldt Bay watershed is generally high (>3 miles of roads per square mile). Pacific Watershed Associates (PWA 2006) reported that between 1989 and 2003 there were 76 miles of road constructed in Freshwater Creek (30.7 mi^2), which resulted in an overall road density of 7.6 mi/mi^2. They also reported that Ryan Slough and Fay Slough, both tributaries to Freshwater Creek, have road densities of 8.7 mi/mi^2, and 8.8 mi/mi^2, respectively. Roads and road ditches extend the stream channel network, concentrate hillslope runoff and capture subsurface flows, often resulting in changes to the natural hydrograph. Specifically, historic peak flows are exceeded due to the increase in road-stream connectivity and peak flows occur more frequently. Further, inboard ditches effectively convey road-related sediment to streams. In some watersheds, road erosion may annually contribute more sediment to the stream system than mass wasting (PWA 2006).

Channel Modification

This threat rates High for adults, pre-smolts, smolts, and watershed processes. The extent of channelization and diking in the lower portion of Humboldt Bay watersheds, as well as the Reclamation District Levee in North Bay and associated tide gates, limits the availability of tidal freshwater and estuarine rearing habitats.

Logging and Wood Harvesting

This threat rates as a High for pre-smolts, smolts and watershed processes. Timber harvest activities in both Freshwater Creek and Elk River have resulted in cumulative watershed effects. Timber harvest in Freshwater Creek increased from 668 acres/year between 1988 and 1997, to 1,166 acres/year between 1998 and 2003 (PWA 2006). Much of the existing streamside canopy in the Eureka Plain HU is either hardwood dominated or of insufficient size to provide large wood recruitment potential. In Freshwater Creek, the existing canopy closure within managed stands is expected to take 40 years to increase to 70 percent (Doughty 2003). The rate of timber harvest in Elk River increased in 1986 over historic rates. Between 1986 and 2008, 14,169 acres of the 14,386 acre North Fork Elk River drainage were approved for harvest under a number of THPs.

The rates of landsliding and associated sediment delivery from recently harvested areas (areas harvested less than 15 years ago) were significantly higher than the rates of landsliding and sediment yield due to landslides from non-harvested areas during the period from 1994 to 1997. For example, landslide sediment yield from recently harvested areas was approximately 1300 percent (13 times) greater than background landslide sediment yield rates (sediment inputs from areas harvested more than 15 years ago) in the North Fork Elk River watershed (Reid 1998).

Past harvest of riparian and upland trees has limited potential large wood recruitment to stream channels, and the current age of trees limits shade provided by canopy. Interim prescriptions in the PALCO HCP (Pacific Lumber Company 1999) have been modified and are intended to restore, protect or maintain water quality objectives and beneficial uses in Clean Water Act section 303(d)-listed waterbodies.

Severe Weather Patterns

This threat rates as High for adults and for watershed processes. Although current water temperatures in the Humboldt Bay watershed are a relatively Low stress, modeled regional average temperature shows a moderate increase over the next 50 years. Average water temperature could increase by up to 0.5 ^{o}C in the summer, and by approximately 1.0 ^{o}C in the winter. Annual precipitation in the Humboldt Bay watershed is predicted to change little over the next century.

Tidally influenced rearing and migratory habitat for pre-smolts, and smolts are most susceptible to sea level rise. Increasing temperatures and rising sea level will reduce water quality and hydrologic function in the summer. Rising sea level will likely reduce the quality and quantity of tidal-wetland rearing habitat in Humboldt Bay, *e.g.*, increase salt marsh and reduce intertidal flats (Galbraith *et al.* 2002). Wetlands could migrate inland with rising sea level, but for the extent of existing levees and dikes.

The tidally influenced habitat of the Humboldt Bay watershed is highly vulnerable to sea-level rise due to the location of urban and residential developments, existing land use and public infrastructure (CNRA 2009; Heberger *et al.* 2009; NMFS 2009). Stressors previously described for estuarine function will likely be exacerbated, depending on decisions and subsequent implementation of actions to protect existing public sector infrastructure [transportation (*e.g.*, highway, airport, port facilities); energy (*e.g.*, power plant, natural gas pipeline, transmission lines); water (*e.g.*, Humboldt Bay Municipal Water District water main, city of Arcata and Eureka wastewater treatment facilities) and public and private land use (*e.g.*, city of Arcata and Eureka; Humboldt Bay National Wildlife Refuge, Humboldt Bay Reclamation District; Humboldt Bay

Harbor, Recreation, and Conservation District). Because of the land and infrastructure ownership, these decisions will be made at multiple Federal, state, and local jurisdictional levels.

Adults will be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (ISAB 2007; Portner and Knust 2007; Feely *et al.* 2008).

Low or Moderate Rated Threats

Logging and Wood Harvesting

This threat rates as Medium for adults and eggs. See previous discussion under Landscape Patterns.

Residential and Commercial Development

Overall, this threat rates as Medium for Chinook salmon. The Humboldt Bay Management Plan (HBHRCD 2007) identified the primary use of Humboldt Bay as port-related activities, in the area below the Samoa Bridge to South Bay (which serves as a salmon migratory corridor and rearing habitat). Further, future development may degrade existing tidally influenced habitat and limit the efficacy of existing or planned restoration projects. Discharge of treated wastewater to Humboldt Bay is permitted from treatment plants for the City of Arcata, greater Eureka, and College of the Redwoods (NCRWQCB 2005), and the volume of discharge would increase with fully realized potential of the land zoned for residential development.

Agriculture

Agriculture rates as a Medium threat for pre-smolt, smolt, and watershed processes, and a Low threat for adults and eggs. Grazing and haying occurs throughout the lower watersheds and likely contributes to increased sediment mobilization and delivery. Cattle grazing and instream watering contribute to degraded riparian and aquatic habitat, primarily in the lower watershed, and reduce its function for rearing. Production of prey is also limited by increased turbidity and nutrient loading from feces. Diking of tidelands and installation of tidegates to create land for agriculture has eliminated the majority of the intertidal rearing habitat around Humboldt Bay.

Disease, Predation and Competition

Non-native species pose a Medium threat to juveniles and smolts both in freshwater and in tidally influenced habitat in the tributary watersheds, as well as in Humboldt Bay. CDFW's Natural Stock Assessment Program captured six Sacramento pikeminnow, a salmonid predator currently present in the Eel River, during routine and subsequent sampling, and during a multi-agency eradication effort in Martin Slough in 2008. CDFW plans to sample Martin Slough monthly and

is working with NOAA Fisheries and other agencies to develop a response plan for addressing future pikeminnow that are captured.

Because Humboldt Bay is used as a port, numerous, non-native invertebrate species, which often appear as fouling organisms on piers and pilings , have been introduced in ballast water, or from vessel hulls (Boyd *et al.* 2002). Culture of the non-native oyster, *Crassostrea japonica*, also introduced a number of non-native invertebrate species into Humboldt Bay. The non-native dwarf eelgrass (*Zostera japonica*) and denseflower cordgrass (*Spartina densiflora*), are present, and were also likely introduced in ballast water and as deposited ballast, respectively. Monitoring of non-native invertebrates and intertidal and salt marsh vegetation in Humboldt Bay, as well as eradication programs, are ongoing.

Water Diversion and Impoundments

Diversions pose a Medium threat to juveniles, smolts and adults. There are no large dams in the Humboldt Bay watershed. The Union Water Company constructed a small dam on Jolly Giant Creek in 1930. The 50-foot high structure, located above the zone of anadromy, within the Arcata Community Forest, is no longer used as a water impoundment. The structure lacks a spillway and is drained by an undersized cast iron pipe. A large amount of sediment is stored in the old reservoir bed and sediment mobilizes downstream when the drainpipe is unclogged and head exists, following frequent plugging.

From the 1920s through 2001, a flashboard dam was installed on Freshwater Creek at Freshwater Park from June through September to create a swimming area. Prior to 2002, this summer dam was a barrier to potential upstream and downstream movement of juvenile salmonids. In order to enable fish passage, the County of Humboldt, owner and operator of Freshwater Park, worked with fisheries biologists and engineers (private, academic, State, and Federal) in 2001 to design, and build: (1) a temporary dam bypass structure (operated 2002-2007); and (2) a permanent concrete fish ladder, embedded in the streambank (2009). Neither the dam, nor the temporary bypass, were installed in 2008. Juvenile salmonids currently utilize the permanent fish ladder, and have been observed moving upstream and downstream of the flashboard dam (HCDPW 2010; 2011).

According to the Department of Water Resources data base (http://www.waterboards.ca.gov/ ewrims/), there are 53 appropriative water rights and diversion points in the Eureka Plain, but they are not all active. However, not all water diversions are registered with DWR. Riparian residential and agricultural uses can comprise significant amounts of water especially during low flow periods. Although water users may need to notify CDFW and obtain a lake or streambed alteration agreement before diverting water, this has not been common practice for small

agriculture and residential withdrawals. Due to channel aggradation and subsequent limited instream water storage, water withdrawals in the summer months can reduce both the fluvial and tidal freshwater habitat available for rearing salmon. Consequently, the combination of reduced natural flow and anthropogenic withdrawals further reduces water quality (*i.e.*, lowered dissolved oxygen) in the remaining habitat.

Mining, Hatcheries and Aquaculture, Fishing and Collecting, Recreational Areas and Activities

Overall rating of these threats is Low or not applicable (Hatcheries and Aquaculture).

Limiting Stresses, Lifestages, and Habitats

The pre-smolt and smolt lifestage is most limiting, primarily due to reductions in quality and quantity of summer rearing habitat. The altered sediment supply, lack of floodplain and channel structure, and impaired estuary are the stresses that most limit rearing opportunities. The combined effect of excess sediment filling pools along with the lack of structure to regulate sediment transport or induce scour, significantly reduces the complexity of the instream habitat. Furthermore, Chinook salmon historically depended on the rich tidally influenced habitat for rearing, and the impaired state of the estuary has further limited rearing opportunities.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating stresses and threats, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. The general recovery strategy for the Humboldt Bay Chinook salmon population is discussed below with more detailed and site-specific recovery actions provided in Humboldt Bay CAP results, which provides the Implementation Schedule for these populations.

Recovery actions to reduce the stresses of the Humboldt Bay Chinook salmon population should focus on restoring the natural watershed processes (*i.e.*, the fluvial transport of wood, water, sediment, nutrients, and energy) within Jacoby Creek, Freshwater Creek, Salmon Creek and Elk River. Improved quality and quantity of habitat, as well as increased accessibility of seasonally important rearing habitats (backwater freshwater habitats, and tidally influenced wetland habitats in spring, summer, and fall) in all of the tributaries to Humboldt Bay will allow for increased growth and survival of individuals. Because many designated land uses in the population area have not yet been realized (*e.g.*, land not yet developed, timber not yet harvested), the opportunity for protection of habitat through innovative incentive programs, alternative land use scenarios, and partnerships provides a means to reduce the stresses and help restore natural

landscape processes. Increasing abundance, as well as increasing the potential for expression of diverse life history strategies through increased diversity of spatially and temporally available spawning and rearing habitats, should enhance the resilience and increase the likelihood of viability of these populations. Because the potential for non-native vegetation to establish in estuarine restoration sites is high due to the disturbance of the substrate and proximity of existing seed sources, estuarine restoration projects should employ measures to enhance colonization by native species.

Population monitoring, as well as implementation of recovery actions in the Elk River watershed, are especially important for recovery.

Improve Estuary Habitat

Restore the physical and biological attributes of the estuary. Improve rearing habitat by increasing in-water structure and overwater cover, restoring access to the tidal slough habitats, and creation of off-channel velocity refugia for winter rearing.

Improve Floodplain Connectivity

Prevent further loss of riparian vegetation and rehabilitate riparian areas that are currently in poor condition. As discussed below the recovery of riparian function will improve LWD recruitment, but also is expected to increase prey availability through terrestrial insect subsidies. Create off-channel freshwater rearing habitat.

Improve Instream Habitat Complexity

Improve large woody frequency across the Humboldt Bay watershed. Riparian areas are in the process of recovery with stands of smaller diameter conifers that currently buffer stream areas. Addition of large wood will provide much needed stream channel complexity until riparian areas reach maturity and begin to recruit large wood naturally to channels. Large wood will improve instream habitat attributes (*e.g.*, pool and riffle frequency, habitat complexity) provide refuge from high flows; and provide for increased growth and survival of juveniles during winter and summer. Information from existing plans and assessments should be utilized in determining high priority streams for large wood restoration projects.

Improve Instream Habitat and Substrate Quality

Continue efforts to reduce sediment delivery from past management caused sources of roads, timber harvest, grazing, and agriculture. Funding must be continued for the implementation of the remaining road and other sediment reduction projects.

Improve Water Quality

Continue efforts to improve water quality by reducing erosion of streambanks from livestock grazing, and off-road vehicle recreational activities.

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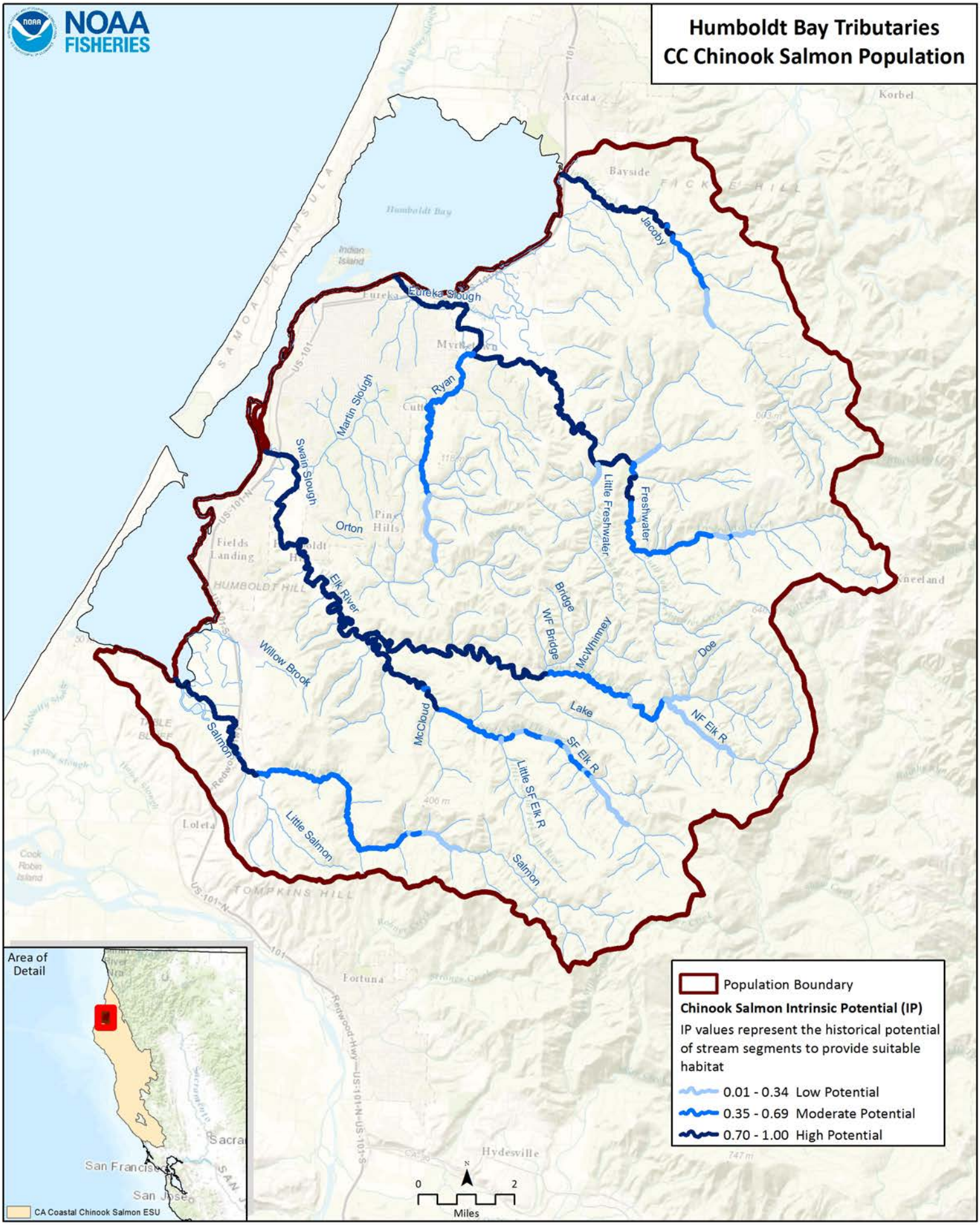
NOAA FISHERIES
Humboldt Bay Tributaries
CC Chinook Salmon Population
Arcata
Korbel
Bayside
Humboldt Bay
Indian Island
Eureka Slough
Jacoby
Ryan
Martin Slough
Swain Slough
Orton
Little Freshwater
Freshwater
Elk River
Bridge
WF Bridge
McWhinney
Doe
Willow Brook
Lake
NF Elk R
McCloud
SF Elk R
Little SF Elk R
Salmon
Little Salmon
Fortuna
Hydesville
Area of Detail
CA Coastal Chinook Salmon ESU
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
0
2
Miles

CC Chinook Salmon Humboldt Bay Tributaries CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Properly Functioning Condition	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	Fair
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	0% of streams/ IP-km (>49% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	99% of streams/ IP-km (>30% Pools; >20% Riffles)	Very Good
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.31	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	54.56% Class 5 & 6 across IP-km	Fair

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	41	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	76.67	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	17.71	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	32.3	Good
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		<1 spawners per IP-km	Poor
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good

			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	81% (0.85mm) and <30% (6.4mm)	Good
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	81% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	41	Fair
3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	92% of streams/ IP-km (>49% average primary pool frequency)	Very Good
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	99% of streams/ IP-Km (>30% Pools; >20% Riffles)	Very Good
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	13% of streams/ IP-km (>80 stream average)	Poor
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.31	Fair
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good

Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.1 - 5 Diversions/10 IP-km	Fair
Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good
Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	54.56% Class 5 & 6 across IP-km	Fair
Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	41	Fair
Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	81% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
Water Quality	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	Good
Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	76.67	Good

			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	17.71	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	32.3	Good
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	13% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.1 - 5 Diversions/10 IP km	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-Km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	41	Fair
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	81% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good

			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	75-90% IP-km (>6 and <14 C)	Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	76.67	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	17.71	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	32.3	Good
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	Fair
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	6.25% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	55.51% of Watershed in Timber Harvest	Poor

			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	22% of Watershed >1 unit/20 acres	Poor
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	51-74% Intact Historical Species Composition	Good
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	12.59 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	10.43 Miles/Square Mile	Poor

CC Chinook Salmon Humboldt Bay Tributaries CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Low	Low	Medium	Medium	Medium	Medium
2	Channel Modification	High	Low	High	High	High	High
3	Disease, Predation and Competition	Medium		Medium	Medium	Low	Medium
4	Fire, Fuel Management and Fire Suppression	Low	Low	Medium	Low	Low	Low
5	Fishing and Collecting	Medium		Medium	Medium		Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Medium	Low	Low	Medium	Low	Medium
8	Logging and Wood Harvesting	Medium	Medium	High	High	High	High
9	Mining	Low	Low	Medium	Low	Low	Low
10	Recreational Areas and Activities	Low	Low	Medium	Low	Low	Low
11	Residential and Commercial Development	Low	Low	Medium	Low	High	Medium
12	Roads and Railroads	Medium	Low	Medium	Medium	High	Medium
13	Severe Weather Patterns	High	Medium	Medium	Medium	High	High
14	Water Diversion and Impoundments	Medium	Low	Medium	Medium	Low	Medium

Humboldt Bay Tributaries Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
HumB-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HumB-CCCh-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat				
HumB-CCCh-1.1.1.1	Action Step	Estuary	Increase connectivity and salmonid access to watersheds entering Humboldt Bay.	1	25	CDFW, NGO	
HumB-CCCh-1.1.1.2	Action Step	Estuary	Assess tidally influenced habitat and develop plan to restore tidal channels.	1	5	California Coastal Conservancy, CDFW, NGO	
HumB-CCCh-1.1.1.3	Action Step	Estuary	Restore tidal wetlands and tidal channels, guided by plan.	1	10	California Coastal Conservancy, CDFW, NGO, NMFS	
HumB-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HumB-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
HumB-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Develop plan to create off-channel ponds, alcoves, and backwater habitat.	2	5	CDFW, NGO, NMFS, NRCS	
HumB-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Create habitat guided by plan.	2	20	CDFW, NGO, NMFS, NRCS	
HumB-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HumB-CCCh-6.1.1	Recovery Action	Habitat Complexity	Improve large wood frequency				
HumB-CCCh-6.1.1.1	Action Step	Habitat Complexity	Assess habitat to determine location and amount of instream structure needed	2	5	CDFW	
HumB-CCCh-6.1.1.2	Action Step	Habitat Complexity	Increase LWD, boulders, or other instream structure, guided by assessment.	2	10	CDFW, NGO, NMFS, Private Landowners	
HumB-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HumB-CCCh-7.1.1	Recovery Action	Riparian	Improve canopy cover				
HumB-CCCh-7.1.1.1	Action Step	Riparian	Plant native riparian species in open areas	3	10	CDFW, NGO	
HumB-CCCh-7.1.1.2	Action Step	Riparian	Remove non-native species that inhibit establishment of native riparian vegetation	3	10	NRCS, Private Landowners, RCD	
HumB-CCCh-7.2	**Objective**	**Riparian**	**Address the inadequacy of existing regulatory mechanisms**				
HumB-CCCh-7.2.1	Recovery Action	Riparian	Improve riparian conditions				
HumB-CCCh-7.2.1.1	Action Step	Riparian	Reduce detrimental environmental impacts of conversion of TPZ land to other uses.	2	10	NMFS, Calfire, BOF	
HumB-CCCh-7.2.1.2	Action Step	Riparian	Work with Calfire and BOF to minimize the number of conversions per landowner	2	10	NMFS, Calfire, BOF	
HumB-CCCh-7.2.1.3	Action Step	Riparian	Institute environmental review as part of TPZ conversions	2	10	Calfire, BOF	
HumB-CCCh-7.2.1.4	Action Step	Riparian	Work to ensure effects of activities on converted areas are minimized.	2	10	NMFS, Calfire, BOF	
HumB-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HumB-CCCh-8.1.1	Recovery Action	Sediment	Improve instream gravel quality to reduce embeddedness				
HumB-CCCh-8.1.1.1	Action Step	Sediment	Assess existing riparian buffers to ensure that buffers are capturing the majority of fine sediments before entering watershed.	3	5	NRCS, RCD	
HumB-CCCh-8.1.1.2	Action Step	Sediment	Identify areas that are currently not functioning as sediment traps.	3	5	CDFW, NGO, NRCS	
HumB-CCCh-8.1.1.3	Action Step	Sediment	Plant riparian species to augment riparian vegetation.	3	5	NGO, NRCS, RCD	
HumB-CCCh-8.1.1.4	Action Step	Sediment	Assess potentially large inputs of fine sediments (e.g., landslides, failed culvert).	3	5	CDFW, NGO, NRCS	
HumB-CCCh-8.1.1.5	Action Step	Sediment	Develop and implement plan to reduce large inputs of fine sediments.	3	5	CalFire, CDFW, NCRWQB, NGO	
HumB-CCCh-12.1	**Objective**	**Agriculture**	**Address the present of threatened destruction, modification, or curtailment of the species habitat or range**				

Humboldt Bay Tributaries Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
HumB-CCCh-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
HumB-CCCh-12.1.1.1	Action Step	Agriculture	Reduce intensity of nutrient and chemical inputs from marijuana cultivation and improve practices to minimize pollutants reaching watercourses.	3	25	CDFW, County, NCRWQB	
HumB-CCCh-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HumB-CCCh-18.1.1	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
HumB-CCCh-18.1.1.1	Action Step	Livestock	Assess grazing impact on riparian condition, identifying opportunities for improvement.	3	5	NRCS, RCD	
HumB-CCCh-18.1.1.2	Action Step	Livestock	Fence livestock out of riparian zones.	2	5	NRCS, Private Landowners, RCD	
HumB-CCCh-18.1.1.3	Action Step	Livestock	Plant vegetation to stabilize stream bank.	2	10	NGO, NRCS, Private Landowners, RCD	
HumB-CCCh-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HumB-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
HumB-CCCh-19.1.1.1	Action Step	Logging	Determine appropriate silvicultural prescription to improve size and density of conifers	3	5	CDFW, NMFS	
HumB-CCCh-19.1.1.2	Action Step	Logging	Plant conifers as guided by prescription	3	5	CDFW, Private Landowners	
HumB-CCCh-19.1.1.3	Action Step	Logging	Thin, or release conifers guided by prescription	3	5	CDFW, Private Landowners	
HumB-CCCh-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
HumB-CCCh-19.2.1	Recovery Action	Logging	Prevent or minimize landscape disturbances				
HumB-CCCh-19.2.1.1	Action Step	Logging	Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements.	3	5	CalFire	
HumB-CCCh-19.2.1.2	Action Step	Logging	Apply BMPs for timber harvest.	3	25	CDFW, Private Landowners	
HumB-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HumB-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
HumB-CCCh-23.1.1.1	Action Step	Roads/Railroads	Assess and prioritize road-stream hydrologic connection and identify appropriate treatment.	3	5	CDFW, NGO, Private Landowners	
HumB-CCCh-23.1.1.2	Action Step	Roads/Railroads	Assess road network for roads that are currently unnecessary for silvicultural operations to minimize mass wasting.	3	5	CDFW, NGO, Private Landowners	
HumB-CCCh-23.1.1.3	Action Step	Roads/Railroads	Decommission roads, guided by assessment	3	25	CDFW, NGO, Private Landowners	
HumB-CCCh-23.1.1.4	Action Step	Roads/Railroads	Upgrade roads, guided by assessment	3	5	CDFW, Private Landowners	
HumB-CCCh-23.1.1.5	Action Step	Roads/Railroads	Maintain roads, guided by assessment	3	25	CDFW, Private Landowners	
HumB-CCCh-23.1.1.6	Action Step	Roads/Railroads	Develop grading ordinance for maintenance and building of private roads that minimizes the effects to Chinook salmon.	3	5	County	
HumB-CCCh-23.1.1.7	Action Step	Roads/Railroads	Develop and implement a plan to stabilize hill slopes and other unstable features.	3	5	CDFW, NGO, Private Landowners	

Little River Population

Chinook Salmon Fall-Run

- Role within ESU: Potentially Independent Population
- Diversity Stratum: Northern Coastal
- Spawner Abundance Target: 700 adults
- Current Intrinsic Potential: 17.4 IP-km

For information regarding NC steelhead and SONCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the SONCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

Since 1998, outmigrant trapping, summer juvenile, and adult spawning surveys have been conducted throughout the watershed on an annual basis and currently provide the best indication of fish abundance and distribution (GDRC 2009; 2010; 2011). Habitat sampling occurs approximately every eight years (GDRC 2006). Habitat and outmigration monitoring data is available from the early 1990s for inferring longer term trends (Vogel 1992; Shaw and Jackson 1994; Vogel 1994). Little River watershed fishery potential was determined in the late 1960s to evaluate potential effects of a proposed dam in the upper watershed, which ultimately was never completed (Hurt 1969).

After being commercially fished for a couple of decades, Chinook salmon were hypothesized to be intermittently present in Little River (Hurt 1969). A small hatchery operated from 1985-1992 that augmented Chinook salmon in the watershed, releasing a maximum of 47,000 smolts a year. Shaw and Jackson (1994) captured 100 Chinook salmon smolts in 1994. Juvenile Chinook salmon data between 1999-2012 fluctuated widely between approximately 100 and 10,000 individuals (GDRC 2012, Figure 1). In 2013, 32,035 outmigrant 0+ Chinook were captured in select Little River tributaries (the same tributaries as Figure 1). In 2014, 1,141 outmigrant 0+ Chinook were captured in these same select tributaries. And in 2015, 573 outmigrant 0+ Chinook were captured in these same tributaries, although during this year outmigrant trapping ceased at Railroad Creek, but began at a station in mainstem Little River.

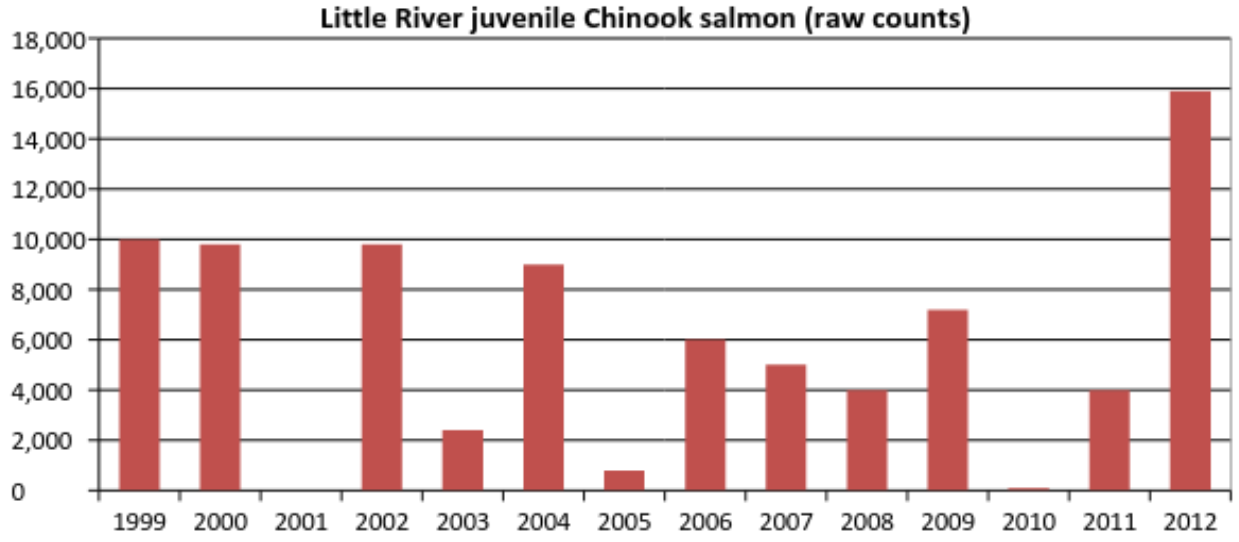

Figure 1. Out-migrant juvenile Chinook salmon raw counts from Little River tributaries, 1998-2012 (GDRC 2009, 2011, 2012).

History of Land Use

Timber harvest, commercial fishing, and livestock grazing all historically occurred in the Little River basin. The first sawmill opened on the Little River in 1907 by the Hammond Lumber Company (Hurt 1969) and the basin was intensely harvested throughout the early 1900s. The logging town of Crannell was built on the coastal plain near the Little River mouth. The river was modified for logging operations, with the main channel flowing through a lumber mill. Logging trucks and roads replaced railroad logging after a fire burned the majority of the watershed in 1945 (Hurt 1969). Large-scale clear cuts, road construction, skid trails, and landings occurred on the highly erodible Franciscan soils that are dominant throughout the basin. Highly erosive geology, in combination with extensive timber harvest and road building over the years, has led to mass wasting events, landslides, and chronic sediment delivery into Little River. Trees were cut in the riparian zone, removing the potential for instream wood recruitment and increasing solar radiation. In the 1930s, a dam was constructed just above the town of Crannell and a commercial fishery for Chinook salmon was established, which largely destroyed the population (Hurt 1969). Dairy cow operations have been conducted on the Little River floodplain between Crannell and the river mouth. Some stream restoration work has taken place; in 1989, the lower 2.5 kms of Little River were fenced to prevent cows from entering the riparian.

Current Resource and Land Management

Today, the majority of the basin is owned by Green Diamond Resource Company (GDRC), and managed for timber production under the guidelines of current state timber harvest regulations and an aquatic habitat conservation plan (HCP, GDRC 2006). Management under the HCP helps protect the watershed from many of the destructive practices that took place historically. An extensive road system (at a density of approximately 7 mi./sq. mi.) winds through the basin, contributing sediment delivery to Little River and tributaries. The flat coastal plain near the mouth of the Little River continues to support livestock grazing. While some of the riparian areas have been fenced to prevent livestock from disturbing them, areas that are not fenced may experience degradation of sensitive vegetation and contribute to bank instability and erosion.

Salmonid Viability and Watershed Conditions

The following indicators were rated Poor through the CAP process for Little River Chinook salmon populations: smolt abundance, spawner density, gravel quality (embeddedness), road density, streamside road density, timber harvest, turbidity, large wood frequency, and V* (see Little River CAP results).

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Little River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Habitat Complexity: Large Wood and Shelter

Large woody debris associated with riparian corridors provides structure for shade, cover, bank stabilization, and breeding sites for invertebrates (Mosley *et al.* 1998). The Habitat Complexity condition has an overall Poor rating for adult, pre-smolt and smolt lifestages. Large wood debris increases habitat complexity by creating pools, velocity refuge, and cover. Large wood debris surveys conducted throughout the watershed in the 1990s revealed that large wood debris throughout Little River is on average less than 4 pieces/100 m (Vogel 1992, LP 1994). Green Diamond completed large wood surveys for the Little River Basin in 2005; survey results show that South Fork Little River and Railroad Creek have the highest volume of large wood, while the mainstem Little River has the lowest volume (GDRC 2009). Current practices under the GDRC HCP provide a riparian buffer, and promote recruitment of LWD by allowing 99 percent of riparian conifers to be older than 60 years, and 70 percent older than 80 years.

Viability: Density, Abundance, and Spatial Structure

Viability conditions, such as density, abundance, and special structure, have an overall Fair rating for adults, pre-smolts, and smolts. This Fair rating is due to the poor spawner density of <1 spawner per IP-km and fair spatial structure of 50-75% of historical range for both adults and pre-smolts. Reduced smolt density, abundance, and diversity may signify decreased adaptations to environmental stochastic events such as marine survival and spawning success. Populations that remain low in abundance have an increased likelihood of becoming extirpated.

Sediment: Gravel Quality and Distribution of Spawning Gravels

Impaired gravel quality and quantity is a High stress for Chinook salmon eggs and smolts. Salmon egg survival is inversely related to fine sediment, which has the potential to suffocate eggs (Koski 1966; Greig *et al.* 2005). A streambed substrate survey revealed that fine sediment concentrations are greatest in Lower South Fork Little River, ranging from 7.5-15.7 percent of sampled sediment particles (Vogel 1994). Increased sediment delivery is primarily a result of high road density and timber harvest activities in Little River. Embedded gravels prevent pre-smolt Chinook salmon from seeking velocity refuge during high winter flows. Embedded gravels also reduce stream productivity, and thus decrease foraging success for pre-smolt Chinook salmon.

Estuary: Quality and Extent

Estuaries provide important juvenile rearing areas for steelhead and Chinook salmon, often fostering faster growth than upper watershed areas due to a high abundance of prey items (Hayes *et al.* 2008). The lower estuary remains unaltered, currently comprising approximately 0.75 river miles of mud flat, wetland, and sandbar habitat in Moonstone Beach County Park and Little River State Park. Upstream of Highway 101, the estuary and many associated tidal channels have been diked, filled, and channelized for agricultural purposes. Estuarine function is severely hampered by loss of tidal wetland and tidal channels. The reduction in estuarine function is considered a High stress for the smolt lifestage because of the lack of rearing and foraging habitat.

Water Quality: Turbidity or Toxicity

Clean and cool well-oxygenated water remains one of the most important ecological requirements for salmonids. Water quality conditions in the Little River have an overall Poor rating for pre-smolts. High road density, riparian vegetation reduction, livestock grazing, and components of timber management contribute to increased turbidity levels. Effects of increased sediment and turbidity loads range from lethal to sublethal (Newcombe and MacDonald 1991), with early life history phases being most sensitive (Sigler *et al.* 1984). Salmonids rely on visual

feeding cues, and increased turbidity may reduce visibility and thus feeding efficiency (Berg and Northcote 1985; Sweka and Kartman 2001).

Riparian Vegetation: Composition, Cover & Tree Diameter

Riparian vegetation provides important habitat functions including shading, habitat complexity for foraging and holding, and channel function. Eliminating or decreasing riparian vegetation may result in stream channelizing and straightening, channel widening, channel aggradation, and lowering of the water table (Belsky *et al.* 1999). Riparian forest condition has an overall Poor rating for pre-smolts and watershed processes due to reduced pool frequency, and thus decreased upstream rearing habitat. Historic logging practices removed the majority of large, old trees from riparian zones throughout watershed; shrubs and both young and mature deciduous and conifers dominate the upper watershed and dense shrubs such as willow and blackberry occupy the lower watershed (Vogel 1992; GDRC 2006). Livestock grazing has removed components of riparian vegetation; historic timber management reduced canopy cover structure and diversity. The reduction of large trees in riparian areas results in decreased potential for large wood recruitment, which consequently reduces habitat complexity.

Sediment Transport: Road Density

The Sediment Transport from high road densities is a condition that has an overall Poor rating for all life history stages, especially early life history phases that are more sensitive to elevated turbidity levels. Little River contains a high density of roads in silvicultural areas (an average of 7.1 miles of road per square mile of land). Processes initiated or affected by roads include landslides, surface erosion, secondary surface erosion, and gullying. Existing road networks are a chronic source of sediment to streams (Swanson and Dryness 1975) and often are the main cause of accelerated surface erosion in forests across the western United States (Harr and Nichols 1993). Important factors that affect road surface erosion include road surface condition, use during wet periods, location relative to watercourses, and steepness.

Very Good or Good Current Conditions

Habitat Complexity: Percent Primary Pools and Pool/Riffle/Flatwater Ratios

Complex pools provide rearing habitat for juvenile Chinook salmon. Reduced pool complexity results in decreased vegetative cover and prey availability, and thus juvenile growth rates. Historical logging resulted in large sediment inputs into Little River, resulting in sediment filling pools. Lack of complex pools, and also fewer deep pools, created flatwater habitats (neither pool nor riffle), which drastically reduced pool complexity. Summaries from habitat typing data

collected by Green Diamond in 2005 indicate that, currently, 84% of the sites surveyed in Little River had over 30% pools and over 20% riffles (GDRC 2009). These same summaries also indicate that 96% of the kilometers surveyed had over 30% pools and over 20% riffles (GDRC 2009).

Velocity Refuge: Floodplain Connectivity

Floodplain habitat provides better rearing and migration habitat for juvenile Chinook salmon than adjacent river channel habitat (Sommer *et al.* 2001). Juvenile salmonid prey availability remains higher in side channels than the main river channel, with a carrying capacity as much as 260 percent higher (Bellmore *et al.* 2013). The floodplain in the lower Little River has been decreased by channel modification, historic timber operations, and the construction of levees for agricultural purposes. All life history phases are affected by decreased availability of floodplain habitat, making rich foraging areas unavailable. As a result, salmonids may be subject to areas of lower food availability and thus slower growth rates.

Threats

The following discussion focuses on those threats that rate as High or Very High (see Little River CAP results). Recovery strategies will likely focus on ameliorating High rating threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Little River CAP results.

Logging and Wood Harvesting

Logging and wood harvesting was rated as a High stress for all life history phases of Chinook salmon and for watershed processes. Historic logging practices in Little River resulted in large-scale clear cuts, road construction, skid trails, and landings on highly erodible soils. Highly erosive geology, in combination with extensive timber harvest, has led to mass wasting events, deep-seated landslides, and chronic sediment delivery into Little River. During the years of intense harvest, the river likely had high turbidity that severely affected development and behavior of all fish species. Decreased habitat complexity, channel aggregation and decreased water quality are all results of intensive silvicultural practices. Management practices have significantly changed, and it is expected that practices such as riparian buffers and sediment management will improve habitat conditions and population abundance.

Agricultural

Next to timber harvest, agriculture is the predominant land use in the lower Little River basin and represents a high threat, especially for sub-adult life stages. The land is used for grazing

livestock, hay operations, and also a minor amount of cranberry bogs. There is little to no livestock exclusion from the river and animals often trample streambanks and overgraze the riparian vegetation. The grazing of livestock adjacent to the stream leads to eroded banks and an excess of sediment and nutrients entering the water. In addition, diversions and ditches associated with agriculture in the area contribute to degraded habitat conditions and poor hydrologic connectivity. The reduction of estuarine function in the Little River is primarily the result of conversion of lowland estuarine habitat to agricultural land and the agricultural practices that occur in the estuarine floodplain.

Roads and Railroads

Roads and railroads were rated as a High stress for all life history phases of Chinook salmon and watershed processes. As described earlier, Little River contains a high density of roads in silvicultural areas. Processes initiated or affected by roads include landslides, surface erosion, secondary surface erosion (landslide scars exposed to rain splash), and gullying. Existing road networks are a chronic source of sediment to streams (Swanson and Dyrness 1975) and often are the main cause of accelerated surface erosion in forests across the western United States (Harr and Nichols 1993). Elevated turbidity levels may result in decreased growth rates of juveniles, reduced survival of eggs, and reduced feeding success due to turbid conditions. GDRC has begun the process of hydrologically disconnecting roads from the Little River watershed.

Channel Modification

Channel modification was rated as a High stress for pre-smolt and smolts. The lower Little River mainstem has been channelized by dikes and levees for agricultural and livestock purposes. The function of the upper estuary (*e.g.,* rearing, refugia, ocean transition) has been degraded, and rearing by juveniles and smolts in or transitioning through mainstem and estuarine habitat is impaired by the lack of intertidal brackish and salt marsh. Both juveniles and smolts suffer from the lost opportunity for increased growth, which would improve their size at time of ocean entry and marine survival.

Severe Weather Patterns

Severe weather patterns related to climate change such as increased temperature, reduced cold-water refugia, and increased incidences of atmospheric river events are currently rated as Medium to all life history phases. Severe weather combined with a landscape of fragile soils, high road density, and timber operations may cause significant amounts of fine sediment input to the Little River. Decommissioning roads and ensuring that adequate stream buffers are in place may offset the deleterious effects of severe weather.

Limiting Stresses, Lifestages, and Habitat

The current condition and threat analyses suggest that physical habitat for adult Chinook salmon including refuge, spawning substrate and water quality are most limiting population abundance and diversity in Little River. Many stresses also exist for pre-smolt and smolts as well. Timber harvest and high road density are the primary threats to Chinook salmon. Historic timber harvest activities reduced large wood abundance and riparian vegetation complexity, consequently reducing habitat complexity. Runoff from the high density roads increase turbidity levels and contribute to decreased water quality, streambed aggradation. Channel modification creates a High threat for pre-smolts and smolts. The unavailability of complex estuarine rearing and foraging habitat subjects pre-smolts and smolts to reduced growth, and thus potentially decreased marine survival and size at maturity.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating current conditions and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. The general recovery strategy for the Little River populations is discussed below with more detailed and site-specific recovery actions provided in Little River CAP results, which provides the Implementation Schedule for this population.

Estuarine Restoration

The estuary provides critical rearing habitat for juvenile Chinook salmon and steelhead. A management plan should be developed for the Little River estuary to restore tidal salt and brackish marshes in order to allow fish to have access to high quality foraging and rearing habitat. Riparian areas currently being used for livestock grazing should be fenced in order to allow native vegetation to recover and become reestablished. Riparian buffer areas should be established to create space for the reestablishment of tidal marshes. Dikes and levees should be removed or set back to restore natural habitat-forming processes. Tidegates should be inventoried and removed in order to create tidal fluctuation. The recreation of complex tidal channels may be necessary east of Highway 101 in areas where the main channel has been straightened and simplified.

Road Decommissioning

Little River contains a high density of dirt logging roads. Sediment loading from these roads contributes to poor salmonid habitat conditions including elevated turbidity levels, stream

aggradation, and impaired gravel quality. Existing road-stream connections should be assessed and upgraded or decommissioned to the maximum extent practical.

Increase In Stream and Off-channel Complexity

Little River currently lacks habitat complexity in many areas due to reduced large woody debris, channel aggradation, invasive species, and altered riparian vegetation. Large wood, boulders, or other instream structure should be added in order to increase complexity and sort sediment. Off-channel ponds, alcoves, and backwater habitat should be re-created. Riparian areas should be revegetated.

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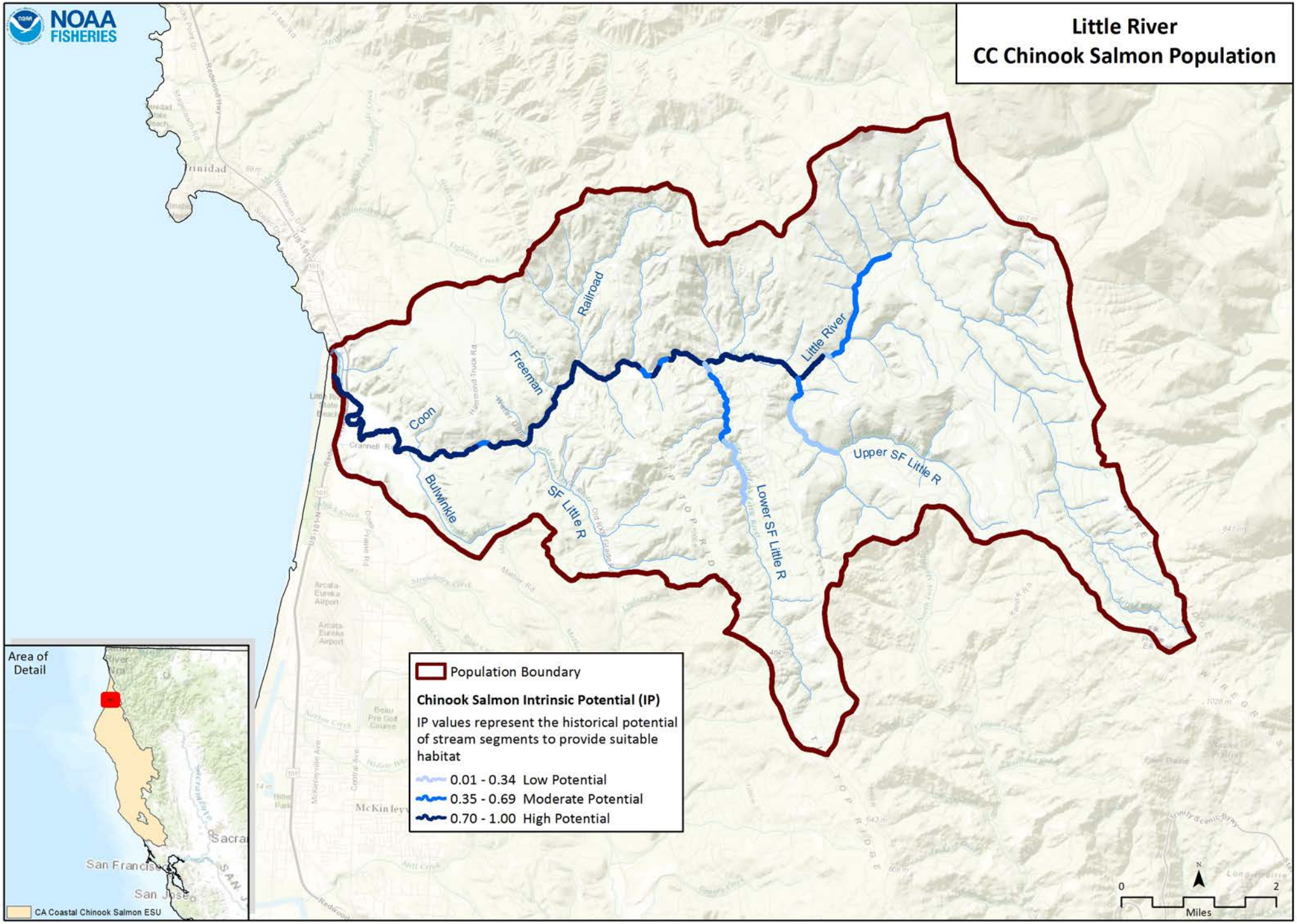
NOAA FISHERIES
Little River
CC Chinook Salmon Population
Railroad
Freeman
Coon
Bullwinkle
SF Little R
Little River
Upper SF Little R
Lower SF Little R
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Area of Detail
CA Coastal Chinook Salmon ESU
San Francisco
San Jose
0
2
Miles

CC Chinook Salmon Little River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	Good
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	Very Good
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.46	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	42.76% Class 5 & 6 across IP-km	Fair

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	<38	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	>80% Response Reach Connectivity	Good
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	40-60	Fair
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	12.1-17.9	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	12.1-17.9	Fair
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		<1 spawners per IP-km	Poor
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	50-74% of Historical Range	Fair
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Good
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good

			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	Fair
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	<38	Fair
3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-km (>49% average primary pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	Very Good
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-km (>80 stream average)	Fair
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.46	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Good
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.01 - 1 Diversions/10 IP-km	Good

Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good
Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	42.76% Class 5 & 6 across IP-km	Fair
Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	<38	Fair
Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	>80% Response Reach Connectivity	Good
Water Quality	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	>90% IP-km (>6 and <14 C)	Very Good
Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	40-60	Fair
Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	12.1-17.9	Fair
Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	25-30	Fair

		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	50-74% of Historical Range	Fair
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-km (>80 stream average)	Fair
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.01 - 1 Diversions/10 IP-km	Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	<38	Fair
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	>90% IP-km (>6 and <14 C)	Very Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	>80% Response Reach Connectivity	Good

			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	40-60	Fair
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	12.1-17.9	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	25-30	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces high risk spawner density per Spence (2008)	Poor
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	Very Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	2.51% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	44.77% of Watershed in Timber Harvest	Poor
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	7% of Watershed >1 unit/20 acres	Very Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair

			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	>3 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	8.9 Miles/Square Mile	Poor

CC Chinook Salmon Little River CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Medium	Low	Medium	Medium	Low	Medium
2	Channel Modification	Medium	Medium	High	High	Low	High
3	Disease, Predation and Competition	Medium		Medium	Medium	Low	Medium
4	Fire, Fuel Management and Fire Suppression	Medium	Low	Medium	Medium	Low	Medium
5	Fishing and Collecting	Medium					Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Low	Medium
8	Logging and Wood Harvesting	High	High	High	High	High	High
9	Mining						
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Low	Medium
11	Residential and Commercial Development	Medium	Low	Medium	Medium	Low	Medium
12	Roads and Railroads	High	High	High	High	High	High
13	Severe Weather Patterns	Medium	Medium	Medium	Medium	Medium	Medium
14	Water Diversion and Impoundments	Medium	Low	Medium	Medium	Low	Medium

Little River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LR-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LR-CCCh-1.1.1	Recovery Action	Estuary	Increase extent of estuarine habitat				
LR-CCCh-1.1.1.1	Action Step	Estuary	Assess tidally influenced habitat and develop plan to restore tidal channels.	2	1	Private	
LR-CCCh-1.1.1.2	Action Step	Estuary	Restore tidal wetlands and tidal channels, guided by plan.	2	5	CDFW	
LR-CCCh-1.1.1.3	Action Step	Estuary	Assess and prioritize tidegates and levees for removal or replacement.	2	1	Private	
LR-CCCh-1.1.1.4	Action Step	Estuary	Remove or replace tidegates and levees, guided by assessment.	2	5	CDFW	
LR-CCCh-1.1.1.5	Action Step	Estuary	Initiate a study to determine if the Highway 101 bridge crossing the Little River is constricting the river channel and impeding river or tidal circulation in the estuary.	2	1	CDFW	
LR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Improve pool/riffle/flatwater ratios (hydraulic diversity)				
LR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Develop plan to restore habitat complexity by recreating off-channel ponds, alcoves, and backwater habitat.	2	1	Private	
LR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Restore habitat complexity in identified areas by implementing actions to increase the frequency of pool habitats.	2	10	CDFW	
LR-CCCh-6.1.2	Recovery Action	Habitat Complexity	Increase large wood frequency				
LR-CCCh-6.1.2.1	Action Step	Habitat Complexity	Develop plan to add large wood, boulders, or other instream structure to specific areas in specific quantities.	2	1	Private	
LR-CCCh-6.1.2.2	Action Step	Habitat Complexity	Place instream structures, guided by assessment.	2	5	CDFW	
LR-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LR-CCCh-7.1.1	Recovery Action	Riparian	Improve canopy cover				
LR-CCCh-7.1.1.1	Action Step	Riparian	Plant native riparian species in denuded areas.	2	2	Private	
LR-CCCh-7.1.1.2	Action Step	Riparian	Remove invasive species that inhibit establishment of native riparian vegetation.	3	5	Private	
LR-CCCh-7.1.2	Recovery Action	Riparian	Prevent or minimize adverse alterations to riparian species composition and structure				
LR-CCCh-7.1.2.1	Action Step	Riparian	Manage riparian forests to promote late-seral characteristics while maintaining bank stability and existing shade.	3	1	Private	
LR-CCCh-7.1.2.2	Action Step	Riparian	Plant conifers, guided by prescription.	2	2	Private	
LR-CCCh-7.1.2.3	Action Step	Riparian	Thin, or release conifers, guided by prescription.	3	5	Private	
LR-CCCh-7.1.2.4	Action Step	Riparian	Fence livestock out of the riparian area and provide off-stream water.				
LR-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LR-CCCh-8.1.1	Recovery Action	Sediment	Improve instream gravel quality to reduce embeddedness				
LR-CCCh-8.1.1.1	Action Step	Sediment	Assess existing riparian buffers to ensure that capturing the majority of fine sediments before entering watershed.	3	1	Private	
LR-CCCh-8.1.1.2	Action Step	Sediment	Identify areas that are currently not functioning as sediment traps.	3	1	Private	
LR-CCCh-8.1.1.3	Action Step	Sediment	Plant riparian species to augment riparian vegetation.	3	3	Private	
LR-CCCh-8.1.1.4	Action Step	Sediment	Assess potentially large inputs of fine sediments (e.g., landslides, failed culvert).	3	1	Private	
LR-CCCh-8.1.1.5	Action Step	Sediment	Develop plan to remove large inputs of fine sediments.	3	1	Private	

Little River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LR-CCCh-8.1.1.6	Action Step	Sediment	Remove large inputs of fine sediments.	3	10	Private	
LR-CCCh-8.1.1.7	Action Step	Sediment	Restore locations that are currently or imminently large producers of fine sediments.	2	10	CDFW, Coastal Conservancy, NMFS, Private Landowners	
LR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
LR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Assess streamside roads and prioritize decommissioning to minimize mass wasting.	2	1	Private	
LR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Develop plan to decommission or maintain roads with mass wasting potential.	2	1	Private	
LR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Decommission or upgrade roads with mass wasting potential throughout watershed.	2	20	CDFW, Private	

Lower Eel and South Fork Eel River Subsets of the Lower Eel River Population

CC Chinook Salmon Fall-Run

- Role within ESU: A subset with the Lower Eel River Functionally Independent Population
- Diversity Stratum: North Coastal
- Spawner Abundance Target: 7,400 adults
- Current Intrinsic Potential: 368.4 IP-km

For information regarding NC steelhead and SONCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the SONCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

Quantitative abundance and distribution estimates of South Fork Eel River Chinook salmon are sparse. Yoshiyama and Moyle (2010) reviewed available information and concluded the Eel River basin historic runs of Chinook salmon likely ranged between 300,000 and 800,000 fish per year, and declined to approximately 50,000-100,000 fish per year in the first half of the 20th century. Chinook salmon spawners were counted in the South Fork Eel River at the Benbow Dam from 1938 through 1975, with a high of 21,011 counted in 1941 and a low of 473 in 1959. It should be noted that Benbow Dam occurs approximately halfway up the South Fork Eel River, and therefore the number of fish counted underestimates the true run size.

Recent survey efforts in both the Lower Eel and South Fork Eel have indicated that Chinook salmon spawner abundance is low compared to their estimated historic run-size. In 2010, the California Department of Fish and Wildlife (CDFW) began conducting surveys focused on adults throughout the South Fork Eel River sub-basin. CDFW estimated 1,128 redds in 2010-11, 563 redds in 2011-12, and 1445 redds in 2012-13. In 2011, citizen volunteers with the Eel River Recovery Project (ERRP) began conducting dive counts of adult Chinook salmon in the lower Eel River and have documented several thousand each year, although it is uncertain as to how many of these fish spawned in the Lower/South Fork Eel population area.

History of Land Use

Settlement of the region began in the 1850s and the first 100 years of activity had lasting effects on the forests, rivers, and fish populations of the region. Settlement of the South Fork Eel did not

experience rapid growth until the 1900s due its remoteness. Canneries were located along the Eel River, and during the 1860s to 1900s it was common to have a commercial salmon catch numbering in the hundreds of thousands of fish in the lower Eel River. In 1904, 345,800 salmon and steelhead were harvested by fishing in the lower portions of the river (Lufkin 1996).

Early timber operations attempted to convert natural timber lands to grazing lands, with little success because the landscape and climate favored the natural vegetation regime. Only when accessibility was well established in the 1900s to 1910s did large-scale timber operations develop to a significant extent (PALCO 2006). The use of log trucks and ground-based tractor yarding began in the 1940s and initiated a period of extensive road building and skid trail use. Railroad and early truck haul routes were commonly located near, or sometimes even within the stream channels. The combination of the early railroad and pre-1970s logging practices had a profound impact on the watercourses in the area (PALCO 2006).

Erosion from poorly constructed roads in the highly erosive Franciscan geology has contributed to increased sediment loads in the region's rivers, leaving streams shallower, warmer, and more prone to flooding (Raphael 1974; Bodin *et al.* 1982). Sediment mobilized from the 1955 and 1964 floods choked the channels with sediment. As a result, many streams have become wider and shallower (USEPA 1999). Levees were built along the lower Eel River to prevent flooding of urban areas, which significantly reduced the size of the estuary and disconnected the floodplain from the main channel.

Sacramento pikeminnow were introduced to Lake Pillsbury in 1980 (CDFG 1997) and have since colonized all accessible reaches of the Eel River watershed. This predator thrives in the warmer waters of the South Fork Eel River resulting from channel aggradation and degraded riparian forests.

Current Resources and Land Management

Most of the South Fork Eel population area is privately owned and is predominantly in timber production. Marijuana cultivation is another land use as well as rural development in some locales. The Humboldt Redwood Company (HRC) Habitat Conservation Plan (HCP) covers approximately 200,000 acres of forestland. The goals of the HRC HCP include trending towards properly functioning aquatic conditions and reducing sediment input by upgrading 1,500 miles of roads (HRC 2012). The Mendocino Redwood Company (MRC) currently has a draft HCP which covers two of the key western tributaries to the South Fork Eel: Hollow Tree Creek and Jack of Hearts Creek. There are several active watershed groups in the area: the Eel River Watershed Improvement Group, Friends of the Eel River, Salmonid Restoration Federation, and

the Eel River Recovery Project. The following are pertinent reports or plans for the Lower Eel and South Fork Eel Rivers:

- South Fork Eel River Basin Report (CDFW 2014)
- Recovery Strategy for California Coho Salmon (CDFG 2004);
- Eel River Salmon and Steelhead Restoration Action Plan (CDFG 1997);
- Lower Eel River Watershed Assessment (CDFG 2010);
- South Fork Eel Watershed Analysis (Fuller *et al.* 1996);
- Humboldt Redwood Company HCP (HRC 2012);
- Mendocino Redwood Company HCP (MRC 2012);
- HRC Watershed Analyses for: Lower Eel/Eel Delta and Upper Eel (PALCO 2006); and
- South Fork Eel and Lower Eel Total Maximum Daily Loads (USEPA 1999; 2007).

Salmonid Viability and Watershed Conditions

The following indicators were rated Poor through the CAP process (see Lower Eel and South Fork Eel CAP results): estuary quality and extent, LWD frequency, staging pools, passage at mouth or confluence, tree diameter, turbidity, gravel quality, shelter rating, baseflow conditions, diversions, floodplain connectivity, temperature, road density, and stream-side road density. Recovery strategies and actions will focus on ameliorating these habitat indicators, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions with the population area.

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The South Fork and Lower Eel CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Estuary: Quality and Extent

The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River salmon populations. The Eel River estuary is severely impaired because of past diking, and filling of tidal wetlands for agriculture and flood protection. Please see the CC Chinook salmon Eel River Overview for a complete discussion and recovery actions.

Water Quality: Temperature

High water temperature is a significant problem throughout most of the population area, especially in the mainstem Eel River and South Fork Eel River. These impaired water

temperature conditions are most stressful for lifestages rearing in the mainstem rivers during the summer. Temperature conditions have a Poor rating for pre-smolts, and smolts.

Water Quality: Turbidity and Toxicity

Turbidity levels high enough to affect salmon health (>25 NTU) were documented in several tributaries of the Van Duzen River, which is a nearby tributary of the Eel River with a similar land use history, from 2000 to 2003 (Harkins 2004). Turbidity is rated Poor for pre-smolts, smolts, and adults, likely reflecting high sediment loads in the basin. Toxicity is rated Fair for pre-smolts, smolts, and adults. Wastewater treatment facilities affect the Lower Eel downstream of the Van Duzen (CDFG 2010) and the Loleta wastewater treatment facility accepts both municipal wastewater and wastewater from the Humboldt Creamery and the Loleta Cheese Factory. This facility discharges into percolation/evaporation ponds on the Eel River; these ponds overflow into the Eel River in the winter (CDFG 2010). Marijuana cultivators use rodenticides and herbicides, and these toxic materials can enter the river.

Habitat Complexity: Large Wood, Shelter, and Pools

Surveys conducted by CDFW (Sonoma Ecology Center 2012) indicate that shelter ratings are poor throughout the population area, with only 11 percent of the IP-km habitat having met desired levels for shelter (primary pools) and LWD. Large wood and shelter conditions have a rating of Poor for pre-smolt and smolt life stages. Pool indicators (% primary pools and pool/riffle/flatwater ratio) are fair for pre-smolts. The combination of a large sediment supply and lack of riparian function has led to a preponderance of flatwater habitats (neither pool nor riffle), which has greatly reduced pool complexity for pre-smolt and smolt life stages. The 1955 and 1964 floods deposited large amounts of sediment, which reduced pool depths and simplified channels.

Sediment Transport: Road Density

High road densities within the population area are primarily associated with past timber harvest and rural residences. Sediment transport conditions from road densities have a rating of Poor for watershed processes, because for every square mile of land there are 3.9 miles of road. Although significant efforts upgrade or decommission roads to reduce their sediment generating potential are ongoing, road density remains high.

Viability: Density, Abundance, and Spatial Structure

Population density is rated Fair for adults. Although recent trends indicate improved abundance (density) of Chinook salmon, longer term data sets suggest that the reduced abundance is acting as a stress to the population. Spatial structure and diversity are generally at acceptable levels,

however, the number of spawners remains depressed as compared to those levels needed for the population to be at low risk of extinction.

Passage/Migration: Mouth or Confluence & Physical Barriers

Adult Chinook salmon tend to enter the Eel River in early September and stage in the lower river until flows become high enough for them to navigate shallow riffles. Due to these impediments to migration early in the season, adults tend to gather in the lower river. These large schools unable to migrate upstream are susceptible to poaching and poor water quality. Furthermore, due to shallow and un-passable riffles in the Van Duzen River, since 2002 the CDFW has installed culverts at the mouth of the Van Duzen River to prevent adults from migrating upstream. The culverts remain in place until flows are high enough to allow for passage. For these reasons, Passage and Migration conditions have a rating of Poor for adults, although the use of the culvert barriers has been discontinued starting in 2015.

Riparian Vegetation: Composition, Cover & Tree Diameter and Habitat Complexity: Percent Primary/Staging Pools, Pool/Riffle/Flatwater Ratios, Large Wood Frequency, V Star

NMFS rated riparian species composition conditions as Fair for watershed processes and Poor for pre-smolts, and rated tree diameter as poor for adults. Due to past harvest of coniferous trees and insufficient replanting, the species composition has been altered and become less conifer-dominant. As such, the trees in the riparian area are dominated by young conifers and species which lack the ability to provide for functional pieces of wood to enter the stream. Riparian Vegetation conditions and Habitat Complexity conditions have an overall rating of Fair, as reflected by the indicators frequency of large wood, percent staging pools, and pool/riffle/flatwater ratio.

Sediment Transport: Road Density and Streamside Road Density

Road density is high, leading to numerous effects including sediment transport into streams and increased peak flows as reflected in the Poor rating for these indicators for watershed processes.

Hydrology: Baseflow, Passage Flows, and Instantaneous Flow Condition

Hydrologic conditions have a rating of Fair to Poor across life stages. Eggs are rated fair for the risk of redd scour from winter flows. Because Chinook salmon are typically in the ocean or rearing in the estuary prior to the onset of lower summer flow conditions, the pre-smolt, smolt, and adult lifestages are primarily exposed to the flow regimes in the fall (adult), winter (adult, pre-smolt), and spring (pre-smolt and smolt). Shallow riffles limit upstream migration of adults during early fall, likely due to both low flows and habitat quality. Erosion and subsequent deposition during larger storm events may be the primary cause for the shallow pools (as reflected by poor Vstar ratings) and simple habitat conditions, rather than the flow conditions

present during early fall (CDFG 2010). However, the high number, condition, and magnitude of diversions greatly affects hydrology, and these diversions typically occur in late summer and early fall when adults are present. Further, the instantaneous flow reduction is rated fair, which likely reflects immediate impacts of diversions.

The reduced summer flow in the mainstem Eel River and South Fork Eel River are primarily related to the increased demand for water for marijuana cultivation (S. Bauer, CDFW, personal communication, January 17, 2013). Marijuana cultivation has become locally abundant, and the water diversion required to support these plants is placing a high demand on a limited supply of water (S. Bauer, CDFW, personal communication, January 17, 2013). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per season (Downie 2012). Reduced summer flows can also be partly attributed to increased evapotranspiration rates resulting from replacement of old-growth forests with younger forests (Perry 2007). These lower flows reduce the quality of summer rearing habitats, resulting in water quality conditions favoring pikeminnow (a predator).

Threats

The following discussion focuses on those threats that rate as High or Very High (see Lower Eel and South Fork Eel CAP results). Recovery strategies focus on ameliorating High or Very High rating threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Lower Eel and South Fork Eel CAP results.

Water Diversion and Impoundments

Water diversion and impoundments were rated as a Very High threat to pre-smolts and a High threat to adults and watershed processes. Marijuana cultivation and associated water diversion is placing a higher demand on a limited supply of water (S. Bauer, CDFW, personal communication, January 17, 2013). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per season (Downie 2012). Summer and fall flows measured at the gage in Scotia have been low even in years following wet springs. Future land uses and increasing diversions could increase water demand, further reducing summer and early fall flow conditions.

Channel Modification

Channel modification is rated as a High stress for pre-smolt and smolt life stages. The Eel River estuary and mainstem has been significantly channelized by dikes and levees and subsequent filling for ranching or livestock purposes. Approximately 60 percent of the estuary has been lost

through the construction of levees and dikes and CDFG (2010) estimates that only 10 percent of salt marsh habitats remain today. The estuary once supported a high degree of estuarine habitat and rearing potential, but very little of that historic function still exists. The function of the estuary (*e.g.*, rearing, refugia, ocean transition) is very important given the degraded habitat conditions and predation and competition from non-native Sacramento pikeminnow occurring upstream of the estuary in the mainstem river. Juveniles and smolts rearing in or transitioning through mainstem and estuarine habitat will continue to be threatened by the degraded conditions in these habitats. Both pre-smolts and smolts suffer from the lost opportunity for increased growth, which would improve their survival at ocean entry.

Disease, Predation and Competition

Disease, predation, and competition is rated as a High threat to pre-smolts primarily due to the presence of the Sacramento pikeminnow. Pikeminnow have become ubiquitous throughout the Eel River and its tributaries and are a known predator of salmonids. This invasive species has large impacts in areas with impaired habitat conditions, because the altered conditions favor production of the pikeminnow over indigenous salmonids. Pre-smolts and smolts are most vulnerable as they are present when conditions are most favorable to pikeminnow. In addition, pikeminnow prey on pre-smolts and compete with smolts for food and territory.

Fishing and Collecting

Fishing and collecting is rated a High threat to adults. Chinook salmon can be harmed and killed during the catch-and-release fishery in the Lower Eel, which attracts hundreds, if not thousands, of anglers every season to target salmonids. Regulations do not currently protect these fish during the entire period of lower flow conditions that occur coincident with their spawning migration. Currently, sport fishing in the mainstem Eel River is subject to a low flow fishing closure whenever the gage at Scotia is recording flows less than 350 cubic feet per second. However, the low flow season does not begin until October 1st of each year, which allows anglers to target Chinook salmon staging in low flow conditions throughout September. Adult Chinook salmon are easy targets for both fishermen and poachers in these extremely low flows. Poor water quality in September contributes to the stress and likely results in increased hook-and-release mortality (Clark and Gibbons 1991).

Bycatch of Chinook salmon occurs in ocean fisheries targeting Chinook salmon stocks that are not protected under the Endangered Species Act. In a biological opinion on the effects of ocean fisheries managed under the Pacific Coast Salmon Plan, NMFS determined the bycatch impacts of these fisheries are likely to jeopardize the continued existence of CC Chinook salmon, and NMFS provided a Reasonable and Prudent Alternative under which the fisheries are managed to avoid the likelihood of jeopardizing the continued existence of CC Chinook salmon (NMFS 2000).

Low or Medium Threats

Roads and Railroads

Road density is high throughout the South Fork and Lower Eel River drainages. Many of these roads are unpaved and leach sediment into these rivers and their tributaries. This fact, combined with the substantial rise in marijuana cultivation and future rural residential development in the South Fork Eel River leads to a Medium threat rating for roads for adults, eggs, smolts, and watershed processes.

Severe Weather Patterns

With future climate change, the frequency, intensity and duration of droughts in the region could all increase which could have a considerable negative effect on the distribution and abundance of Chinook salmon in the South Fork and Lower Eel River drainages.

Limiting Stresses, Lifestages, and Habitats

The threat and stress analysis within the CAP workbook suggests that the diminished abundance of adult, pre-smolt, and smolt lifestages of Chinook salmon are all likely limiting the the population. The primary issues with adult Chinook salmon are water diversions, impoundments, and fishing pressure. These contribute to poor water quality, impediments to migration, and increased stress and mortality while staging in the lower river during the early fall months.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating stresses and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions. The recovery strategy for the Lower Eel and South Fork Eel populations are discussed below with more detailed and site-specific recovery actions provided in the Implementation Schedule (see Lower Eel and South Fork Eel CAP results).

Enhance and Rehabilitate the Quality and Extent of the Eel River Estuary

Efforts should be implemented to restore the quality and size of the estuary including: levee setbacks, tidal slough reclamation, tide gate replacement, increased connectivity between estuary and tributaries entering estuary (e.g., Salt River, Francis, Russ, Williams Creeks), and enhance cover and complexity by adding structures. CDFG (2010) suggests that over 50 percent of the estuary has been reclaimed for other purposes. All of the salmonid species present in the Eel

River watershed highly depend on the estuary, and its restoration would benefit several life stages and contribute to improvements in the diversity of life history traits present.

Improve Habitat Complexity and LWD Recruitment

Take actions to increase shelter ratings, improve pool depths, increase pool volume, increase LWD abundance, and decrease the extent of flatwater habitats (which are considered to be neither riffles nor pools, and are the result of habitat simplification). Shelter ratings, pool depths, and habitat complexity are lacking throughout the population area and are a major stress for most life stages. Actions should be taken immediately to bolster the simplified habitat conditions common throughout the population area.

Investigate and Address Water Diversion and Groundwater Extraction

Flows during late summer and early fall are getting lower each year, even following rather wet springs in recent years. The demand and use of water is contributing to lower summer flows which is exacerbating stagnancy in the mainstem reaches. This lack of flow combined with an increased input of nutrients is resulting in more prolific algae growth throughout the area, which is reducing the dissolved oxygen content of the water and exacerbating the stress of poor water quality conditions.

Improve Canopy Cover and Reduce Water Temperature

Water temperatures throughout the majority of the larger mainstem segments of the river are approaching lethal levels making smolt migration and rearing problematic and stressful. Increasing the amount of instream shade over the water will help in reducing high summer water temperatures. Improvements in riparian vegetation should also contribute to proper riparian function and assist in filtering and preventing sediment from reaching the waterways from upslope.

Reduce Abundance of Sacramento Pikeminnow

Explore how best to reduce the abundance of the Sacramento pikeminnow population. Provide increased refugia habitat for salmonids through the creation of cool and complex habitats, and make habitat less suitable for pikeminnow by managing to reduce water temperature.

Improve Fishing Regulations

The low flow season on the Eel River does not start until October 1st, which allows anglers to target adult Chinook salmon during stressful conditions in September. The low flow closures should begin at the onset of Chinook arrival in the Eel River (e.g. September 1st as regulated in the Mad River). Due its rural setting, poaching is widespread throughout the Eel River and its tributaries and should be more closely monitored.

Focus Initial Efforts on Restoring Key Tributaries

There are several key tributaries to the Lower Eel and South Fork Eel populations that provide excellent spawning and rearing conditions. Efforts should be focused on these key tributaries in the early phases of recovery plan implementation, to ensure that conditions are improved in areas that are occupied and functional. Tributaries such as Hollow Tree Creek, Indian Creek, Sproul Creek, Salmon Creek, and Redwood Creek should be targeted for implementation of recovery actions as soon as feasible to ensure that key areas are bolstered.

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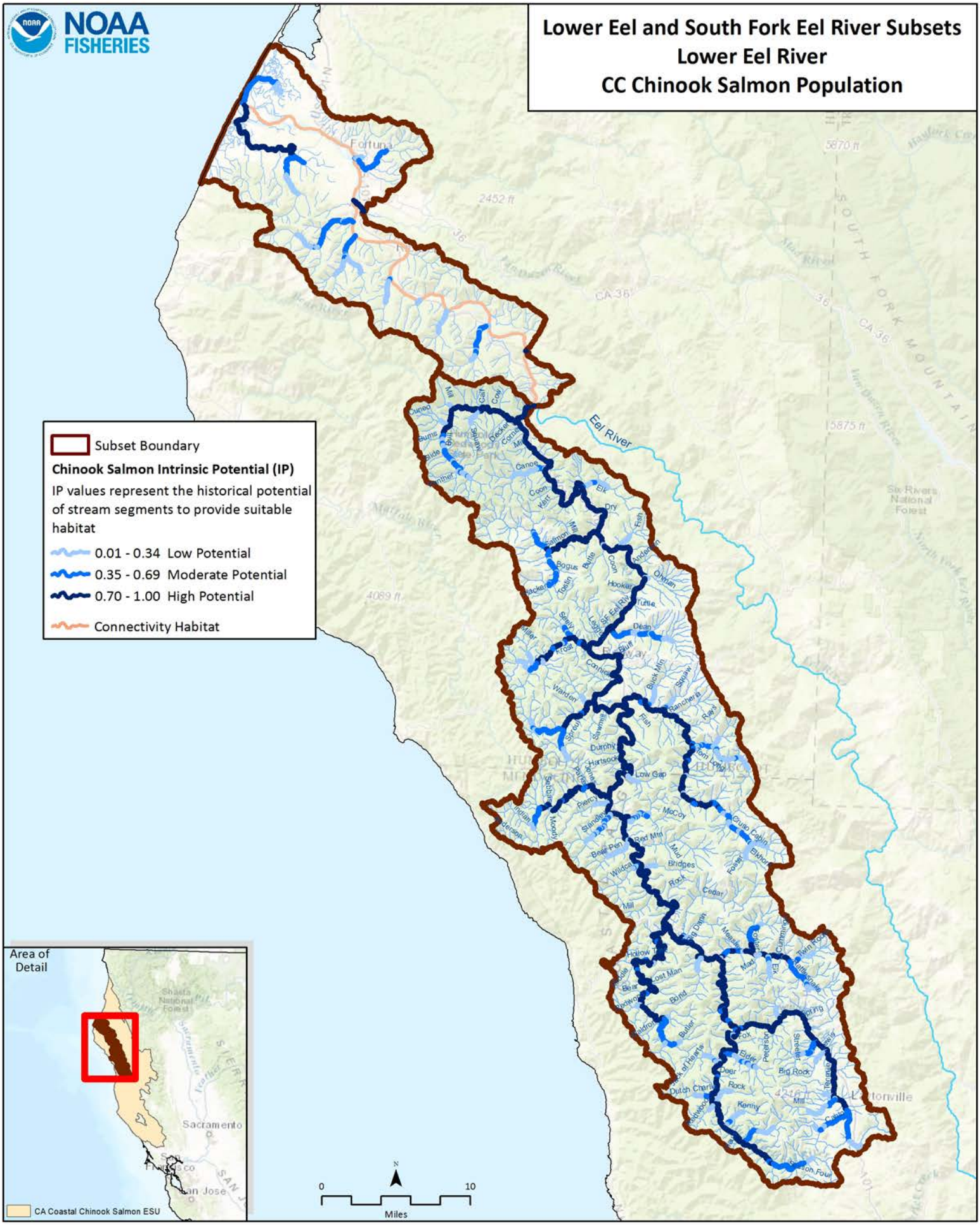
Lower Eel and South Fork Eel River Subsets
Lower Eel River
CC Chinook Salmon Population
Subset Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Connectivity Habitat
Eel River
Fortuna
Area of Detail
Sacramento
San Jose
CA Coastal Chinook Salmon ESU
0
10
Miles
N

CC Chinook Salmon South Fork and Lower Mainstem Eel River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	50% of streams/ IP-km (>49% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	67% of streams/ IP-km (>30% Pools; >20% Riffles)	Fair
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.27	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-km accessible*	Poor
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	99.9 of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	38.07% Class 5 & 6 across IP-km	Poor

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	67.75	Very Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	69.42	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	18.5	Good
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	31.91	Good
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		1-20 Spawners per IP-km	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair

			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	24.85% (0.85mm) and >30% (6.4mm)	Poor
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	53% of streams/ IP-km (>50% stream average scores of 1 & 2)	Fair
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	67.75	Very Good
3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	64% of streams/ IP-km (>49% average primary pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	67% of streams/ IP-km (>30% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	11% of streams/ IP-km (>80 stream average)	Poor
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.27	Fair
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	>5 Diversions/10 IP-km	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk	NMFS Flow Protocol: Risk	NMFS Flow Protocol: Risk	NMFS Flow Protocol: Risk	NMFS Flow Protocol: Risk	Fair

				Factor Score >75	Factor Score 51-75	Factor Score 35-50	Factor Score <35	Factor Score 51-75	
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Riparian Vegetation	Species Composition	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	38.07% Class 5 & 6 across IP-km	Poor
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	67.75	Very Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	53% of streams/ IP-km (>50% stream average scores of 1 & 2)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	<50% IP-km (>6 and <14 C)	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Fair
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	69.42	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	18.5	Good
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	31.91	Good
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good

5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	11% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	>5 Diversions/10 IP-km	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	99.9 of IP-km	Very Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	67.75	Very Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	53% of streams/ IP-km (>50% stream average scores of 1 & 2)	Fair
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	<50% IP-km (>6 and <14 C)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair

			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Fair
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	69.42	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	18.5	Good
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	31.91	Good
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.45% of Watershed in Impervious Surfaces	Very Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	3.98% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	22.31% of Watershed in Timber Harvest	Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	4% of Watershed >1 unit/20 acres	Very Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	5.08 Miles/Square Mile	Poor

			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	4.17 Miles/Square Mile	Poor

CC Chinook Salmon South Fork and Lower Mainstem Eel River CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Medium	Low	Medium	Medium	Medium	Medium
2	Channel Modification	Medium	Low	High	High	Medium	High
3	Disease, Predation and Competition	Medium	Medium	Medium	Medium	Low	Medium
4	Fire, Fuel Management and Fire Suppression	Medium	Low	Medium	Medium	Medium	Medium
5	Fishing and Collecting	High		Low	Medium		Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium
8	Logging and Wood Harvesting	Medium	Low	Medium	Medium	Medium	Medium
9	Mining	Medium	Low	Medium	Medium	Medium	Medium
10	Recreational Areas and Activities	Low	Low	Medium	Medium	Medium	Medium
11	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium
12	Roads and Railroads	High	Medium	High	High	High	High
13	Severe Weather Patterns	Medium	Low	High	High	Medium	High
14	Water Diversion and Impoundments	High	Medium	Very High	Medium	High	High

South Fork and Lower Eel River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SFER-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SFER-CCCh-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat				
SFER-CCCh-1.1.1.1	Action Step	Estuary	Implement conservation easements or land acquisitions that would allow for the removal or modification of tide gates and levees in order to restore the tidal prism and tidal wetlands.	2	25	CDFW, Corps, NOAA RC, Private Landowners, RWQCB	
SFER-CCCh-1.1.1.2	Action Step	Estuary	The impact of property subdivision on streams of Lower Eel River Basin should be minimized through the use of better land management practices. (CDFW-CWPAP 2013).	2	10	CDFW, Humboldt County, Private Landowners	
SFER-CCCh-1.1.1.3	Action Step	Estuary	Where necessary, identify barriers to fish migration in the form of large debris accumulations, culverts, etc. and modify them.	2	5	CDFW, Humboldt County, NMFS	
SFER-CCCh-1.1.1.4	Action Step	Estuary	Improve educational outreach to community (CDFW-CWPAP, 2013).	3	10	CDFW, Humboldt County, NMFS, NOAA RC	
SFER-CCCh-1.1.1.5	Action Step	Estuary	Encourage and partner with Fortuna Creeks Project's urban stream clean-up, habitat restoration and monitoring (CDFW-CWPAP, 2013).	2		Fortuna Creek Project	
SFER-CCCh-1.1.1.6	Action Step	Estuary	Conduct habitat and fish inventories on urban streams of the Middle Subbasin, including Palmer, Jameson, and Rohner Creeks and unnamed tributaries to Strongs Creek (CDFW-CWPAP, 2013).	3	5	CDFW, Humboldt County, Local Agencies	
SFER-CCCh-1.1.2	Recovery Action	Estuary	Reduce turbidity and suspended sediment				
SFER-CCCh-1.1.2.1	Action Step	Estuary	Work to restore natural functioning tidal and drainage patterns within McNulty Slough and the Salt river.	2	10	CDFW, Corps, Farm Bureau, Humboldt County, NOAA RC, Private Landowners, RWQCB	
SFER-CCCh-1.1.2.2	Action Step	Estuary	Increase the tidal prism to help to maintain existing channels and help remove excessive fine sediment accumulation (CDFW-CWPAP, 2013).	2	25	CDFW, Humboldt County, NMFS	
SFER-CCCh-1.1.2.3	Action Step	Estuary	Conduct an upslope erosion inventory on streams in the Middle and Upper Subbasins in order to identify and map stream bank and road-related sediment sources. Sites should be prioritized and improved in order to decrease sediment contributions within the basin (CDFW-CWPAP, 2013).	3	10	CDFW, Humboldt County	
SFER-CCCh-1.1.2.4	Action Step	Estuary	In streams where spawning area is limited, projects should be designed to trap and sort spawning gravels in order to expand and enhance redd distribution (CDFW-CWPAP, 2013).	3	25	CDFW	
SFER-CCCh-1.1.2.5	Action Step	Estuary	Water quality data, including temperature and dissolved oxygen, should be consistently collected throughout the year, for several years, in order to accurately characterize conditions in the streams. Salinities should be collected in the estuary and upstream to determine the extent of brackish conditions (CDFW-CWPAP, 2013).	3	5	CDFW	
SFER-CCCh-1.1.3	Recovery Action	Estuary	Reduce toxicity and pollutants				
SFER-CCCh-1.1.3.1	Action Step	Estuary	Livestock management fencing should be placed in areas where cattle have unrestricted access to streams (CDFW-CWPAP 2013).	2	10	CDFW, Humboldt County, NMFS, NOAA RC, Private Landowners	
SFER-CCCh-1.1.4	Recovery Action	Estuary	Improve the quality of the estuarine habitat zones				
SFER-CCCh-1.1.4.1	Action Step	Estuary	Identify and prioritize locations within the delta where vegetation can be returned to salt tolerant species, thus increasing salt marsh around slough channels and providing a buffer to adjacent lands during inundation (CDFW-CWPAP, 2013).	2	5	CDFW, Humboldt County, NOAA RC	
SFER-CCCh-1.1.4.2	Action Step	Estuary	Programs to increase riparian vegetation should be implemented in streams where shade canopy is below target values of 80% coverage. Additionally, where vegetated with exotic species, it should be considered for native plant restoration (CDFW-CWPAP, 2013).	2	20	CDFW, Humboldt County	
SFER-CCCh-1.1.5	Recovery Action	Estuary	Increase and enhance habitat complexity features				
SFER-CCCh-1.1.5.1	Action Step	Estuary	In creeks where fish spawning and rearing habitat is limited, pool enhancement and instream structures should be added to increase complexity (CDFW-CWPAP, 2013).	2	10	CDFW	
SFER-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SFER-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				

South Fork and Lower Eel River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SFER-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Assess watershed and prioritize potential refugia habitat sites.	1	5	CDFW	
SFER-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows, guided by assessment.	1	20	CDFW	
SFER-CCCh-3.1	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**				
SFER-CCCh-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
SFER-CCCh-3.1.1.1	Action Step	Hydrology	Ensure sub-division of existing parcels does not result in increased water demand during low-flow season.	2	10	Counties, SWRCB	
SFER-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SFER-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
SFER-CCCh-5.1.1.1	Action Step	Passage	Inventory migration and flow barriers and develop plan to restore passage.	2	5	CDFW	
SFER-CCCh-5.1.1.2	Action Step	Passage	Restore passage, guided by plan.	2	10	CDFW	
SFER-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SFER-CCCh-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
SFER-CCCh-6.1.1.1	Action Step	Habitat Complexity	Develop plan to add large wood, boulders, or other instream structure to specific areas in specific quantities.	2	5	CDFW	
SFER-CCCh-6.1.1.2	Action Step	Habitat Complexity	Add structure, guided by plan.	2	10	CDFW	
SFER-CCCh-6.1.2	Recovery Action	Habitat Complexity	Improve pool/riffle/flatwater ratios (hydraulic diversity)				
SFER-CCCh-6.1.2.1	Action Step	Habitat Complexity	Implement actions to increase the frequency of pool habitats.	2	20	CDFW	
SFER-CCCh-6.2	**Objective**	**Habitat Complexity**	**Address the inadequacy of existing regulatory mechanisms**				
SFER-CCCh-6.2.1	Recovery Action	Habitat Complexity	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
SFER-CCCh-6.2.1.1	Action Step	Habitat Complexity	Reduce removal of instream large wood (i.e., wood poaching)	2	10	NPS, CDFW, County	
SFER-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SFER-CCCh-7.1.1	Recovery Action	Riparian	Improve canopy cover				
SFER-CCCh-7.1.1.1	Action Step	Riparian	Remove invasive species that inhibit establishment of native riparian vegetation.	3	5	CDFW	
SFER-CCCh-7.1.1.2	Action Step	Riparian	Plant native riparian species in denuded areas.	2	5	CDFW	
SFER-CCCh-7.2	**Objective**	**Riparian**	**Address the inadequacy of existing regulatory mechanisms**				
SFER-CCCh-7.2.1	Recovery Action	Riparian	Improve riparian conditions				
SFER-CCCh-7.2.1.1	Action Step	Riparian	Reduce detrimental environmental impacts of conversion of TPZ land to other uses.	2	10	NMFS, Calfire, BOF	
SFER-CCCh-7.2.1.2	Action Step	Riparian	Work with Calfire and BOF to minimize the number of conversions per landowner	2	10	NMFS, Calfire, BOF	
SFER-CCCh-7.2.1.3	Action Step	Riparian	Institute environmental review as part of TPZ conversions	2	10	Calfire, BOF	
SFER-CCCh-7.2.1.4	Action Step	Riparian	Work to ensure effects of activities on converted areas are minimized.	2	10	NMFS, Calfire, BOF	
SFER-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SFER-CCCh-10.1.1	Recovery Action	Water Quality	Reduce toxicity and pollutants				

South Fork and Lower Eel River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SFER-CCCh-10.1.1.1	Action Step	Water Quality	Reduce intensity of remote outdoor agriculture's nutrient and chemical inputs and improve practices to minimize nutrient and chemical inputs to watercourses.	2	5	CDFW	
SFER-CCCh-14.1	**Objective**	**Disease/ Predation /Competition**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SFER-CCCh-14.1.1	Recovery Action	Disease/ Predation /Competition	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
SFER-CCCh-14.1.1.1	Action Step	Disease/ Predation /Competition	Assess feasibility and benefits of various methods to eradicate or suppress Sacramento pikeminnow, including genetic technology methods (e.g., deleterious genes).	3	5	CDFW	
SFER-CCCh-14.1.1.2	Action Step	Disease/ Predation /Competition	Take measures to eradicate or suppress fish species using genetic technology or other methods identified as feasible.	3	25	CDFW	
SFER-CCCh-16.1	**Objective**	**Fishing/Collecting**	**Address the inadequacy of existing regulatory mechanisms**				
SFER-CCCh-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
SFER-CCCh-16.1.1.1	Action Step	Fishing/Collecting	Change the low flow season for the main stem Eel River to start on September 1.	1	5	CDFW	
SFER-CCCh-16.1.1.2	Action Step	Fishing/Collecting	Reduce poaching of adult salmonids by increasing law enforcement.	2	5	CDFW	
SFER-CCCh-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SFER-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize adverse alterations to riparian species composition and structure				
SFER-CCCh-19.1.1.1	Action Step	Logging	Determine appropriate silvicultural prescription to improve size and density of conifers.	3	5	CalFire	
SFER-CCCh-19.1.1.2	Action Step	Logging	Plant conifers guided by prescription.	3	20	CalFire, CDFW	
SFER-CCCh-19.1.1.3	Action Step	Logging	Thin, or release conifers guided by prescription.	3	20	CalFire, CDFW	
SFER-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SFER-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
SFER-CCCh-23.1.1.1	Action Step	Roads/Railroads	Reduce road-stream hydrologic connection.	2	10		
SFER-CCCh-23.1.1.2	Action Step	Roads/Railroads	Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective.	3	5	CDFW	
SFER-CCCh-23.1.1.3	Action Step	Roads/Railroads	Assess streamside roads and prioritize sites for relocation to minimize mass wasting.	3	5	CDFW	
SFER-CCCh-23.1.1.4	Action Step	Roads/Railroads	Decommission or relocate roads away from streamsides and unstable land features, guided by assessment.	3	15	CDFW	
SFER-CCCh-23.1.1.5	Action Step	Roads/Railroads	Upgrade roads, guided by assessment.	2	15	CDFW	
SFER-CCCh-23.1.1.6	Action Step	Roads/Railroads	Maintain roads, guided by assessment.	3	50	CDFW	
SFER-CCCh-25.1	**Objective**	**Water Diversion /Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SFER-CCCh-25.1.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
SFER-CCCh-25.1.1.1	Action Step	Water Diversion /Impoundment	Establish a forbearance program, using water storage tanks to decrease diversion during periods of low flow.	2	25	RWQCB	
SFER-CCCh-25.1.1.2	Action Step	Water Diversion /Impoundment	Monitor forbearance compliance and flow.	3	25	RWQCB	

South Fork and Lower Eel River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SFER-CCCh-25.1.2	Recovery Action	Water Diversion /Impoundment	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
SFER-CCCh-25.1.2.1	Action Step	Water Diversion /Impoundment	Screen all diversions to prevent juvenile mortality.	2	25	CDFW	

Mad River Population

CC Chinook Salmon Fall-Run

- Role within ESU: Functionally Independent Population
- Diversity Stratum: North Coastal
- Spawner Abundance Target: 3,000 adults
- Current Intrinsic Potential: 94.4 IP-km

For information regarding NC steelhead and SONCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the SONCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

There are no known systematic adult or juvenile population surveys for CC Chinook salmon on the Mad River. Fall-run Chinook salmon spawner surveys and rotary screw trapping have been conducted in recent years but the level of effort has varied within and between years, making statistical inferences impossible. CDFW operated a fish ladder from 1938 through 1964 at Sweasey Dam (built in 1938 and removed in 1970), producing the only known reliable population time series for Chinook salmon in the Mad River.

Fall-run Chinook salmon are documented within the Mad River basin up to the boulder roughs reach (rkm 80) located near Bug Creek (Spence *et al.* 2008; Stillwater Sciences 2010). Chinook salmon utilize both the mainstem Mad River and several tributaries for spawning including Lindsay Creek, North Fork Mad River, Cañon Creek, Maple Creek, and Blue Slide Creek (Stillwater Sciences 2010).

In 1905, an estimated 200,000 pounds of Chinook salmon were harvested commercially in the Mad River, leading to an estimated run of 10,000 fish, not including escapement and recreational catch (Ridenhour *et al.* 1961). By the middle of the 20th century, runs of Chinook salmon had declined substantially. The largest Chinook salmon return to Sweasey Dam was 3,139 in 1941, with the population declining significantly to less than 100 by the 1960s. In the fall of 2003 and 2004, sporadic, incomplete redd counts on the Mad River during spawner surveys were 457 and 281, indicating there were at least a few hundred spawners in those years. Therefore, it is likely that the population of adult fall-run Chinook salmon in the Mad River is greater than the high risk threshold identified by Spence *et al.* (2008) of 94 adult spawners, but substantially less than low risk threshold of 3,000. Sparkman (2002) estimated that 954,027 (854,178 –1,053,876) 0+ fall Chinook salmon emigrated past the trap site, located near the hatchery, from March 30 – July 14,

2001. Sparkman observed 1900 adult Chinook from September – December 2015 during snorkel surveys (M. Sparkman, CDFW, personal communication, 2016). Spence *et al.* (2008) wrote that they did not have enough data available on Mad River fall-run Chinook salmon to determine the current population viability. Spring-run Chinook salmon in the Mad River are thought to be extinct (Spence *et al.* 2008), though their historical prevalence relative to that of fall Chinook salmon has not been documented. The CDFW will be using DIDSON sonar in the Mad River to estimate abundances of Chinook salmon beginning in 2014, which could help future long-term salmonid monitoring.

History of Land Use

Historically, bands of the Wiyot Tribe inhabited the lower portion of the Mad River and fished for salmon and steelhead in the watershed (Sturtevant 1978). After whites settled in the area in the mid-1800s, logging and ranching became the primary land uses. Today, logging, road building, gravel mining, grazing, agriculture and water diversion and impoundment are the human activities that have the most pronounced effect on salmonid habitat in the Mad River basin. Mad River Hatchery currently produces approximately 150,000 steelhead smolts annually, supporting a recreational fishery with economic importance to the region.

These land uses have reduced available habitat throughout the basin. The watershed has been heavily logged, some areas more than once, since the early 1900s (Stillwater Sciences 2010). Increased erosion from logged hillslopes and roads, especially during the 1955 and 1964 flood events, has filled the Mad River with sediment and created chronically high turbidity levels (Stillwater Sciences 2008). Although the Mad River basin has naturally high rates of sediment delivery due to unstable hillslopes prone to landslides and high rates of surface erosion, the U.S. Environmental Protection Agency (USEPA) estimated that 64 percent of all sediment delivered to streams was attributed to human and land management-related activities, with roads being the dominant source (USEPA 2007). In the lower Mad River and North Fork areas, sediment loading is currently five times greater than natural background loading levels (USEPA 2007). Compounding the increase in sediment delivery, riparian vegetation loss has reduced shading and lowered instream large wood abundance. Most forest stands within the basin are now comprised of smaller diameter trees with a greater percentage of hardwoods, which provide different ecological function than redwood and conifer species that occurred historically (GDRC 2006).

Current Resources and Land Management

Much of the North Fork Mad River watershed and the lower and middle portions of the Mad River basin are owned by Green Diamond Resource Company (GDRC) and managed for timber

production under an Aquatic Habitat Conservation Plan. Grazing occurs on large ranches throughout the Mad River basin, as well as more concentrated grazing along the reaches of the lower river and its tributaries. Most of the upper basin is part of the Six Rivers National Forest (SRNF), and is managed using an ecosystem-based approach that provides for resource protection under the Northwest Forest Plan (FEMAT 1993). The largest communities in the watershed, Arcata, Blue Lake and McKinleyville, are situated along the lowermost reach near the mouth of the Mad River. Extensive instream gravel mining occurs throughout the lower Mad River. Instream gravel mining is focused in the 7-mile reach of the lower Mad River between Blue Lake and Arcata. Extensive instream gravel mining occurs throughout the lower Mad River, although mining practices have greatly improved since the 1970s. The majority of large gravel bars on the lower mainstem Mad River, between Blue Lake and Highway 299, are mined each year, and annual mining typically removes the estimated mean annual recruitment of gravel coming into the mining reach. Although the U.S. Army Corps of Engineers permits gravel mining with numerous mitigation measures, such as a head-of-bar buffer to maintain river flow around the gravel bar and a skim floor elevation that maintains low to moderate channel confinement, gravel mining reduces the availability of complex rearing habitat, and particle size, which could impact aquatic invertebrates and juvenile feeding in the lower Mad River (NMFS 2004; 2010).

The following list highlights important groups or documents that are pertinent to the Mad River:

- Mad River Stakeholders Group: http://www.naturalresourcesservices.org;
- Lindsay Creek Watershed Group: http://www.naturalresourcesservices.org/lindsay-creek.html;
- Mad River Watershed Assessment: http://www.naturalresourcesservices.org/mad-river-watershed-management-plan.html;
- Green Diamond Resource Company: http://www.greendiamond.com;
- Mad River Sediment Source Analysis: http://www.epa.gov/region9/water/tmdl/mad/GMA-Mad-River-SSA-final-report-Dec2007-no-plates.pdf;
- Mad River TMDL: http://www.epa.gov/region9/water/tmdl/mad/Mad-TMDL-122107-signed.pdf; and
- Mad River Alliance: http://www.facebook.com/pages/Mad-River-Alliance/481159968568471.

Salmonid Viability and Watershed Conditions

The following indicators are rated Poor through the CAP process for CC Chinook salmon: aquatic invertebrates (EPT), percent of primary and staging pools, pool/riffle/flatwater ratio, road density, shelter, and turbidity. Other indicators that are identified as impaired include the

following: LWD frequency, number and magnitude of diversions, estuary quality, redd scour, and tree diameter. Recovery strategies will focus on improving these poor conditions as well as those needed to ensure population viability and functioning watershed processes (see Mad River CAP results).

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Mad River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Sediment Transport: Road Density

Overall, the sediment load allocations reflect a total 57 percent reduction over the 1976-2006 time period, or an 89 percent reduction in human-and management-related sediment (USEPA 2007). However, because existing management-related sediment loading is so high in the watershed, dramatic cuts in sediment are necessary for habitat improvement (USEPA 2007). Cañon Creek, the North Fork Mad River, Maple Creek, Boulder Creek, Lindsay Creek, the Lower Mad River, and the Lower Middle Mad River all have 50 percent or more of their watershed area in Franciscan Melange, a very erosive geology type. Road building and logging have accelerated erosion rates within this naturally erosive geology. In the lower Mad River and North Fork areas, total sediment loading is currently five times greater than natural sediment loading (USEPA 2007). Most of the hydrologic units within hydrologic sub-areas HSAs in the lower portion of the Mad River watershed, including Little River, Blue Lake, North Fork Mad River, and Butler Valley, have very high road densities of greater than 3 road miles per square mile area. The Lower Middle Mad River has the largest area underlain by Franciscan Melange (40.4 mi2). Road-related landslides contribute 622,942 tons of sediment per year in the Mad River watershed, making sediment transport a substantial stress to this population (Mad River CAP Results). Sediment accumulation at the mouths of tributaries, such as Cañon Creek, may inhibit juvenile and adult access (D. Halligan, Stillwater Sciences, personal communication, 2011). Excess sediment in the Mad River affects all lifestages and all populations of listed salmonids in the basin. High gravel embeddedness likely causes poor survival of eggs and fry in watersheds such as the North Fork Mad River. Elevated turbidity also makes feeding and respiration difficult for fry and juvenile salmonids.

Estuary: Quality and Extent

Estuary condition in the Mad River has a rating of Fair for juveniles. The estuary was once connected to many sloughs and other off-channel rearing habitat, such as overflow channels and cut-off meanders. Natural slough channels were blocked in the 1900s, and the mainstem river

channel was straightened and channelized in an attempt to minimize overbank flooding (Stillwater Sciences 2010). Channel banks in the estuary were stabilized by the construction of gravel berms, rip rap, and riparian vegetation planted in the 1980s (Stillwater Sciences 2010) and, as a result, active channel area in the reach has declined by 32 percent since 1941 (Stillwater Sciences 2008). Overall, the relocation of the mouth has increased the size of the estuary, but available estuarine rearing habitat is simplified, with little instream structure or diversity, very little off-channel habitat, and highly altered estuarine function.

Habitat Complexity: Altered Pool Complexity and/or Pool/Riffle Ratios

Sediment loading in the Mad River watershed has aggraded stream reaches, particularly in the lower and middle Mad River watershed. Downstream of the Bug Creek confluence, landslide sediment input exceeds the transport capacity of the river, resulting in a locally aggraded mainstem channel (USEPA 2007). This has caused pools to fill in and become shallow, altering the pool: riffle ratio in several stream reaches. Low LWD volume has also reduced the number and quality of pools in stream in the Mad River watershed. Some short sections of the lower North Fork and lower Mad River mainstem are confined by flood control levees on the right side of the river around the town of Blue Lake and in the Mad River bottoms, downstream of Highway 101. These levees disconnect the channel from its floodplain and limit the formation of off-channel habitat, which is critical for juvenile winter rearing success.

Habitat Complexity: Large Wood and Shelter

Stillwater Sciences (2010) identified several stream reaches as suffering from low LWD volume. Industrial timber removal of trees, ages 40-80 years, will likely substantially reduce LWD recruitment in the future. However, there is evidence that LWD recruitment is improving in some areas, such as Dry Creek and Cañon Creek (Stillwater Sciences 2010). Areas that are lacking LWD include the Lower Mad River sub-basin, North Fork Mad River sub-basin, Maple Creek, and Powers Creek sub-basin. Surveys conducted by CDFW on Black Creek (a.k.a. Black Dog Creek), located along the west side of the Mad River just upstream of Maple Creek at approximately RM 28.3, identified a relatively low level of LWD and recommended installing wood structures to improve pool habitat quality and instream cover levels (Stillwater Science 2010).

Viability: Density, Abundance and Spatial Structure

Information provided above in the *Fish and Distribution* section shows that Chinook salmon are likely below the low risk spawner thresholds but above the depensation thresholds. Although Chinook salmon have access to most of their historical spawning habitat, poor habitat complexity within the estuary likely limits the expression of life history diversity.

Water Quality: Turbidity or Toxicity

Analyses detailed in USEPA (2007) indicate there are hundreds of active landslides in the Mad River watershed, which during winter and spring storms create turbid water conditions that stress Chinook salmon fry. Sediment input directly into streams by landslides can also smother available spawning gravel, lowering survival from the egg to fry lifestage. Turbidity is problematic throughout the Middle and Lower Mad River watersheds and in the North Fork Mad River.

Hydrology: Redd Scour

Fall-run Chinook salmon in the Mad River spawn in the lower reaches of the drainage, often in the mainstem Mad River. This spawning strategy makes Chinook salmon particularly susceptible to activities or events that increase gravel scouring frequency or severity. Fall-run Chinook salmon spawn timing (November and December) also makes them particularly vulnerable to redd scouring precipitation events. Logged hillsides with high road densities in the basin promote faster runoff from rain storms that would occur in the absence of logging. Gravel mining destabilizes gravels, making them more mobile at a lower flow than they would be otherwise.

Very Good or Good Current Conditions

Very Good or Good rated conditions include altered riparian species composition and structure, floodplain connectivity: quality and extent, hydrology: water flow, passage and migration, watershed hydrology, and landscape disturbance.

Threats

The following discussion focuses on those threats that rate as High or Very High (Mad River CAP Results). Recovery strategies will likely focus on ameliorating High rating threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Mad River CAP Results.

Channel Modification

Channel modification is a significant threat for juveniles in the Mad River (Mad River CAP Results). The draining of estuary wetlands and construction of high levees for pasture lands has reduced the volume of winter rearing habitat in the lower portions of the watershed, while constructed levees have effectively cut off access to valuable off-channel and slough habitat.

Water Diversion and Impoundments

Water diversions and impoundments affect the function of watershed processes by changing the timing and magnitude of flow events. Matthews Dam, which forms Ruth Reservoir, stores rainfall during the first several rainstorms of the winter season annually spilling after the reservoir is full. This unnaturally attenuates flow in the Mad River, altering the normal hydrologic signal in the Mad River. In years of below average precipitation, flow increases resulting from fall rainstorms are more limited in magnitude, which likely creates barriers to migration at the mouths of some tributaries. Out of basin water diversions or transfer of water from the Humboldt Bay Municipal Water District (HBMWD) could pose a significant threat to Chinook salmon in the Mad River by reducing habitat during certain times of year, decreasing flow variability, and elevating stream temperatures.

Roads and Railroads

Roads are a High threat across all lifestages, and one of the primary threats for these populations. Most of the hydrologic units within HSAs in the lower portion of the Mad River watershed, including Little River, Blue Lake, North Fork Mad River, and Butler Valley, have very high road densities of greater than 3 mi./sq. mi. Overall, the sediment load allocations reflect a total 57 percent reduction over the 1976-2006 time period, or an 89 percent reduction in human-and management-related sediment, suggesting the threat from roads is decreasing. However, roads remain a significant threat even though the volume of sediment due to human activities has been decreasing (USEPA 2007). This threat will remain high in the future for Mad River Chinook salmon populations until a plan is developed that systematically prioritizes and treats landslides and roads that contribute sediment to the aquatic environment.

Mining

Mining/gravel extraction is rated as a High threat to juveniles. Historic gravel extraction was very damaging to the habitat in the lower Mad River until 1994. Current instream mining practices are much improved over past practices. However, gravel extraction still reduces overall habitat complexity and reduces the quality and quantity of available pool habitat. Given the sensitivity of the channel to disturbance (i.e., current lack of floodplain and channel structure; 15 low levels of instream wood), gravel extraction is a high threat to rearing juveniles and a moderate threat to adults who require resting habitat in pools during upstream migration.

Logging and Wood Harvesting

Timber harvest is rated as a High threat to Chinook salmon in the Mad River. Many of the changes that have occurred to instream and riparian conditions in the basin reflect legacy effects of more intensive timber harvest from previous decades. The majority of private timber land in the Mad River basin is owned by the Green Diamond Resource Company (Green Diamond), and

will continue as timberland into the future. The HCP lays out goals and objectives to minimize and mitigate timber harvest effects through measures related to road and riparian management, slope stability, and harvesting activities. Although the private timber land is managed under an aquatic HCP that reduces the effects of timber harvest, elevated sediment yields, impaired LWD recruitment, and decreased stream shading are still expected to occur in the future.

Low or Medium Rated Threats

Low or Medium rated threats include agriculture, disease, predation and competition, fire, fuel management and fire suppression, fishing and collecting, recreational areas and activities, residential and commercial development, severe weather patterns, and livestock farming and ranching.

Limiting Stresses, Lifestages, and Habitats

The threat and stress analysis within the CAP workbook suggest that pre-smolt and smolt productivity is likely limiting subsequent adult Chinook salmon abundance within the Mad River watershed. In addition, gravel scouring events likely play a role in poor spawner success during years of high precipitation. Excessive turbidity during the winter and spring months, reduced habitat complexity, and a smaller, simplified estuary have reduced the quality and extent of rearing habitat for Chinook salmon in the Mad River.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating the stresses and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. The general recovery strategy for the Mad River populations is discussed below with more detailed and site-specific recovery actions provided in Mad River CAP results, which provides the Implementation Schedule for this population.

Address Upslope Sediment Sources

Existing problem roads (gullied, rutted, with inadequate drainage) and active erosion sites should be prioritized and addressed as part of a comprehensive sediment reduction plan for the Middle and Lower Mad River subwatersheds, which are the areas with the greatest volume of sediment input (Stillwater Sciences 2010). While Green Diamond Resource Company has been prioritizing their roads for treatment, the work needs to be performed across multiple private ownership boundaries. Because roads are the dominant source of sediment in the watershed, improving road condition and maintenance may be the most cost-effective approach to address elevated turbidity within the watershed (USEPA 2007). The main fish-producing tributaries to the Mad

River (Lindsay Creek, North Fork Mad River, Canon Creek, and Maple Creek) should be treated first (USEPA 2007).

Increase Instream Shelter Ratings and Pool volume

Availability of shelter habitat should be improved within reaches of the Middle and Lower Mad River subwatersheds with currently low pool availability and quality. Adding LWD will improve habitat complexity in existing pool habitats where shelter components are currently comprised of undercut banks and emergent aquatic vegetation. In other reaches, restoration efforts should implement wood/boulder structures into degraded reaches to increase pool frequency and volume. Additions of large wood have occurred in NF Mad, mainstem Mad, Lindsay Creek and Leggit Creek. These efforts have been for the most part successful at improving habitat. Beneficial uses of water from Ruth Reservoir by the Humboldt Bay Municipal Water District should be explored including elevating fall flows during rainstorms, and providing additional habitat for fisheries restoration. Eradication of reed canary grass on Lindsay Creek is a recovery action step to be carried out in the future and would further improve the habitat in Lindsay Creek. A new Habitat Conservation Plan for HBMWD would be a valuable step to outline how water no longer needed for industrial uses could be used to benefit salmonids.

Increase Mainstem and Estuary Habitat Complexity

The lower portions of the mainstem Mad River (downstream from Mad River hatchery) suffer from a lack of LWD and, in certain areas, disconnection with the floodplain (near Blue and downstream from Highway 299). Priority should be placed on expanding rearing areas, such as creation of off-channel ponds, wetlands, sloughs, and backwaters, to the lower Mad River, its tributaries and the Mad River estuary. Where possible, land should be purchased from willing landowners in order to expand floodplain habitat availability. Gravel mining effects to Chinook salmon, permit minimization measures, and gravel mining techniques and annual extraction volumes should be re-evaluated.

Decrease Water Temperatures

The Mad River is currently listed as water temperature impaired in some parts of the watershed. Water temperature has been identified as a recovery action and will be addressed through the management of shade by planting conifers to increase riparian vegetation and improving canopy cover.

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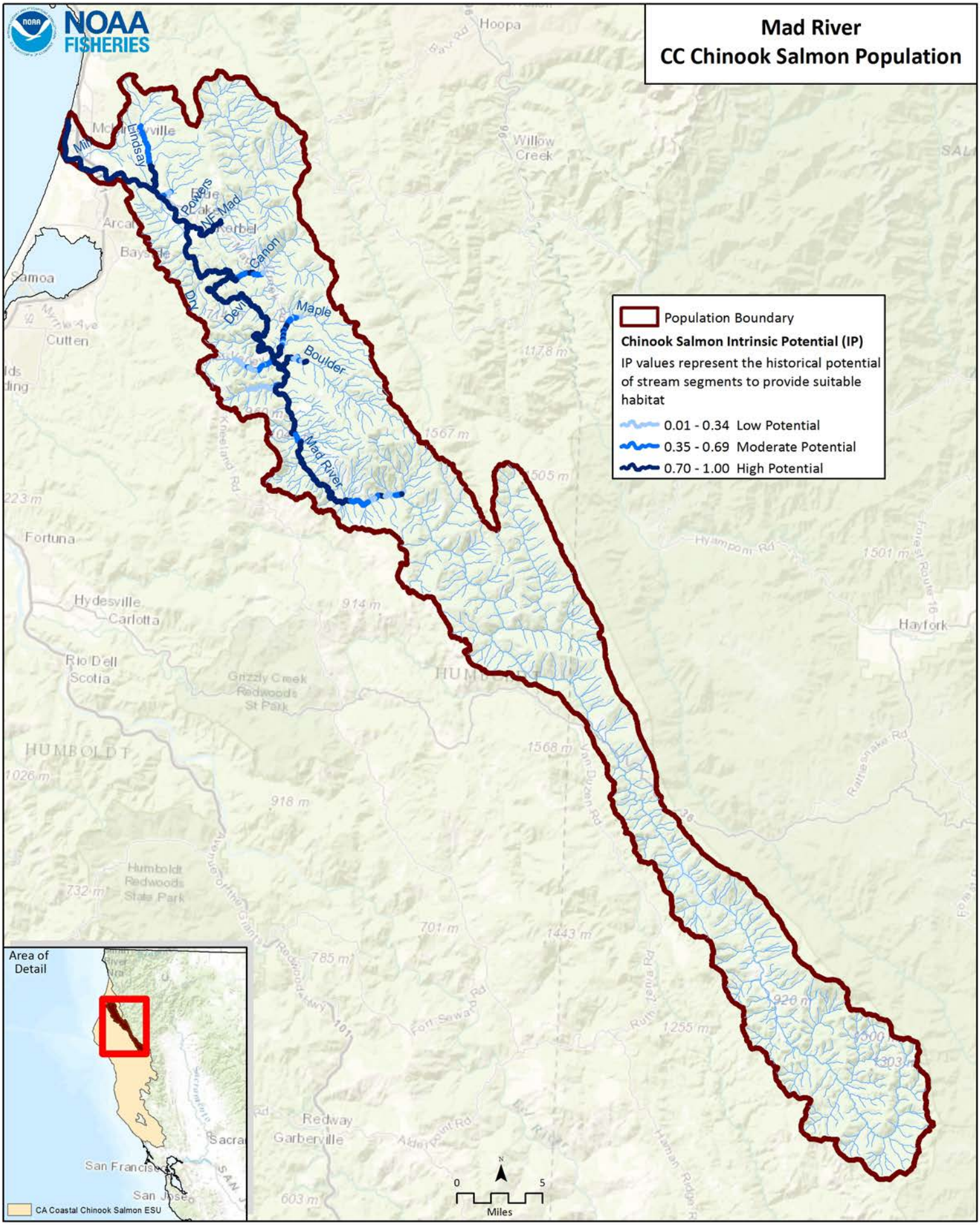
NOAA FISHERIES
Mad River
CC Chinook Salmon Population
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Lindsay
Powers
NF Mad
Canon
Dry
Devil
Maple
Boulder
Mad River
Hoopa
Willow Creek
Samoa
Cutten
Fortuna
Hydesville
Carlotta
Rio Dell
Scotia
Grizzly Creek Redwoods St Park
Humboldt Redwoods State Park
Hayfork
Redway
Garberville
Area of Detail
San Francisco
San Jose
CA Coastal Chinook Salmon ESU
0
5
Miles

CC Chinook Salmon Mad River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Properly Functioning Condition	Good
			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Fair
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	0% of streams/ IP-Km (>49% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	48% of streams/ IP-Km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.15	Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 42	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	80% IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	44.52% Class 5 & 6 across IP-km	Fair

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	80% of IP-km	Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	84	Very Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	>80% Response Reach Connectivity	Good
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	70% of streams/ IP-km maintains severity score of 3 or lower	Fair
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	57.5	Fair
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	10	Poor
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	28	Fair
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		20.2 Spawners per IP-km	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	91% of Historical Range	Very Good
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 33	Very Good
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 42	Good

			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	11% (0.85mm) and <30% (6.4mm)	Very Good
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	100% of streams/ IP-km (>50% stream average scores of 1 & 2)	Fair
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	84	Very Good
3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	27% of streams/ IP-km (>49% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	48% of streams/ IP-Km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	0% of streams/ IP-km (>80 stream average)	Poor
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.15	Good
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 42	Good
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 33	Very Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.3 Diversions/10 IP-km	Fair

			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 33	Very Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	80% IP-km	Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	50% Intact Historical Species Composition	Fair
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	84	Very Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	100% of streams/ IP-km (>50% stream average scores of 1 & 2)	Very Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	>80% Response Reach Connectivity	Good
			Water Quality	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	60% IP-km (>6 and <14 C)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	49% of streams/ IP-km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	57.5	Fair
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	10	Poor
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	28	Fair

		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	91% of Historical Range	Very Good
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	0% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.3 Diversions/10 IP-km	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 33	Very Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	80% IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	84	Very Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	100% of streams/ IP-km (>50% stream average scores of 1 & 2)	Very Good
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	60% IP-km (>6 and <14 C)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	>80% Response Reach Connectivity	Good

			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	70% of streams/ IP-km maintains severity score of 3 or lower	Fair
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	57.5	Fair
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	10	Poor
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	28	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence et al (2012)	Smolt abundance which produces moderate risk spawner density per Spence et al (2012)	Smolt abundance to produce low risk spawner density per Spence et al (2012)	not applicable	Smolt abundance to produce low risk spawner density per Spence et al (2012)	Good
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.29% of Watershed in Impervious Surfaces	Very Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	0.4% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	19.12% of Watershed in Timber Harvest	Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	4% of watershed >1 unit/20 acres	Very Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	50% Intact Historical Species Composition	Fair

			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	5.15 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	4.02 Miles/Square Mile	Poor

CC Chinook Salmon Mad River CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Medium	Low	Medium	Medium	Medium	Medium
2	Channel Modification	Medium	Low	High	High	Low	High
3	Disease, Predation and Competition	Medium	Low	Low	Medium		Medium
4	Fire, Fuel Management and Fire Suppression	Medium	Low	Medium	Medium	Medium	Medium
5	Fishing and Collecting	Medium		Low	Low		Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Medium	Medium	Medium	Medium	Medium	Medium
8	Logging and Wood Harvesting	Medium	Medium	Medium	Medium	Medium	Medium
9	Mining	Medium	Medium	Medium	Medium	Medium	Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Low	Medium
11	Residential and Commercial Development	Medium	Medium	Medium	Medium	Medium	Medium
12	Roads and Railroads	Medium	High	High	High	High	High
13	Severe Weather Patterns	Medium	Low	Medium	Medium	Medium	Medium
14	Water Diversion and Impoundments	Medium	Medium	Medium	Medium	High	Medium

Mad River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
MdR-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MdR-CCCh-1.1.1	Recovery Action	Estuary	Increase extent of estuarine habitat				
MdR-CCCh-1.1.1.1	Action Step	Estuary	Assess and prioritize levees for setback or removal.	2	2	County	
MdR-CCCh-1.1.1.2	Action Step	Estuary	Remove or set back levees, guided by assessment.	2	8	CDFW	
MdR-CCCh-1.1.1.3	Action Step	Estuary	Assess tidally influenced habitat and develop plan to restore tidal channels.	1	2	CDFW	
MdR-CCCh-1.1.1.4	Action Step	Estuary	Restore tidal wetlands and tidal channels, guided by plan.	1	10	CDFW	
MdR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MdR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
MdR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Assess watershed and prioritize potential refugia habitat sites.	2	2	CDFW	
MdR-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Implement projects that create refugia habitats, guided by assessment.	2	8	CDFW	
MdR-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MdR-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
MdR-CCCh-5.1.1.1	Action Step	Passage	Develop plan to restore passage of all life stages.	3	2	County	
MdR-CCCh-5.1.1.2	Action Step	Passage	Implement plan.	3	10	County	
MdR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MdR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
MdR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Develop plan to add large wood, boulders, or other instream structure to specific areas in specific quantities.	2	2	CDFW	
MdR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Place instream structures, guided by assessment.	2	10	CDFW	
MdR-CCCh-6.2	**Objective**	**Habitat Complexity**	**Address the inadequacy of existing regulatory mechanisms**				
MdR-CCCh-6.2.1	Recovery Action	Habitat Complexity	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
MdR-CCCh-6.2.1.1	Action Step	Habitat Complexity	Reduce removal of instream large wood (i.e., wood poaching)	2	10	NPS, CDFW, County	
MdR-CCCh-7.1	**Objective**	**Riparian**	**Address the inadequacy of existing regulatory mechanisms**				
MdR-CCCh-7.1.1	Recovery Action	Riparian	Improve canopy cover				
MdR-CCCh-7.1.1.1	Action Step	Riparian	Determine appropriate silvicultural prescription for benefits to listed salmonids.	3	5	CDFW	
MdR-CCCh-7.1.1.2	Action Step	Riparian	Plant conifers, guided by prescription.	3	5	CDFW	
MdR-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MdR-CCCh-8.1.1	Recovery Action	Sediment	Improve instream gravel quality and quantity				
MdR-CCCh-8.1.1.1	Action Step	Sediment	Develop study to analyze the frequency and effect of gravel scouring events.	3	2	NMFS	
MdR-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MdR-CCCh-10.1.1	Recovery Action	Water Quality	Reduce turbidity and suspended sediment				
MdR-CCCh-10.1.1.1	Action Step	Water Quality	Develop and fund a feasibility study to address the significant turbidity issues from Ruth Reservoir/Matthews Dam outlet.	2	2	CDFW, NMFS, PGE	

Mad River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
MdR-CCCh-10.1.1.2	Action Step	Water Quality	Fund and implement recommendations from proposed feasibility study to address significant turbidity issues from the Ruth Reservoir/Matthews Dam outlet.	2	5	CDFW, NMFS, PGE	
MdR-CCCh-14.1	**Objective**	**Disease/Predation/Competition**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MdR-CCCh-14.1.1	Recovery Action	Disease/Predation/Competition	Reduce the threat of invasive species to aquatic habitats				
MdR-CCCh-14.1.1.1	Action Step	Disease/Predation/Competition	Eradicate reed canary grass.	2	5	CDFW	
MdR-CCCh-16.1	**Objective**	**Fishing/Collecting**	**Address the overutilization for commercial, recreational, scientific or educational purposes**				
MdR-CCCh-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
MdR-CCCh-16.1.1.1	Action Step	Fishing/Collecting	Re-evaluate fishery management plan.	3	2	CDFW, NMFS	
MdR-CCCh-16.1.1.2	Action Step	Fishing/Collecting	Limit fishing impacts to levels consistent with recovery.	3	25	CDFW, NMFS	
MdR-CCCh-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MdR-CCCh-18.1.1	Recovery Action	Livestock	Improve watershed conditions				
MdR-CCCh-18.1.1.1	Action Step	Livestock	Assess grazing impact on riparian condition, identifying opportunities for improvement.	3	2	CDFW	
MdR-CCCh-18.1.1.2	Action Step	Livestock	Develop grazing management plan to meet objective.	3	2	CDFW	
MdR-CCCh-18.1.1.3	Action Step	Livestock	Fence livestock out of riparian zones.	3	5	Private	
MdR-CCCh-18.1.1.4	Action Step	Livestock	Plant vegetation to stabilize stream bank.	3	5	Private	
MdR-CCCh-18.1.1.5	Action Step	Livestock	Relocate instream livestock watering sources.	3	2	Private	
MdR-CCCh-19.1	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
MdR-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to watershed processes				
MdR-CCCh-19.1.1.1	Action Step	Logging	Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements specified in 14 CCR 898.2(d) prior to approval by the Director (similar to a Spotted Owl Resource Plan).	3	3	CalFire	
MdR-CCCh-19.1.1.2	Action Step	Logging	Apply BMPs for timber harvest.	3	20	CalFire	
MdR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MdR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
MdR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective.	3	2	RWQCB	
MdR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Decommission roads, guided by assessment.	3	10	Private	
MdR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Upgrade roads, guided by assessment.	3	10	Private	
MdR-CCCh-23.1.1.4	Action Step	Roads/Railroads	Maintain roads, guided by assessment.	3	2	Private	
MdR-CCCh-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
MdR-CCCh-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				

Mad River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
MdR-CCCh-23.2.1.1	Action Step	Roads/Railroads	Develop grading ordinance for maintenance and building of private roads that minimizes the effects to Chinook.	3	3	CDFW	

Mattole River Population

CC Chinook Salmon Fall-Run

- Role within ESU: Functionally Independent Population
- Diversity Stratum: North Coastal
- Spawner Abundance Target: 4,000 adults
- Current Intrinsic Potential: 177.5 IP-km

For information regarding NC steelhead and SONCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the SONCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

In the mid-to late 1950s and in 1960, the average run size adult Chinook salmon was estimated at 5,000 Chinook salmon (CDFG 1965). The Mattole Restoration Council (1995) stated, "For Mattole Chinook salmon, the data suggest that the number of spawners dropped from about 3,000 in 1981-82 to around 100 in the 1990-91 season." Based on the number of live fish and redds seen on spawning grounds in recent survey years, the spawning population likely numbers in the hundreds. The number of redds per survey mile (escapement index) observed since the mid-1990s range from 0.13 redds/mile in 2011-12 to 1.68 redds/mile in 1996-97 (MSG 2015).

The age of Chinook salmon adults spawning in the Mattole River is uncertain. The reported age of returning Chinook salmon was primarily 3 to 4 years, with few 5 years old (Myers *et al.* 1998). Based on scale samples of adults captured at a weir in the lower Mattole River (Thompson 2006), the spawning run of Chinook salmon in 2005 was composed of a high proportion (44 percent) of age 2 fish. This finding likely reflects a high percentage of jacks, with the remainder of the run consisting of age 3 (11 percent), age 4 (39 percent), and age 5 (2 percent) fish.

As summarized by Myers *et al.* (1998), an alternative reproductive strategy for Chinook salmon is for males to mature at an early age. Jack Chinook salmon males mature in their first or second ocean years, and offer a reduced risk of mortality, but younger (smaller) males may be at a competitive disadvantage in securing a mate. The incidence of jack males has underlying genetic determinants and appears to be, in part, a response to favorable growing conditions. Although overall the number of live fish observed was low in 2011-12, the relative number of Chinook salmon jacks observed in the Mattole River in the 2011-2012 spawning season was the highest since 1994 (Thompson 2012).

The majority of juvenile Chinook salmon migrate during the spring, and immigrate through the mouth of the Mattole River to the ocean. Prior to downstream migration, juvenile Chinook salmon have been observed rearing in the mainstem and larger tributaries (Bajer 2011). During the summer when the river becomes disconnected, small numbers of juvenile Chinook salmon have been observed in large pool habitats in the upper mainstem river (Mattole River and Range Partnership 2009a). Outmigrant trapping data at river kilometer 6.28 in the lower mainstem Mattole River was conducted from April into July, until 2011, with gear deployment and removal contingent on a river flow of 300 to 400 cfs, and closure of river mouth, respectively. The most recent population estimates of juvenile Chinook salmon, those from 2009, 2010, and 2011, were 123,874, 170,823, and 461,832, respectively (Piscitelli 2012).

In 2001 through 2004, MSG rescued juvenile Chinook salmon from drying and disconnected upper reaches of the Mattole River and relocated downstream. MSG has also trapped Chinook salmon out-migrants just upstream of the estuary, and held them in rearing ponds at Mill Creek for fall release The relationship of these rearing and relocation programs to the number of returning adults was undetermined and these practices were discontinued in 2005. MSG maintains that the lack of tag recoveries indicates the programs were successful in not precluding a wild, self-sustaining run from surviving (as is sometimes feared when hatchery techniques are utilized). MSG also maintains that the consistent recovery of tags in prior years indicates the programs were helping to preserve the existence of the Chinook salmon run during the period of very low escapement of the 1980s and 1990s (Thompson 2007).

History of Land Use

The watershed encompasses an area of approximately 194,560 acres (304 square miles) and supports a population of over 2,000 people. The main population centers are in Petrolia, Honeydew, and Whitethorn, although rural residences are scattered throughout the watershed. The majority (84 percent) of the land has a housing density of 1 housing unit or less per 160 ac (NMFS GIS). However, residences occupy approximately 16 percent of the land adjacent to the mainstem and tributaries of the Mattole River (NMFS GIS). Both historic and current land uses are agriculture and forestry.

High intensity timber management in the basin (wide-scale road building and tractor logging) occurred during the 1950s and 1960s. From 1947 to 1987 an estimated 82 percent of the timber was harvested. By 1988, over 90 percent of old-growth forests had been harvested; and by 1996, late seral habitats comprised less than 8 percent of the original forest cover. A large part of the remaining late seral stage acreage lies within the USBLM King Range National Conservation

Area, and 12 percent of the Mattole River watershed lies within this management area. Failure of logging operations to re-establish Douglas fir and other conifers after harvesting allowed for the establishment of more aggressive hardwood species. Once firmly established, hardwood stands are difficult and costly to restore back into conifer. However, conifers will return over time.

Tractor and haul roads cut into logged hillsides, along with high amounts of rainfall, increased erosion and sediment delivery to Mattole River streams. The lack of reforestation also likely contributed to increased sediment loads, which in combination with other disturbances, left streams shallower, warmer, and more prone to flooding (Raphael 1974; Bodin *et al.* 1982). The 1955 and 1964 floods choked channels with sediment, filling deep pools (MRC 2005). Currently, timber harvest continues on private and industrial timberlands in the forested uplands throughout the Mattole River basin at a much-reduced rate and under much stricter regulations.

One large industrial timberland owner, Humboldt Redwood Company (HRC), in the Mattole River watershed operates under a state and federal Habitat Conservation Plan (HCP) on 18,350 acres in the western and northern basin (PALCO 1999; HRC 2012).

With the establishment of rural residences and smaller ranches, water use has increased over the last 50 years. Currently, much of the demand for residential and agricultural uses is accommodated through instream diversions or shallow wells, which may be affecting streamflows during summer low-flow periods. Much of the domestic demand occurs in the southern basin. Many areas in the Mattole watershed have experienced increasing levels of marijuana cultivation. Many of these operations require water sources during the late spring and early summer, which coincides with juvenile Chinook rearing. The energy of the water flowing into unscreened water diversions (pumps) may directly increase mortality of juvenile Chinook salmon, either through entrainment of individuals into the diversion pipe or impingement of individuals across the mouth the diversion pipe by the water flow.

Current Resources and Land Management

The estimated land use pattern in the Mattole River watershed (Mattole Restoration Council 2005) is comprised of rural residential (32 percent), ranch (31 percent), industrial timberland (13 percent) and conservation (24 percent). Conservation lands include those managed by the U. S. Bureau of Land Management (USBLM), Sinkyone Wilderness State Park, Sanctuary Forest, and the North Coast Regional Land Trust. In addition to ownership and occupation of the land, human activities on the land directly and indirectly affect the quantity and quality of surface water because of the hydrologic connection of the land to the surface and ground water. The quality and quantity of aquatic habitat in the mainstem of the Mattole River, as well as its main

tributaries (North Fork Mattole, Upper North Fork Mattole, Mill Creek, Squaw Creek, Bear Creek, Thompson Creek, Honeydew Creek, and Bridge Creek) are affected by the varied land use activities.

The Mattole River Basin Assessment (Downie *et al.* 2003) divided the watershed into five sub-basin planning units (Estuary, Northern, Eastern, Southern, and Western) as an assessment scale upon which to conduct analyses of findings, form conclusions, and suggest improvement recommendations, and identified limiting factors for anadromous salmonids including, poor estuarine conditions, lack of habitat complexity, increased sediment levels, high water temperatures, and inadequate summer flows.

Overall, the current landscape is comprised of either small-diameter conifer forest, or hardwood-dominated forests that provide different ecological functions. Remaining late-seral conifer stands are fragmented and found largely on the public lands in the western and eastern basin. The HRC HCP has a requirement to maintain a minimum of 10 percent late-seral stands on covered lands until 2049 (HRC 2012); and HRC is also designating several late seral stands as "high conservation value forest," which will be protected as long as the company remains the landowner. The HCP includes mitigation strategies related to timber management, forest road construction and maintenance, and rock quarrying. The HCP includes land in the Mattole River watershed. The goals of the HCP are to achieve and move towards properly functioning aquatic conditions for anadromous salmonids within the management area covered by the HCP. To ensure habitat goals are met, the HCP relies heavily on watershed analysis, monitoring, and adaptive management tools. The Mattole Watershed Analysis Cumulative Effects Public review draft was completed in 2011.

The conservation ethic and natural resource protection efforts of Mattole residents has been recognized and financially supported by state and federal resource agencies and grant programs for many decades. Since 1985, the various groups within the Mattole River basin collectively have received over $9 million from the California Department of Fish and Wildlife's (CDFW) Fisheries Restoration Grants Program, and NOAA's Pacific Coast Salmon Recovery Fund, NOAA Restoration Center, and other sources. In addition, the State Water Resources Control Board has contributed significant funding to address water quality problems (*i.e.*, sediment and temperature impairments) in the watershed. In total, more than $15 million has been spent on restoration efforts within the Mattole River basin. Projects include barrier removal, road upgrade and removal, fisheries science, water quality monitoring, and stream bank stabilization.

The Mattole River and Range Partnership (MRRP), formed in 2002, is an unincorporated association of five local nonprofit organizations including the Mattole Restoration Council (MRC), the Mattole Salmon Group (MSG), the Middle Mattole Conservancy, the Mattole Fire Safe Council, and Sanctuary Forest, Inc., working together to develop an enhancement program for the watershed. MRRP members each take responsibility for different aspects of watershed management and recovery, working closely with county, state and Federal government partners.

The following plans and assessments have identified restoration opportunities and facilitated needed changes in land use practices to reduce impacts on aquatic habitat and yet maintain a working landscape:

- Mattole Estuary Restoration 5-Year Plan (USBLM 2013)
- Mattole Headwaters Streamflow Improvement Plan (Trout Unlimited *et al.* 2012);
- The Mattole Forest Futures Project (BBW Associates 2011);
- Mattole Coho Recovery Strategy (MRRP 2011)
- Mattole Integrated Coastal Watershed Management Plan (MRRP 2009b) ;
- The Mattole Watershed Plan (MRC 2005);
- King Range National Conservation Area Resource Management Plan (USBLM and EDAW 2004);
- Mattole River Watershed Assessment Report (Downie *et al.* 2003);
- Mattole River Total Maximum Daily Loads for Sediment and Temperature (USEPA 2003);
- Mill Creek Watershed Analysis (USBLM 2001);
- Honeydew Creek Watershed Analysis (USBLM 1996);
- Dynamics of recovery: a plan to enhance the Mattole estuary (MRC 1995);
- Bear Creek Watershed Analysis (USBLM 1995); and
- Elements of Recovery (MRC 1989).

Salmonid Viability and Watershed Conditions

Viability attributes of density and spatial structure for Chinook salmon adults were rated Fair based on the recent spawner surveys (MSG 2015). Smolt abundance was rated fair based on the status of Chinook salmon adults, which originate from smolts.

The following indicators were rated Poor through the CAP process for Chinook salmon adults: large wood frequency, percentage of staging pools, floodplain connectivity, and water quality (turbidity). For eggs, the spawning gravel quality indicator rated as Poor.

The following indicators were rated Poor through the CAP process for Chinook salmon pre-smolts: shelter rating, floodplain connectivity, water quality (turbidity), low flows and diversions, estuary condition, and water temperature.

The following indicators were rated Poor through the CAP process for smolts: shelter rating, water quality (turbidity and temperature), quality and extent of estuary, floodplain connectivity, gravel quality, and water flow.

Recovery strategies will typically focus on improving these habitat indicators, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the Mattole River watershed.

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Mattole River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Viability: Density, Abundance, and Spatial Structure

Relative to historic numbers and recovery targets, the numbers of spawning adults is likely above the depensation threshold but below the low-risk threshold, resulting in a "Fair" rating. Expression of diverse life history outmigration and rearing strategies of juvenile Chinook salmon is limited by the quantity and quality of both freshwater and estuarine habitat.

Hydrology: Baseflow and Passage Flows, and Redd Scour

The Hydrology has a Poor rating for pre-smolts and smolts due to impaired water flow in the spring and summer in the Mattole River tributaries and mainstem. Low flow conditions increase water temperatures and even leave some tributaries dry during the summer season, creating an inhospitable environment for rearing and reducing the overall summer rearing and migration habitat availability. The effect of this stress on these lifestages is most acute when natural low flow conditions of little or no rainfall during summer and fall months are exacerbated by high rural and residential water use during the same period. Low flows can result in stranding of individuals in disconnected pools, where high water temperature and low dissolved oxygen may become lethal. Isolation of individuals in shallow pools may result in increased risk of exposure to terrestrial predators. Reaches in the southern basin are particularly prone to seasonal drying. Gravel-scouring conditions rated as Fair for eggs, which is a function of watershed hydrology processes.

Sediment Transport: Road Density

Sediment transport is rated poor for watershed processes. High road densities within the Mattole River watershed are primarily associated with rural residences and timber harvest. The high density (2.26 miles/square mile) of roads within 100-meters of stream channels are of particular concern. Although significant efforts to decommission and upgrade roads have occurred on federal, county, and some private lands, road density on private lands remains high. Increased sediment delivery has filled pools, widened channels, and simplified stream habitat throughout the basin including the estuary. The widening of channels in the mainstem and major tributaries has likely exacerbated the rates of streambank failures and channel braiding.

Habitat Complexity: Percent Primary Pools and Pool/Riffle/Flatwater Ratios and Habitat Complexity: Large Wood and Shelter

Habitat Complexity conditions have Poor ratings. Available data indicate that there are not enough adult holding pools in the population area. Pool depths are generally poor to fair throughout most of the basin, with the exception of the headwaters region. Pool frequency varies widely, with most of the Very Good ratings occurring in the smaller tributaries of the southern basin. Accelerated delivery of sediment to Mattole River channels from roads and historic timber harvest activities have resulted in aggraded channels and shallow pools. This lack of complex overwintering habitat throughout much of the system may be a major factor in the population decline of Chinook salmon.

Sediment: Gravel Quality and Distribution of Spawning Gravels

The Mattole River is listed as sediment-impaired under section 303(d) of the Clean Water Act (USEPA 2003). Excessive fine sediment results in poor spawning habitat for adults, egg death, reduced velocity refugia for pre-smolts due to filling of pools, and reduced productivity of food organisms for pre-smolts and smolts. Gravel quantity rated poor for eggs, while the degree of embeddedness rated poor for eggs, pre-smolts and smolts and food productivity rated fair for pre-smolts and smolts.

Velocity Refuge: Floodplain Connectivity

The condition of Velocity Refuge has an overall rating of Fair for adults and Poor for pre-smolts. The primary indicator for this habitat attribute is availability and abundance of velocity refuge during periods of high flow. Velocity refugia are provided by physical features (*e.g.*, pools, large wood) discussed previously, as well as access to quality floodplain habitat. Adults lack sufficient pools and off-channel areas where they can rest while undergoing their spawning migration. Pre-smolts have insufficient areas of low or no velocity, where they would hold, adjacent to flowing water, from which they would feed.

Water Quality: Temperature

Water temperature has an overall rating of Fair for pre-smolts and smolts. The Mattole River is listed as temperature-impaired under section 303(d) of the Clean Water Act (USEPA 2003). Elevated stream temperatures in the summer and early fall are the result of multiple site-specific factors including reduction of riparian canopy and associated shade, low pool volumes due to excessive sedimentation, and low summer flows due to water diversions. The coolest water temperatures are found in the southern basin, near the community of Whitethorn, where headwater tributaries (Thompson, Mill, Bridge, and Buck creeks) consistently provide cold-water discharge to the mainstem Mattole. In the lower seven miles of the Mattole River, three primary tributaries provide cold-water inflow: Lower Mill Creek, which enters the Mattole at River Mile 2.8; Stansberry Creek at River Mile 1.3; and Lower Bear Creek at River Mile 1.0. Additional sources of cold water in the lower river include Collins Gulch, Jeffrey Gulch, Jim Goff Gulch, Titus Creek, and Tom Scott Creek, although most of these tributaries likely do not flow year-round. However, these tributaries may be sources of subsurface cold water to the mainstem providing some isolated pockets of cool water refugia.

Estuary: Quality and Extent

The pre-smolt and smolt lifestages are vulnerable to degraded estuarine habitat. Prior to major land disturbances which increased the volume of sediment delivery, the Mattole River estuary/lagoon was notable for its depth and numerous functioning slough channels on both the north and south banks of the river (MRC 1995). Currently, stored sediment in the mainstem and slough channels of the lower river has reduced both volume and complexity of habitat in the Mattole River estuary/lagoon, and riparian cover is lacking. Although formation of a sand bar across the mouth of the Mattole River is a natural phenomenon, the timing and duration of bar closure is also affected by legacy and current anthropogenic factors that influence the hydrology and streamflow into the estuary. Lack of access to the river can be a stressor to adults when this occurs. Although some smolts can become stranded in the estuary when the bar forms early, the vast majority make it through the estuary prior to bar formation in most years (Queener 2016). In the last ten years, numerous large, dead trees have been placed in the estuary, improving the complexity of rearing and holding habitat for smolts that pass through the lagoon as well as those that become trapped there. This improvement of habitat conditions in the estuary resulted in an overall rating of fair for the quality and extent of the estuary/lagoon.

Water Quality: Increased Turbidity

The condition of Water Quality: Turbidity has an overall Poor ranking for adults, pre-smolts and smolts. As described earlier, increased turbidity can result in behavioral responses to suspension

of sediments that may limit distribution, growth, and survival. Chronic high concentration of fine sediment in the water column, as well as degree of embeddedness of the substrate, can limit availability of epibenthic grazer and predator taxa of benthic macroinvertebrates, an important food source for salmonids.

Riparian Species Composition and Structure

Degraded riparian forest conditions exist across the basin. Riparian species composition was rated Fair for watershed processes. Streamside canopy cover is variable. Conditions in the southern tributaries are mostly very good, but elsewhere canopy cover exists in a range of conditions. Much of the streamside canopy is either hardwood dominated or of insufficient size to provide large wood. Widespread conversion of forests from conifer- to hardwood- dominant (*e.g.*, tanoak and madrone) has likely led to increased fire hazards throughout the basin, as dense hardwoods are prone to high intensity and rapid burns. However, larger and more intense wildfires that remove the hardwoods may, over the long-term, enhance development of conifer-dominated stands in riparian zones.

Very Good or Good Current Conditions

Passage/Migration: Physical Barriers

Passage/Migration: Physical Barriers have an overall rating of Very Good for adults, juveniles and smolts. Numerous culverts in the Mattole River watershed have been upgraded or replaced with bridges, and numerous projects are planned. Few man-made physical barriers (*e.g.*, culverts, dams) remain that restrict habitat; however, juvenile passage associated with water diversions remains a concern.

Landscape Patterns: Agriculture, Timber Harvest and Urbanization; Hydrology: Impervious Surfaces; Hydrology: Redd Scour

The percent of watershed utilized for Agriculture, Timber Harvest, and Urbanization conditions is low, resulting in an overall rating of Very Good, and Hydrology: Impervious Surfaces condition rates Very Good. For watershed processes, the ratings were a result of overall low density of residences, the relatively low amount of the watershed with impervious surfaces associated with urbanization, and the relatively low percentage of the watershed harvested for timber in the past 10 years.

Threats

The following discussion focuses on those threats that rate as High or Very High (see Mattole River CAP Results). Recovery strategies will likely focus on ameliorating High rating threats;

however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Mattole River CAP Results.

Severe Weather Patterns

This threat is rated High for eggs, pre-smolts, smolts, and adults. This threat is rated as Medium for watershed processes. The likely increased frequency of severe weather patterns relative to the past patterns (more frequent storms and increased rainfall in the winter, longer dry periods without rain in the spring, summer, and fall) pose a High threat to the Mattole River Chinook. Meteorological drought happens when dry weather patterns dominate an area. Hydrological drought occurs when low water supply becomes evident, especially in streams, reservoirs, and groundwater levels, usually after many months of meteorological drought[1]. Altered freshwater systems, due to increased air temperatures and changes in the timing, amount and type (*i.e.*, rain vs. snow) of precipitation, are a major climate induced ecosystem concern (Osgood 2008). The primary concerns center on altered streamflows and warmer temperatures affecting survival and passage through tributaries by reducing the available habitat, life history diversity and freshwater survival rates for juvenile salmonids.

Increased frequency and magnitude of flows from storms and flooding in the winter are likely to increase redd scour and may affect the quantity and quality of spawning gravels, and the amount and quality of pool habitat in many watersheds. Growth and survival of winter rearing juveniles without access to both instream and off-channel velocity refugia are likely decreased due to potential flushing from the system during flood flows. In addition, lack of access to the floodplain during high flows limits the opportunity for feeding on riparian invertebrates.

In the summer, stream reaches currently experiencing temperatures near the thermal maxima for juvenile salmonids may become uninhabitable, and currently habitable reaches may become thermally marginal. Rainfall patterns may or may not exacerbate water temperature problems. Areas subject to low summer flows may experience further summer flow decreases. Water withdrawals that are currently of limited impact on salmonids may increase in impact as streamflows diminish.

Water Diversions and Impoundments

This threat is rated Very High for pre-smolts and High for smolts. Currently, there are no large long-standing dams within the Mattole River watershed. However, concerns regarding irrigated

[1] http://www.ncdc.noaa.gov/climate-monitoring/dyk/drought-definition

agriculture and sub development of parcels could increase water demand and further reduce spring and summer streamflows. Additionally, future streamflow alterations could alter the hydrodynamics of the estuary during the summer months. Existing and future residential and agricultural development, including marijuana cultivation, should be prevented from reducing summer and spring baseflows or groundwater recharge to the extent that rearing habitat functions are impaired. Greater participation in programs to cease pumping when mainstem flows reach 0.7 cfs are likely to result in measurable increases in low summer streamflows (Sanctuary Forest Inc. 2014). An ongoing Sanctuary Forest forbearance program, where water is stored in tanks during the winter for spring and summer use, will continue to reduce the number of summer and spring water diversions. However, this program alone is likely not sufficient to eliminate this threat.

Roads and Railroads

Roads and railroads are rated as a High threat for Chinook salmon eggs, pre-smolts, smolts, and adults. Unpaved roads, unlike paved surfaces, serve as both conduits for water and sources of sediment. Because roads are a component of the human transportation system, standards for road construction and maintenance are under various jurisdictions depending on ownership and level of service. A 1993 inventory estimated 3,350 miles of active and abandoned roads in the Mattole basin, with 115 miles maintained by the county, 25 miles maintained by BLM, leaving 425 miles of active and 2,800 miles of abandoned roads that are not managed or maintained (NCRWQCB 2005). In addition to roads that account for approximately 76 percent of human-induced erosion, logging, conversion of forestland to pasture, and over grazing contribute to erosion and sedimentation of the streams in the watershed (NCRWQCB 2005). Fine sediment inputs from poorly built, improperly maintained, and abandoned roads will continue. Even with current logging road improvements and standards (rolling dips, rock surfaces, and road widths), legacy logging roads remain a threat to salmonid habitat quantity and quality throughout the Mattole River watershed. More efficient private and public road networks and decommissioning efforts on problem roads where feasible can prevent further Chinook salmon habitat degradation within the watershed.

Low or Medium Rated Threats

Logging and Wood Harvesting

Logging and wood harvesting are rated as Medium threat to Chinook salmon adults, eggs, pre-smolts, smolts, and watershed processes. Future management and recovery actions need to protect all salmonid habitat from degraded water quality conditions (turbidity and increased

temperature) associated with timber harvest, and ensure the continuation of watershed rehabilitation efforts.

Residential and Commercial Development

Residential and commercial development is rated as a Medium threat for adults, pre-smolts, smolts, and watershed processes, and Low for eggs. Because residences and businesses are connected by roads and will require water, planning and permitting of future development should insure that streamflows are not reduced and sediment delivery to streams is not accelerated.

Agriculture; Livestock Farming and Ranching: Fire, Fuel Management and Fire Suppression: Recreational Areas and Activities

For Chinook salmon, these threats are rated as Medium for adults, pre-smolts, and smolts. Regulation of land use activities under the Humboldt County General Plan, implementation of USDA Natural Resource Conservation Service best management practices, and preparation of updated fire plans, need to continue and include provisions to prevent erosion and maintain water quality.

Limiting Stresses, Lifestages, and Habitats

The most limiting stresses are a lack of channel complexity that results in insufficient pools and riffles, reduced cover, and reduced velocity refuge for pre-smolts and smolts. The egg lifestage is limited by elevated fine sediment that reduces survival to emergence in many spawning areas of the Mattole River. This sediment also results in chronic turbidity during the winter months when all pre-smolts and smolts are still in the river, reducing growth and survival of these life stages. Diversions result in reduced flow in the river in the summer months, leading to degraded habitat, including increased water temperature, and causing death of the pre-smolts and smolts present at that time.

General Recovery Strategy

Recovery strategies generally focus on improving instream habitat conditions and ameliorating stresses and threats, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions. The general recovery strategy for the Mattole River Chinook salmon population is discussed below with more detailed and site-specific recovery actions that provide the Implementation Schedule for this population. Implementation of recovery actions may integrate the outcome of past planning efforts (Downie *et al*. 2003; MRC 2005; MRRP 2009a and 2009b), *e.g.*, sub-basin

delineation, action prioritization, social capital of existing private/public partnerships, completed and ongoing habitat restoration and streamflow improvement projects. To insure that the recovery actions have the desired outcome of a self-sustaining population of Chinook salmon in the Mattole River, monitoring of the habitat indicators, as well as the fish populations, may be necessary. Creative partnerships will be the key to leveraging funding and habitat benefits.

Improve Estuary Habitat

Restore the physical and biological attributes of the estuary, including the north and south bank slough channels. Improve juvenile Chinook salmon rearing habitat for by increasing in-water structure and overwater cover. During dry years when estuarine lagoon is formed early and high water temperatures and increased predation are likely, consider feasibility of captive rearing of Chinook salmon pre-smolts.

Improve Late Spring and Summer Baseflow

Conduct outreach with landowners and residents to decrease diversion of ground and surface water during the late spring and summer months. Support research (*e.g.*, Mattole River Headwaters SIP) that focuses on improving groundwater recharge in tributary streams. Increase streamflow in the headwater regions by using regulatory mechanisms, developing a water budget, encouraging water conservation, and increasing participation in the forbearance program. Promote water conservation during low-flow periods. Consider feasibility of fish rescue and relocation or rearing. Use the streamflow improvement plans and streamflow thresholds for juvenile salmonid rearing habitat for the Mattole Headwaters Southern sub-basin (McBain and Trush 2012; Trout Unlimited *et al.* 2012) as a model for other sub-basins.

Improve Floodplain Connectivity

The floodplain should be reconnected to the channel in as many locations as possible. In particular, formation of velocity refuge for pre-smolts is vitally important, so that they may occupy areas of low or no velocity adjacent to areas of flowing water.

Improve Riparian Conditions

The approach to improving riparian conditions in the basin should focus on preventing further loss of riparian vegetation and on rehabilitating riparian areas that are currently in poor condition, which primarily occur in the inland subbasins of this watershed in areas where past land use and soil conditions result in insufficient substrate to support woody plants. As discussed

below, the recovery of riparian function will improve LWD recruitment, but is also expected to improve water quality with respect to stream temperatures for salmonid rearing.

Improve Instream Habitat Complexity

Improve large woody frequency across the Mattole River watershed. Riparian areas are in the process of recovery with stands of smaller diameter conifers that currently buffer stream areas. Addition of wood will provide much-needed complexity to the stream channel until riparian areas reach maturity and begin to recruit naturally to channels. Large wood will improve instream habitat attributes, *e.g.*, pool and riffle frequency and habitat complexity; provide important refuge from high flow events; and increase growth and survival of juveniles during winter and summer. Large wood will also lead to increased heterogeneity in instream habitat conditions, which can create access to hyporheic areas that form thermal refugia. Such areas can be important during the hot summer months when some small number of smolts remain in the river. Information from existing plans and from groups such as the Mattole Salmon Group should be utilized in determining high priority streams for large wood restoration projects.

Improve Substrate Quality

Continue efforts to reduce sediment delivery from existing and future roads, harvested timber areas, grazing areas, and agriculture. Over the past few decades, the Mattole Restoration Council's Good Roads Clear Creeks Program has been working systematically through the watershed to upgrade and reduce sediment sources (MRC 2012). Implement remaining road and other sediment reduction projects. Continue efforts to improve water quality by reducing erosion of streambanks from livestock grazing and off-road vehicle recreational activities.

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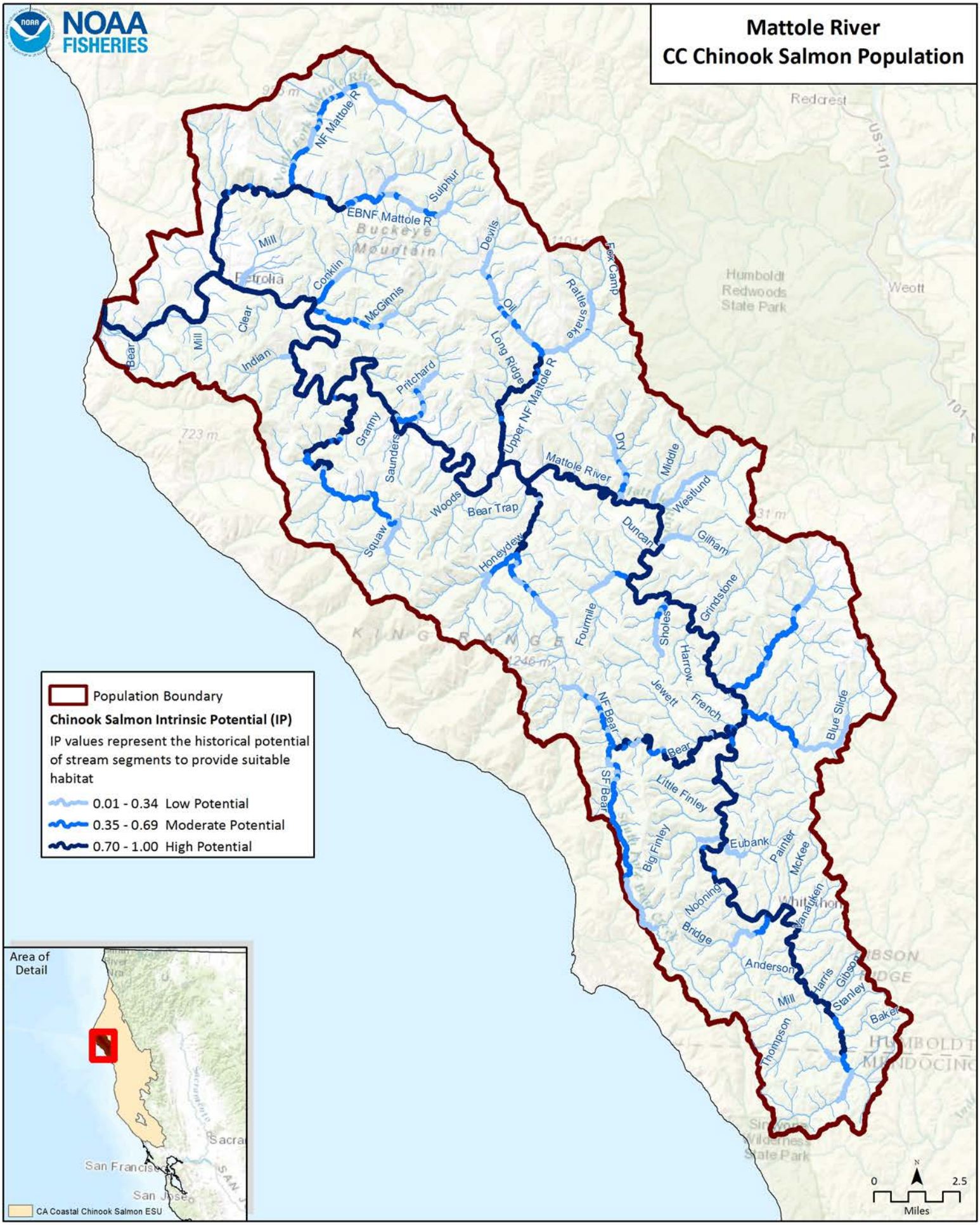
NOAA FISHERIES
Mattole River
CC Chinook Salmon Population
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Area of Detail
CA Coastal Chinook Salmon ESU
San Francisco
San Jose
Sacra
Redcrest
US-101
Weott
Humboldt Redwoods State Park
Petrolia
Buckeye Mountain
KINGS RANGE
Sinkyone Wilderness State Park
NF Mattole R
EBNF Mattole R
Sulphur
Mill
Conklin
McGinnis
Devils
Fox Camp
Rattlesnake
Oil
Long Ridge
Clear
Bear
Indian
Pritchard
Granny
Saunders
Upper NF Mattole R
Mattole River
Dry
Middle
Westlund
Woods
Bear Trap
Squaw
Honeydew
Duncan
Gilham
Grindstone
Fourmile
Sholes
Harrow
Jewett
French
NF Bear
Blue Slide
Bear
SF Bear
Little Finley
Big Finley
Eubank
Painter
McKee
Nooning
Whitlaken
Manatken
Bridge
Anderson
Harris
Gibson
Stanley
Mill
Baker
Thompson
0
2.5
Miles

CC Chinook Salmon Mattole River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	0% of streams/ IP-Km (>49% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% of streams/ IP-Km (>30% Pools; >20% Riffles)	Fair
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.17	Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-Km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	42.25% Class 5 & 6 across IP-km	Fair

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-Km to 74% of IP-km	Fair
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	45.4	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-Km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	68.12	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	14.71	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	29.15	Fair
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		1-20 Spawners per IP-Km	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	>90% of Historical Range	Very Good
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair

			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	19.57% (0.85mm) and >30% (6.4mm)	Poor
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	35% of streams/ IP-Km (>50% stream average scores of 1 & 2)	Poor
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	45.4	Fair
3	Pre Smolt	Condition	Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	74% of streams/ IP-Km (>49% average primary pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% of streams/ IP-Km (>30% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	25% of streams/ IP-Km (>80 stream average)	Poor
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.17	Good
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor

			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	>5 Diversions/10 IP km	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-Km or <16 IP-Km accessible*	Poor
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	45.4	Fair
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	35% of streams/ IP-Km (>50% stream average scores of 1 & 2)	Poor
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	<50% IP-Km (>6 and <14 C)	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-Km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	68.12	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	14.71	Fair

			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	29.15	Fair
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	>90% of Historical Range	Very Good
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	25% of streams/ IP-Km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	>5 Diversions/10 IP km	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-Km or <16 IP-Km accessible*	Poor
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	45.4	Fair
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	35% of streams/ IP-Km (>50% stream average scores of 1 & 2)	Poor
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	<50% IP-Km (>6 and <14 C)	Poor

			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-Km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	68.12	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	14.71	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	29.15	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.07% of Watershed in Impervious Surfaces	Very Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	0% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	7.35% of Watershed in Timber Harvest	Very Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	1% of watershed >1 unit/20 acres	Very Good

			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	2.96 Miles/Square Mile	Fair
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	2.39 Miles/Square Mile	Poor

CC Chinook Salmon Mattole River CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Medium	Low	Medium	Medium	Medium	Medium
2	Channel Modification	Medium	Low	Medium	Medium	Low	Medium
3	Disease, Predation and Competition	Medium		Medium	Medium	Medium	Medium
4	Fire, Fuel Management and Fire Suppression	Medium	Medium	Medium	Medium	Low	Medium
5	Fishing and Collecting	Medium		Low	Low		Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Low	Medium
8	Logging and Wood Harvesting	Medium	Medium	Medium	Medium	Medium	Medium
9	Mining	Medium	Low	Medium	Medium	Low	Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Low	Medium
11	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium
12	Roads and Railroads	Medium	High	Medium	Medium	Medium	Medium
13	Severe Weather Patterns	High	High	High	High	Medium	High
14	Water Diversion and Impoundments	Medium	Low	Very High	High	Medium	High

Mattole River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
MtR-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MtR-CCCh-1.1.1	Recovery Action	Estuary	Increase extent of estuarine habitat				
MtR-CCCh-1.1.1.1	Action Step	Estuary	Identify impaired areas of estuary and convert these areas to functioning tidal habitat.	2	2	BLM	
MtR-CCCh-1.1.1.2	Action Step	Estuary	Convert areas identified in plan to functioning tidal habitat.	2	5	BLM	
MtR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MtR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
MtR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Develop plans to recreate off-channel ponds, alcoves, and backwater habitat throughout watershed, including in lower river/estuary.	1	5	BLM	
MtR-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Recreate habitat guided by plans.	1	5	Private	
MtR-CCCh-2.1.1.3	Action Step	Floodplain Connectivity	Assess watershed for areas to reconnect the floodplain.	1	5	NGO	
MtR-CCCh-2.1.1.4	Action Step	Floodplain Connectivity	Re-connect the floodplain, guided by assessment.	1	20	BLM	
MtR-CCCh-2.1.1.5	Action Step	Floodplain Connectivity	Support efforts of using beaver dam analogs for floodplain reconnection and groundwater recharge.	2	2-	Private	
MtR-CCCh-3.1	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**				
MtR-CCCh-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
MtR-CCCh-3.1.1.1	Action Step	Hydrology	Ensure sub-division of existing parcels does not result in increased water demand during low-flow season.	2	10	Counties	
MtR-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MtR-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
MtR-CCCh-5.1.1.1	Action Step	Passage	Investigate alternatives and provide fish passage at the Bear Creek/Lighthouse Road crossing.	2	5	County	
MtR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MtR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
MtR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Develop prescription to manage riparian forests to promote late-seral characteristics while maintaining bank stability and existing shade	3	50	NGO	
MtR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Plant conifers as guided by prescription.	3	20	NGO	
MtR-CCCh-6.1.1.3	Action Step	Habitat Complexity	Thin from below, or release conifers, guided by prescription.	3	10	Private	
MtR-CCCh-6.1.2	Recovery Action	Habitat Complexity	Increase large wood frequency throughout watershed, including in lower river/estuary.				
MtR-CCCh-6.1.2.1	Action Step	Habitat Complexity	Assess habitat to determine location and amount of instream structure needed, and add structure guided by assessments.	2	5	NGO	
MtR-CCCh-6.1.2.2	Recovery Action	Habitat Complexity	Improve pool/riffle/flatwater ratios (hydraulic diversity)				
MtR-CCCh-6.1.2.3	Action Step	Habitat Complexity	Implement actions to increase the frequency of pool habitats.	2	10	NGO	
MtR-CCCh-6.2	**Objective**	**Habitat Complexity**	**Address the inadequacy of existing regulatory mechanisms**				
MtR-CCCh-6.2.1	Recovery Action	Habitat Complexity	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
MtR-CCCh-6.2.1.1	Action Step	Habitat Complexity	Reduce removal of instream large wood (i.e., wood poaching)	2	10	NPS, CDFW, County	
MtR-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MtR-CCCh-7.1.1	Recovery Action	Riparian	Remove invasive plant species and replace with native species.				

Mattole River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
MtR-CCCh-7.1.1.1	Action Step	Riparian	Remove invasive species that inhibit establishment of native riparian vegetation.	3	20	NGO	
MtR-CCCh-7.1.1.2	Action Step	Riparian	Plant native riparian species in open areas.	3	25	NGO	
MtR-CCCh-7.1.2	Recovery Action	Riparian	Restore riparian vegetation				
MtR-CCCh-7.1.2.1	Action Step	Riparian	Develop a comprehensive riparian restoration plan focused on areas where woody plants lack suitable substrate for establishment (on larger tributaries and on the lower mainstem)	3	2	CDFW, NGO, NMFS	
MtR-CCCh-7.1.2.2	Action Step	Riparian	Plant trees, guided by restoration plan	3	5	CDFW, NGO, NMFS	
MtR-CCCh-7.2	**Objective**	**Riparian**	**Address the inadequacy of existing regulatory mechanisms**				
MtR-CCCh-7.2.1	Recovery Action	Riparian	Restore riparian vegetation				
MtR-CCCh-7.2.1.1	Action Step	Riparian	Reduce detrimental environmental impacts of conversion of TPZ land to other uses.	2	10	NMFS, Calfire, BOF	
MtR-CCCh-7.2.1.2	Action Step	Riparian	Work with Calfire and BOF to minimize the number of conversions per landowner	2	10	NMFS, Calfire, BOF	
MtR-CCCh-7.2.1.3	Action Step	Riparian	Institute environmental review as part of TPZ conversions	2	10	Calfire, BOF	
MtR-CCCh-7.2.1.4	Action Step	Riparian	Work to ensure detrimental effects of activities on converted areas are minimized.	2	10	NMFS, Calfire, BOF	
MtR-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MtR-CCCh-8.1.1	Recovery Action	Sediment	Improve quantity and distribution of spawning gravels				
MtR-CCCh-8.1.1.1	Action Step	Sediment	Assess potentially large inputs of fine sediments that are imminent and will affect occupied areas (i.e. failing banks, failing culverts, failing roads)	2	5	NGO, agency	
MtR-CCCh-8.1.1.2	Action Step	Sediment	Develop and implement plan to prevent large, imminent inputs of fine sediments that will affect areas occupied by Chinook salmon (i.e., failing banks, failing culverts, failing roads).	2	5	NGO, agency	
MtR-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MtR-CCCh-10.1.1	Recovery Action	Water Quality	Prevent or minimize impairment to water quality (instream water temperature)	3			
MtR-CCCh-10.1.1.1	Action Step	Water Quality	Identify areas in need of more shade, describe timber management methods that will increase shade over time, and implement methods in identified areas.	3	10	CDFW	
MtR-CCCh-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MtR-CCCh-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (instream water temperature)				
MtR-CCCh-12.1.1.1	Action Step	Agriculture	Assess effects (e.g., flow, water quality) of marijuana cultivation.	1	20	NMFS	
MtR-CCCh-12.1.1.2	Action Step	Agriculture	If needed, develop plan to reduce effects of marijuana cultivation.	1	20	NMFS	
MtR-CCCh-12.1.1.3	Action Step	Agriculture	Implement plan.	1	20	NMFS	
MtR-CCCh-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MtR-CCCh-18.1.1	Recovery Action	Livestock	Prevent or minimize impairment to water quality (instream water temperature)				
MtR-CCCh-18.1.1.1	Action Step	Livestock	Identify areas where livestock have access to riparian vegetation and develop plan to fence livestock from areas.	2	10	NRCS, RCD	
MtR-CCCh-18.1.1.2	Action Step	Livestock	Install fence, guided by plan.	2	5	Private	
MtR-CCCh-19.1	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
MtR-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize landscape disturbances				

Mattole River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
MtR-CCCh-19.1.1.1	Action Step	Logging	Amend California Forest Practice Rules to include regulations which describe the specific analysis, protective measures, and procedure required by timber owners and CalFire to demonstrate timber operations described in timber harvest plans meet the requirements.	3	50	CalFire	
MtR-CCCh-19.1.1.2	Action Step	Logging	Apply BMPs for timber harvest	3	100	Private	
MtR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of habitat or range**				
MtR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
MtR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Identify and prioritize existing roads that are no longer necessary for silvicultural operations.	3	10	NGO	
MtR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Assess streamside roads and prioritize sites for relocation.	3	10	NGO	
MtR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Maintain roads, guided by assessment.	3	25	Private	
MtR-CCCh-23.1.1.4	Action Step	Roads/Railroads	Upgrade roads, guided by assessment.	3	5	Private	
MtR-CCCh-23.1.1.5	Action Step	Roads/Railroads	Develop plan to decommission roads.	3	10	NGO	
MtR-CCCh-23.1.1.6	Action Step	Roads/Railroads	Decommission roads throughout watershed guided by the plan.	3	5	Private	
MtR-CCCh-23.1.1.7	Action Step	Roads/Railroads	Relocate roads away from unstable land features.	3	20	Private	
MtR-CCCh-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
MtR-CCCh-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
MtR-CCCh-23.2.1.1	Action Step	Roads/Railroads	Develop grading ordinance for maintenance and building of private roads that minimizes the effects to Chinook.	3	5	County	
MtR-CCCh-25.1	**Objective**	**Water Diversion/Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
MtR-CCCh-25.1.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (stream flow)				
MtR-CCCh-25.1.1.1	Action Step	Water Diversion/Impoundment	Review authorized diversions for opportunities to increase instream flow during summer low flow period.	2	50	SWRCB	
MtR-CCCh-25.1.1.2	Action Step	Water Diversion /Impoundment	Provide incentives to reduce diversions during the summer.	2	10	CDFW, SWRCB	
MtR-CCCh-25.1.1.3	Action Step	Water Diversion/Impoundment	Identify unauthorized diversions.	2	10	SWRCB	
MtR-CCCh-25.1.1.4	Action Step	Water Diversion/Impoundment	Enforce existing regulations to cease unauthorized diversions.	2	10	CDFW, RWQCB, SWRCB	
MtR-CCCh-25.1.1.5	Action Step	Water Diversion/Impoundment	Create water budgets to avoid over-allocating water diversions.	2	10	CDFW, RWQCB, SWRCB	
MtR-CCCh-25.1.2	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (stream flow)				
MtR-CCCh-25.1.2.1	Action Step	Water Diversion/Impoundment	Establish a forbearance program, using water storage tanks to decrease diversion during periods of low flow.	2	10	CDFW, RWQCB, SWRCB	
MtR-CCCh-25.1.2.2	Action Step	Water Diversion/Impoundment	Implement forbearance program.	2	10	CDFW, RWQCB, SWRCB	

Mattole River Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
MtR-CCCh-25.1.2.3	Action Step	Water Diversion/Impoundment	Monitor forbearance compliance and flow.	2	5	CDFW, RWQCB, SWRCB	

Redwood Creek Population

CC Chinook Salmon Fall-Run

- Role within ESU: Functionally Independent Population
- Diversity Stratum: North Coastal
- Spawner Abundance Target: 3,400 adults
- Current Intrinsic Potential: 116.1 IP-km

For information regarding NC steelhead and SONCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the SONCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

Various monitoring programs are used to estimate Chinook salmon abundance and distribution within the Redwood Creek watershed. Since 2000, CDFW has operated a juvenile out-migrant trap in the middle portion of mainstem Redwood Creek at river mile 34 (known as the upper trap), and since 2004 CDFW has also operated a juvenile outmigrant trap in the lower portion of mainstem Redwood Creek at river mile 4 (known as the lower trap). A juvenile outmigrant trap has also been in operation since 2011 in Prairie Creek, near its confluence with mainstem Redwood Creek, previously (years 1998 to 2001) the trap was located near the middle of Prairie Creek. Seining also occurs in the estuary from June to October each year to estimate population abundance. Spawner surveys have been conducted in Prairie Creek since 1999, and in the entire basin since 2009. A dual frequency identification sonar (DIDSON) unit has also been in mainstem Redwood Creek from 2009 to the present to help determine adult abundance by using sonar imagery to estimate the number of fish migrating past the unit.

Monitoring results vary annually and by program. Ricker (2011b; 2011a) conducted spawning surveys and carcass counts in the Redwood Creek basin in 2009-2010 (November to March) and 2010-2011 (November to April). In the 2009-2010 field season they observed no live Chinook salmon (but 35 unidentified live fish), 23 Chinook salmon carcasses, and 158 identified or predicted Chinook salmon redds. In the 2010-2011 field season they observed 234 live Chinook salmon spawners, 36 Chinook salmon carcasses, and 334 identified or predicted Chinook salmon redds (Ricker 2011a; Ricker 2011b). Multiplying each redd by the common conversion factor of 2.5 adults would give a population estimate of 395 to 835 adults, respectively. However, since Chinook salmon are mainstem spawners, water may be too turbid to survey accurately, redds can be covered with sediments in between redd surveys, and redd counts can underestimate the total population of Chinook salmon adults. In addition, the Chinook salmon redd surveys were

conducted under the GRTS coho salmon frame, and did not cover all spawning areas used by Chinook salmon.

DIDSON has been used since 2009 to the present 2015-2016 season to estimate escapement of adult salmonids entering Redwood Creek to spawn (Metheny 2012). Although numerous issues still need to be addressed with using DIDSON to estimate escapement, including differentiating between migrating adults of different species with overlapping run timing, Metheny (2012) estimated that in the 2009 to 2010 season between 2,318 and 2,444 adult Chinook salmon entered Redwood Creek (includes Prairie Creek) to spawn, considerably higher than estimates of the adult population derived from redd counts. During the 2013 to 2014 fall and winter season, Sparkman (M. Sparkman, CDFW, personal communication, 2015) estimated that 3,487 adult Chinook salmon entered lower Redwood Creek to spawn in the basin.

Population abundance estimates for age 0+ Chinook salmon in lower Redwood Creek vary by year, from a high in 2013 of 566,859 to a low of 85,149 in 2006 (percentage of smolts ranged from 66 to 100 percent). The average abundance of 0+ Chinook salmon in lower Redwood Creek from 2004 to 2014 is 232,866. Abundance at all outmigrant traps in the basin peaked in 2013, with an estimated population abundance of 663,373 total 0+ Chinook salmon, of which an estimated 497,698 were smolts. The abundance of 1+ Chinook salmon in year 2012 equaled 64 individuals, and indicated for the fourth consecutive year that yearling Chinook salmon are relatively rare in Redwood Creek (Sparkman 2013). Average abundance for 1+ Chinook salmon over years 2009 – 2012 equaled 103 individuals (Sparkman 2013). Based on outmigrant monitoring in lower Redwood Creek, the mean population estimate for 0+ Chinook salmon from 2005 to 2012 was 145,772, and most of these age 0+ juveniles were smolts (81 percent).

Sparkman has also trapped outmigrants at the mouth of Prairie Creek from 2011 to 2014, with population estimates for 0+ Chinook salmon from Prairie Creek ranging from 15,148 in 2011 to 96,817 in 2013 (M. Sparkman, CDFW, personal communication, 2015). The trap on lower Redwood Creek is located at approximately river mile 4, upstream of the confluence with Prairie Creek, which is located at approximately river mile 3, therefore, we combine information from both traps to derive a smolt estimate for Chinook salmon for the entire population. Combining the recent smolt estimates for lower Redwood and Prairie creeks, we estimate that the total smolt population in 2011 was 133, 901; in 2012 was 210,483; in 2013 was 497,698; and in 2014 was 146,539 (M. Sparkman, CDFW, personal communication, 2015). Using a common but approximate estimate of ocean survival of 1 percent, would give an adult population estimate ranging from 1,335 adult Chinook salmon to 4976 adults, which is greater than the estimate based on redd counts, and closer to the recent DIDSON derived estimates of adult abundance (i.e., between 2,218 to 3,487 adult Chinook salmon). May and June were the most abundant months, on average for

the past six years, for age 0+ Chinook salmon emigration at the lower trap (Sparkman 2010). Timing of outmigration varies and can peak in April and in summer, with fry migrating earlier than fingerlings.

Estimates of the historical abundance of Redwood Creek Chinook salmon range from 5,000 (CDFG 1965 as cited in Good et al. 2005) to 1,000 adults (Wahle and Pearson 1987). These are estimates based on professional opinion and evaluation of habitat conditions, not on rigorous field sampling (Good *et al.* 2005), but are presented here for comparison with more recent abundance estimates.

Chinook salmon are distributed throughout the Redwood Creek basin and occupy most of their historic habitat throughout the basin. Chinook salmon spawn in upper, middle, and lower Redwood Creek mainstem, Redwood Creek tributaries, and Prairie Creek and its tributaries, primarily between November and February (Ricker 2011a, 2011b).

History of Land Use

The Redwood Creek basin reflects a long legacy of watershed disturbance, primarily through intensive timber harvest and associated road building, the construction of flood control levees and through conversion of wetlands and bottom lands to agricultural production. Timber harvest cleared the majority of floodplain and valley bottom areas within the basin by the latter half of the nineteenth century. Commercial timber harvest within the greater watershed started in the 1930s. Several upper slopes and ridge tops were logged by 1936, and by 1948 approximately 6 percent of the watershed had been harvested (Best 1995). From 1949 to 1954, approximately 27 percent of the original forested land and 22 percent of the watershed was harvested with the majority of harvest occurring in the upper and middle watershed. From 1955 to 1962, approximately 15 percent of the watershed was logged with a larger portion from within the lower watershed. The 1966 aerial photos showed that approximately 55 percent of the original coniferous forests were logged from 45 percent of the drainage (Best 1995). Unfortunately, the majority of the 1963 to 1966 harvest within the upper watershed occurred within the Redwood Creek inner gorge and its steeper tributaries. This required the construction of numerous roads and tractor yarding trails that significantly increased the frequency and magnitude of landslides during the December 1964 flood. The sediment mobilized from the 1964 flood significantly aggraded much of Redwood Creek and its tributaries, resulting in wide and shallow, simplified stream habitat with a lack of pools and instream structure.

From 1966 to 1970, logging continued at a similar rate, with tractor logging the primary yarding method. By 1970, nearly 65 percent of the original coniferous forest or 53 percent of the watershed

was logged. As old-growth forests declined in the 1970s, commercial companies began re-entering previously harvested areas to remove residual old-growth from previously logged areas. At the end of Best's (1995) study period in 1978, over 80 percent of the original forests were logged, or 66 percent of the watershed. The aerial photos show that nearly 69 percent of the original forests in the lower watershed, 92 percent in the middle watershed, and 81 percent in the upper watershed, or 66, 73, and 59 percent of the respective watershed areas were logged in a 42 year period, coinciding with the five largest floods in Redwood Creek.

In 1978, Redwood National Park was expanded from the narrow strip of old growth redwood along the lower one-third of mainstem Redwood Creek that was the original Park dating from 1968, and logging ended within the lower watershed that is protected as National and State Park lands (*i.e.,* the lower one-third of the watershed, and most of the Prairie Creek subwatershed are park lands, approximately 44 percent of the basin is Federal or state land). The expanded National Park contains much of the land that was extensively logged, and the Park is actively restoring its landscape by removing roads and engaging in restoration of its second growth forests.

Approximately 56 percent of the basin is private land, and commercial timber companies and small ranch and timber land owners continue to harvest timber on a rotational basis throughout the upper and middle watershed areas (approximately the upper two-thirds of the watershed are privately owned). Timber harvest practices of today are regulated by the California State Forest Practice Rules in general, and since 2006, lands owned by Green Diamond Resource Company have been managed under an Aquatic Habitat Conservation Plan (AHCP) (GDRC 2006). The AHCP contains many elements that will improve aquatic habitat over time, including an intensive geologic review program for unstable lands and a road decommissioning and upgrading program, both designed to reduce sediment inputs. However, many of the effects of intensive, historic timber harvest practices, such as reduced riparian shading, reduced large wood inputs to the streams and increased sediment inputs, continue to influence the habitat found today in the Redwood Creek basin.

Following post-European human settlement into the Redwood Creek floodplain and subsequent flooding in the town of Orick during the 1953, 1955, and 1964 high flows, the Corps constructed two earthen embankment flood control levees with riprap slope protection and associated infrastructure (*e.g.,* relief wells, flap gates, drains) on either side of the lower mainstem channel of Redwood Creek. The levees were constructed from 1966 to 1968, and confined Redwood Creek for 3.4 miles from the estuary upstream past the confluence of Prairie Creek. Prior to levee construction the Corps sent a report on their plans for construction of a flood control project in Redwood Creek and a request for comments from various Federal and state agencies. Both the

U.S. Fish and Wildlife Service (USFWS) and California Department of Water Resources (DWR) expressed numerous concerns regarding the impacts of the proposed flood control project on fish (CDWR 1961; USFWS 1961), including effects on riparian vegetation and pool habitat.

The constructed flood control channel followed the existing Redwood Creek channel alignment, except sections were straightened and the last meander was cut-off and now forms the South Slough. The levees were extended into the estuary, approximately 2,000 feet beyond the preliminary designs (Ricks 1995), in a mostly theoretical attempt to flush sediment to the ocean during high flows, which has not worked, as sediment deposits in the estuary (NHE 2010). Recent analysis (NHE 2010) has determined that design flaws (*e.g.*, channel bed elevation set below grade and without enough channel gradient) of the original flood control project encourage sediment deposition rather than sediment transport. In addition, the design flow of 77,000 cfs, which was at the time of construction thought to be a return interval flood of 250 years, is now known to be a flood return interval flood of approximately 2,000 to 4,000 years. Considering the design flaws, the sediment transport rates in Redwood Creek, and habitat needs within the flood control project, the original flood control project design did not consider the geomorphic and ecological effects of the trapezoidal channel or the long-term maintenance (*i.e.*, riparian vegetation and gravel removal) needs. Levee construction has disconnected the channel from its floodplain, tributaries, sloughs and off-channel winter rearing habitat, prevents channel migration and creation of new habitat, and has greatly impacted estuarine function (Cannata *et al.* 2006) for rearing Chinook salmon and steelhead.

In summary, these historic land uses have combined to produce simple instream habitat in much of the mainstem of Redwood Creek and its tributaries and estuary, with reduced availability of shelter, cover, shade, off-channel low velocity areas, pools, and an estuary that is much reduced in size, complexity and function from historic conditions. In contrast, much of the Prairie Creek subwatershed contains habitat in good condition, and provides valuable refugia habitat for listed salmonids.

Current Resources and Land Management

As noted above, about 44 percent of the basin is Federal or state land, with most of that being managed by Redwood National and State Parks (RNSP) with the goals of restoring and preserving the natural landscape. The remaining 56 percent of the basin is privately held, with most of the private land owned by commercial timber companies. The Green Diamond Resource Company is the largest private landowner in the basin and manages approximately 33,038 acres in the Redwood Creek watershed under their AHCP. The Redwood Creek Watershed Group (RCWG) has been active for about 10 years, has authored an integrated watershed strategy,

promotes partnerships for habitat restoration and grant funding, and continues to meet quarterly to bring together various partners and efforts within the basin. The following are pertinent reports or plans for the Redwood Creek basin:

- NMFS Recovery Plan for SONCC Coho Salmon, Final (NMFS 2014);
- Redwood Creek Integrative Watershed Strategy (RCWG 2006);
- Redwood Creek Watershed Assessment (Cannata *et al.* 2006);
- Redwood National Park Land and Resource Management Plan (NPS 2000);
- Green Diamond Resource Company AHCP (GDRC 2006); and
- Recovery Strategy for California Coho Salmon (CDFG 2004).

Salmonid Viability and Watershed Conditions

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Redwood Creek CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Velocity Refuge: Floodplain Connectivity

Lower Redwood Creek has been disconnected from its floodplain by the construction of flood control levees, which limit access to low gradient, off-channel rearing habitat (including tributaries, sloughs and wetlands) in the depositional area of mainstem Redwood Creek. In addition, roads limit floodplain connectivity in other low gradient stream sections, and much of the mainstem of Redwood Creek flows through a relatively narrow watershed with inner gorges and steep slopes adjacent to the stream channel. The quality of floodplain habitat has also been reduced by conversion to agriculture adjacent to lower and middle sections of Redwood Creek. Velocity Refuge: Floodplain connectivity condition has a rating of Poor for pre-smolts and smolts.

Estuary: Quality and Extent

The Redwood Creek estuary was once a large and diverse habitat area that was essential for diversity and productivity of all Redwood Creek salmonid populations. Since 1968, flood control levees have bisected the estuary, which has disconnected the channel from sloughs, wetlands, tributaries and secondary channels, and has reduced the spatial area of the Redwood Creek estuary by over 50 percent (Ricks 1995). Currently, rearing habitat within the estuary and transition zone is simplified, with little cover, shelter, or access to off-channel areas. In addition, diversion culverts in the south levee limit access to the South Slough and Strawberry Creek, two of the remaining off-channel habitats in the estuarine area (which also include North Slough and

Sand Cache Creek, which are blocked by sand deposition and reed canary grass much of the year). Specifically, the diversion culverts are closed during winter and spring, limiting access to habitat that provides shelter from high water velocities. However, the south levee culverts were constructed to increase fish access and water quality in the South Slough by creating a second point for water exchange in addition to the existing South Slough outlet channel into the estuary at the end of the south levee. If the culverts are left open during winter and early spring, river derived sediment would deposit in the South Slough further decreasing habitat access. Fish are still able to access the South Slough and Strawberry Creek during certain flows when the South Slough is connected to the most downstream portion of the estuary, or when the gates are open, as evidenced by a coho juvenile that was PIT tagged in Prairie Creek in October 2015 and found in Strawberry Creek in late December. RNSP is working to refine the operations of the south levee culverts to maximize fish access to off-channel areas and to minimize sediment deposition within the South Slough.

Low dissolved oxygen and warm water temperatures are also an issue in the estuary and South Slough, and the operation of the diversion culverts may aggravate already poor water quality. Since Chinook salmon juveniles are dependent on extended estuarine rearing to provide growth that maximizes ocean survival, and to provide a diversity of out-migration timing which also increases ocean survival, the reductions in the quality and spatial area of the estuary results in a condition rated as Poor for smolts and for pre-smolts.

Water Quality: Temperature

High summer water temperature is a significant problem throughout most of the population area, especially in the middle and upper sections of mainstem Redwood Creek. Impaired water temperatures are rated as a Poor condition for smolts, and pre-smolts, particularly in the closed estuary, and since emigration timing varies and continues into summer months. Redwood Creek is listed as temperature impaired under section 303d of the Clean Water Act. High summer water temperatures in mainstem Redwood Creek, including the estuary, is one of the factors limiting salmonid production in the basin (Cannata *et al.* 2006; Sparkman 2006). Summer water temperature increases from the headwaters of Redwood Creek to the lower-middle section within Redwood National Park, then water temperatures gradually decrease as the river approaches the Pacific Ocean, as measured during a thermal infrared imaging flight during the summer of 2003. The middle section of Redwood Creek basin contains summer water temperatures with maximum weekly maximum temperatures (MWMT) ranging from 23 to 27°C. The Park has monitored water temperature of tributaries and mainstem Redwood Creek locations since the 1990s. In 2014, between May 22 and October 12, mainstem water temperature was measured upstream of the Tall Trees Grove within Redwood National Park. For the period July 1 through August 31, the average water temperature was 20.5°C, the maximum 24.1°C, and the minimum

17.9°C. The maximum weekly average temperature (MWAT) was 21.2°C, and the maximum weekly maximum temperature (MWMT) was 23.8°C. During the July 1 - August 31 period, the water temperature was at or greater than 18°C 99.9 percent of the time (NPS 2014).

Madej *et al.* (2006) describes the middle section of Redwood Creek as the "hot zone", and notes that channel aggradation and widening, combined with the removal of large riparian conifers has played a role in increasing summer water temperatures. Sparkman (2012) has also monitored water temperatures at the upper smolt trap in the middle section of Redwood Creek since 2000. The average daily (24 hour period) stream temperature from March 25, 2014 to August 7, 2014 was 15.6 degrees C (or 60.1 degrees F) (95% CI = 14.9 – 16.3 degrees C), with daily averages ranging from 7.8 to 22.3 degrees C (46.0 – 72.1 degrees F). Median daily stream temperature during this time frame equaled 15.4 degrees C (or 59.7 degrees F). The maximum stream temperature for 2014 occurred on July 31, and equaled 26.3 degrees C (79.3 degrees F). Average stream temperature for the 2014 study year (truncated for equal comparisons with pervious study years) equaled 15.5 degrees C (59.9 degrees F). Average daily stream temperatures during the trapping periods did not statistically change over time (years).

Madej *et al.* (2006) also reports that the greatest thermal complexity occurs in lower Redwood Creek upstream of the leveed reach, within the area where Redwood Creek flows within a narrow watershed with inner gorges and steep slopes adjacent to the stream channel, within Redwood National Park. In this reach, Madej *et al*. (2006) measured with thermal infrared imaging many cool springs, seeps, side channels and tributaries. Lower Prairie Creek, other tributary streams, and lower Redwood Creek, close to the ocean and within the temperate, summer fog belt, have lower temperatures relative to middle and upper Redwood Creek, but lower Redwood Creek is still warmer than the preferred temperature range of salmon and steelhead, causing stressful conditions for rearing juvenile salmonids, including Chinook salmon that mostly outmigrate as 0+ juveniles and are dependent upon the estuary and lower river to gain size needed for ocean survival. Water temperatures in Redwood Creek were monitored by Sparkman (2009) at the lower out migrant trap (river mile 4) during April through July for the period 2004 through 2008. During that time, the maximum weekly average temperature (MWAT) and MWMT ranged from 18.2 to 19.3°C and 21.1 to 22.7°C, respectively. In contrast, the optimum temperature range for rearing Chinook salmon is 10 – 15.6°C (USEPA 1999).

Viability: Density, Abundance, and Spatial Structure

Viability conditions have an overall rating of Fair for adults, pre-smolts and smolts. Although information from out-migrant monitoring in 2013 indicates improved abundance of presmolt and smolt Chinook salmon lifestages, longer term data show that reduced abundance and diversity of Chinook salmon are acting as a stress to the population (M. Sparkman, CDFW, personal

communication, 2015). Based on out-migrant monitoring in lower Redwood Creek, the average population estimate for age 0+ Chinook salmon from 2005 to 2012 is 145,772 juveniles, and most of these age 0+ juveniles were smolts (81 percent). Estimates of adult abundance range from 395 spawners, which is based on spawning surveys (Ricker 2011a, 2011b) to 2,444 spawners, based on DIDSON estimates (Metheny 2012), to a more recent DIDSON estimate of 3,487 (M. Sparkman, CDFW, personal communication, 2015), to a low and high of 1,339 to 4,976 adults using smolt abundance estimates with an estimated ocean survival of 1 percent. However, as already described, since Chinook salmon are mainstem spawners, redds can be covered with sediments in between redd surveys and redd counts can underestimate the total population of Chinook salmon adults. In addition, smolt estimates vary greatly by year, and ocean survival is estimated. Thus, Chinook salmon population abundance is above the depensation level of 114 spawners, but most likely below the spawner target level of 3,400 for this population, on average. The spatial structure of the Chinook salmon population is mostly intact and passage and migration are rated as Very Good for this population, but expression of juvenile life history diversity is negatively influenced by the poor condition of the estuary. In addition, loss of a Chinook salmon spring-run in Redwood Creek contributes to decreased diversity (M. Sparkman, CDFW, personal communication, 2015).

Sediment: Gravel Quality and Distribution of Spawning Gravels

Sediment conditions have an overall rating of Fair for adult, eggs, pre-smolt, and smolt lifestages. The Fair sediment rating for Chinook salmon reflects the species' more limited distribution and less freshwater residency when compared with the Poor sediment rating described for steelhead. Redwood Creek has naturally high sediment loads, which have been increased by past logging, landslides, and road building (Best 1995). Due to instream gravel mining for flood control in lower Redwood Creek and timber harvest activities in the rest of the basin, stream particle size has decreased in parts of the basin. Smaller particle sizes do not offer presmolt Chinook salmon the velocity refuge that is needed for shelter during higher winter flows. In addition, the increase in fine sediment decreases the productivity of food for presmolt Chinook salmon and also make redds more prone to scour during flood flows, negatively affecting eggs of both populations.

Water Quality: Turbidity or Toxicity

Water Quality: Turbidity conditions have an overall Poor rating for adults, pre-smolts and smolts. However, this stress has been declining in recent years as the watershed heals from past logging and road building. Klein and Anderson (2011) documented shifts in the fine and course sediment budgets of Redwood Creek at the Orick gage. There is a decrease in annual bedload and suspended sediment loads when comparing the time period 1954 to 1974 to the time period 1975 to 2009. The higher sediment loads during the 1954 to 1974 period were caused by extensive logging and road building in a watershed with steep terrain and highly sheared and fractured

rocks during a period of large storms and floods. Several researchers (Harden 1995; Kelsey *et al.* 1995; Madej and Curren 2009; Madej and Ozaki 2009) documented the substantial increase in hillslope sediment erosion and stream channel sediment deposition following the extensive legacy logging and road building during the 1950s to 1970s. Other researchers (Madej and Ozaki 1996) have also documented the extensive sediment deposition and its long-term migration through Redwood Creek's channel. In addition to increased turbidity levels, recent monitoring conducted in summer of 2010 by RNSP shows low dissolved oxygen levels in the Redwood Creek estuary and South Slough.

Riparian Vegetation: Composition, Cover & Tree Diameter and Habitat Complexity: Percent Primary Pools and/or Pool/Riffle/Flatwater Ratios, and Large Wood and Shelter

Riparian Vegetation: Composition and conditions have a Poor rating for pre-smolt. The conversion of riparian areas to agriculture, the construction of flood control levees, and riparian vegetation removal for flood control in the leveed reach of Redwood Creek have altered riparian species composition within the basin. In addition, past harvest of coniferous trees within the riparian zone during logging has also altered riparian composition and the current riparian zones contain fewer coniferous trees, and in the case of Redwood Creek within the Orick valley, little riparian vegetation remains. Throughout much of the watershed riparian vegetation is dominated by hardwood species and young conifers, which will take many years to grow in order to provide functional, large pieces of instream wood. However, the 1968 original park boundaries protected much of the old growth streamside riparian forest in lower-middle mainstem Redwood Creek within the park.

The combination of an aggraded and widened channel, and lack of large wood supply has led to flatwater habitat (neither pool nor riffle), which has drastically reduced pool complexity leading to a Poor rating for adults, pre-smolt, and smolt lifestages. In addition, Habitat Complexity: Large Wood and Shelter conditions have a Poor rating for adults, pre-smolts and smolts. The increase in sediment yields and reductions in large wood inputs from streamside logging have reduced shelter habitat throughout the watershed, and removal of riparian vegetation for flood control purposes has decreased shelter and cover in lower Redwood Creek. However, Prairie Creek, which is mostly protected by park lands, contains more complex habitat with greater amounts of large wood and pools.

Sediment Transport: Road Density

Sediment Transport: Road density conditions have an overall Poor rating. High road densities within the population area are primarily associated with past timber harvest and rural residences. Road densities range from 2 to 8 miles of road per square mile of land, with an average road density of 4.8 miles of road per square mile of area (Cannata *et al.* 2006). Although significant

efforts continue to be made to upgrade and remove roads to reduce their sediment generating potential (e.g., road density within the park has decreased with the removal of 260 miles of old logging roads), road density remains high. However, the density is decreasing and recent estimates of suspended sediment and bedload passing the gage at Orick show reduced sediment transport in Redwood Creek (Klein and Anderson 2011).

Hydrology: Redd Scour

Redd Scour conditions are rated as poor for eggs. Sparkman (2012) describes population abundances estimated for the lower out-migrant trap on Redwood Creek (river mile 4) are influenced by flood flows in the middle portion of the basin. Describing the stress of redd scour, Sparkman (2011a; 2011b; 2012) found a declining trend in populations of age 0+ and age 1+ Chinook salmon over the past several years from the upper (river mile 34) and lower traps in Redwood Creek. This trend was significantly negative over time for age 0+ Chinook salmon in upper Redwood Creek and was not significantly negative in lower Redwood Creek until flood type flows were added to the model, indicating that Chinook salmon populations passing through the lower basin were influenced by population abundance and flood type flows in the upper basin (Sparkman 2012). Increased sediment yield and channel aggradation have likely increased the chances of redds being scoured by flood flows.

Very Good or Good Current Conditions

Very Good or Good rated conditions include passage and migration, and watershed hydrology. In addition, many aspects of landscape patterns (i.e., percent of watershed in timber harvest, agriculture and urbanized) were rated as very good currently, but based on past timber harvest practices (i.e., legacy timber harvest), landscape disturbance and watershed processes were rated as a high stress for this population. High road densities, past logging that has removed large conifers from riparian areas, and landslides that have been exacerbated by roads and timber harvest activities are the leading contributing factors to the stressful watershed processes condition. Large sediment inputs to Redwood Creek have caused channel aggradation, widening and a lack of deep pools within many channels. However, impervious surfaces and the extent of urban development within the population are favorably rated.

Threats

The following discussion focuses on those threats that rate as High or Very High (see Redwood Creek CAP Results). Recovery strategies will likely focus on ameliorating Very High and High rated threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Redwood Creek CAP Results.

Channel Modification

Channel modification is rated as a Very High threat for presmolt and smolt lifestages. Channel modification is also rated as a High threat for watershed processes and adults (summer and winter). The Redwood Creek estuary and lower mainstem river has been channelized and confined by levees for 3.4 miles, from the river mouth to the beginning of the steeper stream channel that is naturally confined. As previously discussed, over 50 percent of the estuary has been lost through the construction of levees (Ricks 1995), and levees prevent access to important sloughs, wetlands and low gradient tributaries. The estuary, transition zone and lower river once contained complex summer and winter rearing habitat (Cannata *et al.* 2006) that was critical to successful completion of the freshwater juvenile lifestage, but very little of that historic function still exists. The potential function of the estuary (*e.g.*, growth, diversity, shelter, and ocean transition) becomes even more critical given the degraded rearing conditions found upstream in mainstem Redwood Creek and most of its tributaries. Both populations suffer from the decreased opportunity for increased juvenile growth and out-migration timing diversity that the current estuary and low gradient habitat provides.

Roads and Railroads

Roads are rated as a High threat for adult and presmolt Chinook salmon lifestages. Roads are also rated as a High threat for watershed processes. As of 2006, Cannata *et al.* (2006) found that the Redwood Creek basin has an average of approximately 4.8 miles of road per square mile of area. Cannata *et al.* (2006) also found that the road density drops to 2.15 miles of road per square mile of area within the Prairie Creek and lower river sub-basins, and that private lands in the middle and upper portions of the Redwood Creek basin average over 8 miles of road per square mile of area. Fine sediment availability increases in basins with more than three miles of road per square mile of area (Cederholm *et al.* 1981). Considering the Very High road density, sediment yields from roads is currently a High threat, and Redwood Creek is listed as sediment impaired under section 303d of the Clean Water Act. NMFS expects that with ongoing upgrading and removal of roads by private landowners in the middle and upper basin, as well as the continuation of road removal in RNSP, that this threat will decrease over time. We note that as of 2016, RNSP removed approximately 260 miles of old logging roads from park lands within the basin, but the rate of road removal has decreased in recent years due to budget constraints.

Disease, Predation and Competition

This threat is rated as Very High for smolts primarily due to the degraded habitat conditions, lack of cover and high rates of juvenile predation found in the estuary. Monitoring indicates that juveniles continue to enter the estuary during the summer months (Anderson 2005; Sparkman 2010). Chinook salmon that remained in the estuary were larger than those that emigrated to the

ocean (Anderson 2005; Sparkman 2011) prior to the river mouth closure. This larger size can increase the probability of survival in the ocean (Reimers 1973; Bilton 1984; Beamer and Larsen 2004; Bond *et al.* 2008) provided these larger juveniles are able to survive summer and fall-rearing conditions and out-migrate to the ocean after the creek mouth re-opens in the fall. However, Anderson's data (Anderson 2011a; Anderson 2011b) show consistent and large declines in numbers of seined individuals and decreased juvenile population estimates within the estuary during summer and early fall sampling when the creek mouth is closed. Researchers believe that the dramatic decline in juveniles abundance within the closed estuary is due to lack of carrying capacity, and poor cover habitat with resulting predation, rather than juveniles migrating back upstream (D. G. Anderson, Redwood National and State Parks, personal communication November 30, 2011; M. Sparkman, CDFW, personal communication, 2011). Thus, the estuary is a bottleneck in the production of Redwood Creek Chinook salmon. Extended estuarine rearing affords an increased size at ocean entry and increased ocean survival compared to Chinook salmon that leave the estuary earlier at a smaller size before the mouth of the estuary closes to the ocean.

Logging and Wood Harvesting

Logging is rated as a High threat to most lifestages of CC Chinook salmon. Although current timber harvest practices are more protective of salmonid habitat than previous practices, timber harvest continues to threaten salmonids in Redwood Creek by increasing sediment yield and by reducing streamside shading and potential large wood recruitment, affecting the quality and quantity of rearing and spawning habitat. Approximately half of the basin is in private ownership as industrial timberland, and commercial timber harvest continues in the middle and upper portions of Redwood Creek. Sediment yields have decreased in recent years (Klein and Anderson 2011), but poor instream habitat and riparian conditions persist throughout much of the basin (Madej *et al*. 2006), making Redwood Creek sensitive to ongoing threats from reductions in riparian shading and large wood recruitment that stem from timber harvest activities. In addition, large wood is often removed (i.e., "poached") from lower and middle Redwood Creek during the winter when it is transported downstream by high flows. The large wood is then used for redwood carvings, sculptures, and for firewood. Removal of large wood from the channel exacerbates the problem of low levels of large wood recruitment from logged riparian areas.

Water Diversion and Impoundments

Aerial photographs of the Redwood Creek basin show numerous and large marijuana plantations, particularly in the Redwood Valley area in the middle portion of the basin. Marijuana cultivation and associated water diversion is placing a higher demand on a limited supply of water (S. Bauer, CDFW, personal communication, January 17, 2013). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of

water per season (Downie 2012). In addition, rural development in the Redwood Valley area is consuming more water, both for domestic and agricultural uses (M. Sparkman, CDFW, personal communication, December 2012), further reducing spring and summer flow conditions.

Mining

Instream gravel mining, mostly for flood control purposes, is rated as a High threat for presmolts and smolts. The leveed reach of Redwood Creek began aggrading with gravel immediately following levee construction. In an effort to combat this natural process and maintain the flood control project as designed, Humboldt County extracted gravel sporadically between 1968 and 2000, and annually between 2004 and 2010. Gravel removal results in simplified habitat, with reductions in pool availability, coarse surface particles and riparian vegetation, all components of habitat that are important for shelter and cover habitat. Currently, Humboldt County is proposing to mine large quantities of gravel due to the ongoing deposition of gravel in the flood control project reach. NHE (2010) found that the flood control project was not designed to transport gravel through the leveed reach; as a result design deficiencies lead to gravel accumulation and the subsequent need to remove gravel to increase flood water conveyance capacity.

Severe Weather Patterns

Flood flows and extreme weather have a large influence on Chinook salmon smolt abundance in Redwood Creek (Sparkman 2013), and are considered a high threat to the egg, pre-smolt and smolt life stages. Sparkman (2012) describes that population abundances estimated for the lower out-migrant trap on Redwood Creek (river mile 4) are influenced by flood flows in the middle portion of the basin, that lead to redd scour and lack of shelter. Flood flows occur during the late fall, winter and spring in Redwood Creek, and habitat conditions throughout much of Redwood Creek, but especially the estuary, make pre-smolts and smolts vulnerable to being washed downstream due to lack of shelter from high water velocities.

Low or Medium Rated Threats

Low and Medium rated threats for Chinook salmon include: residential and commercial development, livestock farming and ranching, agriculture, recreational areas and activities, fire, fuel management and fire suppression, and hatcheries and aquaculture.

Limiting Stresses, Lifestages, and Habitats

Current conditions and threat analysis indicates that the Chinook salmon presmolt and smolt lifestages are limiting the viability of the Chinook salmon population. The degraded condition of the estuary, including lack of cover and increased predation risk, impaired floodplain

connectivity, high summer water temperatures, and general lack of habitat complexity, are all limiting factors for this population.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating stresses and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. The general recovery strategy for the Redwood Creek populations is discussed below with more detailed and site-specific recovery actions provided in Redwood Creek CAP results, which provides the Implementation Schedule for these populations.

Enhance and Rehabilitate the Quality and Extent of the Redwood Creek Estuary and Improve Floodplain Connectivity

Efforts should be implemented to restore the quality and size of the estuary and to improve connection with the floodplain. Methods include: levee modification; reconnection and improvement of slough, wetland and tributary habitats; and enhancing cover and complexity by improving riparian vegetation quality and extent, and by adding structural elements to the channel. Chinook salmon in the Redwood Creek watershed are highly dependent on the estuary and on low gradient tributaries and off-channel habitats. The restoration of the estuary and re-connection of the floodplain would benefit several lifestages of Chinook salmon and contribute to improvements in life history diversity, ocean survival and adult abundance.

Habitat Complexity: Large Wood and Shelter

Take actions to increase shelter ratings, improve pool frequency and depths, increase pool volume, increase LWD abundance, and decrease the extent of flatwater habitats. Shelter ratings, pool depths, and habitat complexity are lacking throughout the watershed and are a major stress for most lifestages. Actions include retaining conifers in riparian zones, adding LWD to channels, allowing riparian vegetation to grow in the leveed reach, and preventing removal of LWD from stream channels.

Reduce Sediment Inputs

Continuing to reduce sediment input is an important component to the Redwood Creek recovery strategy for Chinook salmon. To increase habitat complexity and improve water quality, continue to remove or upgrade roads, reduce other sources of sediment input, and decrease instream gravel removal. Reducing sediment inputs will be especially effective at increasing habitat complexity and water quality when accomplished in conjunction with additions of large wood and other structural improvements to stream channels.

Logging and Riparian Management

As described above, shelter ratings and habitat complexity are lacking throughout the watershed and encouraging large wood recruitment to stream channels when managing riparian areas is an important component of increasing instream habitat complexity. Discourage the harvest of old-growth and large redwoods or other conifer trees within riparian areas. Large riparian conifers provide more value to the streams in terms of shading and LWD recruitment than smaller second growth trees.

Protect and Restore Habitat in Prairie Creek

Within the Redwood Creek watershed, the Prairie Creek subwatershed is unique in that it contains higher quality habitat than the rest of the basin. Prairie Creek is mostly contained within National and State Park land, but does contain some private land and roadways. It is critical to continue to protect (and restore where necessary) the higher quality habitat in Prairie Creek for all salmonid species within the basin.

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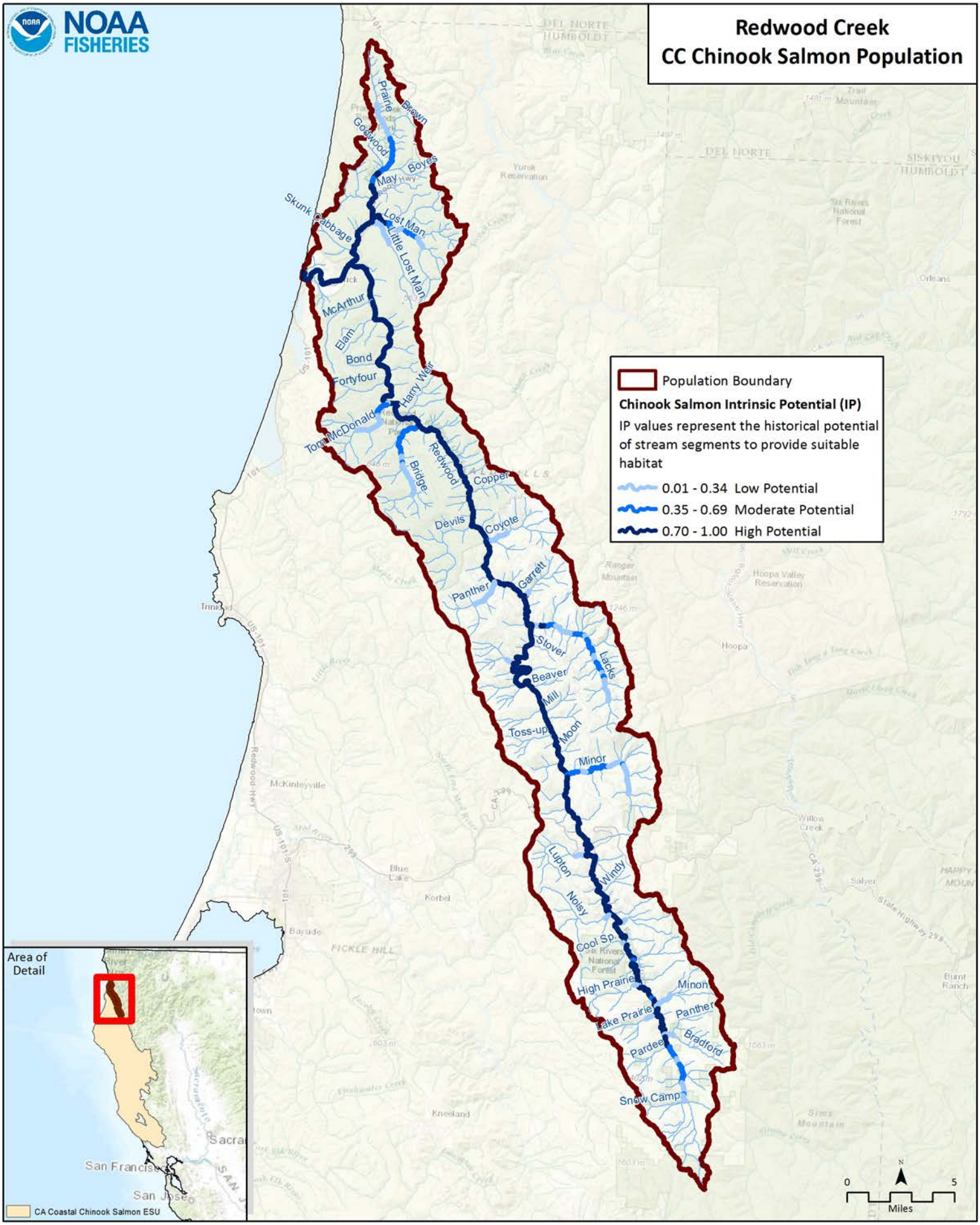
NOAA FISHERIES
Redwood Creek
CC Chinook Salmon Population
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Prairie
Brown
Goodwood
Boyes
May
Skunk Cabbage
Lost Man
Little Lost Man
McArthur
Elam
Bond
Fortyfour
Harry Weir
Tom McDonald
Bridge
Redwood
Copper
Devils
Coyote
Panther
Garrett
Slover
Beaver
Lacks
Mill
Toss-up
Moon
Minor
Lupton
Windy
Noisy
Cool Sp.
High Prairie
Minor
Lake Prairie
Panther
Pardee
Bradford
Snow Camp
Area of Detail
CA Coastal Chinook Salmon ESU
0
5
Miles

CC Chinook Salmon Redwood Creek CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<4% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<1% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	0% of streams/ IP-km (>49% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	7% of streams/ IP-km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.19	Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score = 58	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-Km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	39.41% Class 5 & 6 across IP-km	Fair

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	28.69	Poor
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	75	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	12.1-17.9	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	30-40	Good
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		1-20 Spawners per IP-km	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score = 50	Good
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Poor

			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	16.04% (0.85mm) and <30% (6.4mm)	Fair
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	89% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	28.69	Poor
3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	88% of streams/ IP-km (>49% average primary pool frequency)	Good
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	7% of streams/ IP-km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	0% of streams/ IP-km (>80 stream average)	Poor
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.19	Good
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score = 75	Fair
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score = 58	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.1 - 5 Diversions/10 IP-km	Fair

			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score = 58	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	Impaired/non-functional	Poor
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	28.69	Poor
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	89% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	<50% IP-km (>6 and <14 C)	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	75	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	12.1-17.9	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	30-40	Good

		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	0% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.1 - 5 Diversions/10 IP-km	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score = 58	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	28.69	Poor
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	89% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	<50% IP-km (>6 and <14 C)	Poor
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor

			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	75	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	12.1-17.9	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	30-40	Good
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.09% of Watershed in Impervious Surfaces	Very Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	0.46% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	13.4% of Watershed in Timber Harvest	Very Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	1% of Watershed >1 unit/20 acres	Very Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	51-74% Intact Historical Species Composition	Good

			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	8.26 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	7.62 Miles/Square Mile	Poor

CC Chinook Salmon Redwood Creek CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Medium	Low	Medium	Medium	Low	Medium
2	Channel Modification	High	Medium	Very High	Very High	High	Very High
3	Disease, Predation and Competition	Medium		High	Very High	Low	High
4	Fire, Fuel Management and Fire Suppression	Medium	Low	Medium	Medium	Low	Medium
5	Fishing and Collecting	Medium		Low	Low		Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Medium	Medium	Medium	Medium	Medium	Medium
8	Logging and Wood Harvesting	High	High	High	High	High	High
9	Mining	Medium	Low	High	High	Medium	High
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Low	Medium
11	Residential and Commercial Development	Medium	Medium	Medium	Medium	Medium	Medium
12	Roads and Railroads	High	Medium	High	High	High	High
13	Severe Weather Patterns	Medium	High	High	High	Medium	High
14	Water Diversion and Impoundments	Medium	Medium	Medium	Medium	Medium	Medium

Redwood Creek Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RC-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RC-CCCh-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat				
RC-CCCh-1.1.1.1	Action Step	Estuary	Assess feasibility of modifying levees by working with landowners and stakeholders, and prioritize sections of levees for setback or removal.	1	2	USACE, NGO, County, landowners, NPS, NMFS	
RC-CCCh-1.1.1.2	Action Step	Estuary	Modify or setback levees, guided by assessment.	1	10	USACE, NGO, County, landowners, NPS, NMFS	
RC-CCCh-1.1.1.3	Action Step	Estuary	Modify operation of diversion culverts in South Slough to increase access to estuarine and tributary habitat.	1	1	NPS	
RC-CCCh-1.1.1.4	Action Step	Estuary	Increase passage into South Slough, Strawberry Creek, Sand Cache Creek, North Slough (estuarine tributaries).	1	2	NPS, NGO, landowners, County	
RC-CCCh-1.1.2	Recovery Action	Estuary	Rehabilitate inner estuarine hydrodynamics				
RC-CCCh-1.1.2.1	Action Step	Estuary	Assess tidally influenced habitat and develop plan to restore tidal channels.	1	2	USACE, NGO, County, landowners, NPS, NMFS	
RC-CCCh-1.1.2.2	Action Step	Estuary	Restore tidal wetlands and tidal channels, guided by plan.	1	10	USACE, NGO, County, landowners, NPS, NMFS	
RC-CCCh-1.2	**Objective**	**Estuary**	**Address the inadequacy of existing regulatory mechanisms**				
RC-CCCh-1.2.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat				
RC-CCCh-1.2.1.1	Action Step	Estuary	Assess design flaws of the Redwood Creek Flood Control Project that encourage sediment deposition and amend criteria used to assess flood control project.	1	2	USACE, County, NMFS	
RC-CCCh-1.2.1.2	Action Step	Estuary	Modify flood control project to address design flaws and amend criteria.	1	10	USACE, County, NMFS	
RC-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RC-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
RC-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Assess watershed for areas to reconnect the floodplain.	1	3	NPS, NGO, CDFW, NMFS, County, landowners	This action step should coordinate with other action steps.
RC-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Re-connect the floodplain, guided by assessment.	1	10	NPS, NGO, CDFW, NMFS, County, landowners	Lower river, Redwood Valley, Prairie Creek, and other low gradient areas.
RC-CCCh-2.2.1	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
RC-CCCh-2.2.1.1	Action Step	Floodplain Connectivity	Assess watershed and prioritize potential refugia habitat sites.	1	3	NPS, NGO, CDFW, NMFS, landowners	This action step should coordinate with other action steps.
RC-CCCh-2.2.1.2	Action Step	Floodplain Connectivity	Implement projects that create refugia habitats, guided by assessment.	1	10	NPS, NGO, CDFW, NMFS, landowners	
RC-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RC-CCCh-5.1.1	Recovery Action	Passage	Assess physical passage barriers				
RC-CCCh-5.1.1.1	Action Step	Passage	Modify or remove physical passage barriers where they exist, such as within occupied tributaries to Redwood Creek and Prairie Creek	2	10	NPS, NGO, CDFW, NMFS, landowners	
RC-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RC-CCCh-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools and low velocity shelter habitat				
RC-CCCh-6.1.1.1	Action Step	Habitat Complexity	Develop a plan to restore habitat complexity, reduce water temperatures and provide shelter and cover.	2	4	NPS, CDFW, NGO, landowners, NMFS	This recommendation should be coordinated with other action steps to reduce redundancy.
RC-CCCh-6.1.1.2	Action Step	Habitat Complexity	Restore habitat complexity in identified areas, by using additions of large wood or creation of low velocity habitat.	2	5	NPS, CDFW, NGO, landowners, NMFS	
RC-CCCh-6.1.2	Recovery Action	Habitat Complexity	Increase large wood frequency and shade in riparian areas				
RC-CCCh-6.1.2.1	Action Step	Habitat Complexity	Manage riparian vegetation to promote late seral characteristics while maintaining bank stability and existing shade.	3	10	NPS. CalFire, CDFW, landowners	
RC-CCCh-6.1.3	Recovery Action	Habitat Complexity	Improve instream channel complexity				

Redwood Creek Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RC-CCCh-6.1.3.1	Action Step	Habitat Complexity	Reduce instream vegetation and gravel removal in lower Redwood Creek.	1	1	USACE, County, NMFS	
RC-CCCh-6.2	**Objective**	**Habitat Complexity**	**Address the inadequacy of existing regulatory mechanisms**				
RC-CCCh-6.2.1	Recovery Action	Habitat Complexity	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
RC-CCCh-6.2.1.1	Action Step	Habitat Complexity	Reduce removal of instream large wood (i.e., wood poaching)	2	10	NPS, CDFW, County	
RC-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RC-CCCh-7.1.1	Recovery Action	Riparian	Improve riparian condition				
RC-CCCh-7.1.1.1	Action Step	Riparian	Remove non-native species that inhibit fish passage (e.g., invasive aquatic vegetation, such as reed canary grass) and establishment of native riparian vegetation.	2	3	NPS, CDFW, NGO, landowners	
RC-CCCh-7.1.1.2	Action Step	Riparian	Plant native riparian species to prevent the recolonization of invasive aquatic vegetation.	2	4	NPS, CDFW, NGO, landowners	
RC-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RC-CCCh-10.1.1	Recovery Action	Water Quality	Reduce turbidity and suspended sediment				
RC-CCCh-10.1.1.1	Action Step	Water Quality	Assess potentially future large inputs of fine sediments (e.g., landslides, failed culverts at imminent risk into occupied habitat).	2	3	NPS, NGO, CDFW, landowners	
RC-CCCh-10.1.1.2	Action Step	Water Quality	Reduce fine sediment input from areas that are currently large sediment producers and are at imminent risk of sediment entering occupied habitat	2	5	NPS, NGO landowners, CDFW	
RC-CCCh-14.1	**Objective**	**Disease/Predation/Competition**	**Address disease or predation**				
RC-CCCh-14.1.1	Recovery Action	Disease/Predation/Competition	Prevent or minimize reduced density, abundance, and diversity based on the biological recovery criteria				
RC-CCCh-14.1.1.1	Action Step	Disease/Predation/Competition	Retain riparian vegetation within flood control project to increase cover habitat and reduce predation.	1	10	USACE	
RC-CCCh-14.1.1.2	Action Step	Disease/ Predation/ Competition	Evaluate effects of New Zealand Mud Snails	3	10	NPS, CDFW, NMFS	
RC-CCCh-14.1.1.3	Action Step	Disease/ Predation/ Competition	Take action to reduce NZMS based on evaluation	3	10	NPS, CDFW, NMFS	
RC-CCCh-18.1	**Objective**	**Livestock**	**Address the inadequacy of existing regulatory mechanisms**				
RC-CCCh-18.1.1	Recovery Action	Livestock	Prevent or minimize alterations to riparian species composition and structure				
RC-CCCh-18.1.1.1	Action Step	Livestock	Identify areas where livestock have access to riparian vegetation, develop plan to fence livestock from area.	2	2	NPS, landowners, NGO, RCD, NRCS	
RC-CCCh-18.1.1.2	Action Step	Livestock	Install fence, guided by plan.	2	2	NPS, landowners, NGO, RCD, NRCS	
RC-CCCh-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
RC-CCCh-19.2.1	Recovery Action	Logging	Prevent or minimize adverse alterations to riparian species composition and structure				
RC-CCCh-19.2.1.1	Action Step	Logging	Develop plan that identifies areas in need of more shade and large wood recruitment that currently support Chinook salmon and describes timber management methods that will increase shade and wood recruitment overtime.	3	2	CalFire, NPS, CDFW	
RC-CCCh-19.2.1.2	Action Step	Logging	Manage forests in identified areas to increase shade and large wood recruitment, guided by plan.	3	10	CalFire, NPS, CDFW	
RC-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RC-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				

Redwood Creek Chinook Salmon (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RC-CCCh-23.1.1.1	Action Step	Roads/Railroads	Decommission roads that are at high risk of imminent failure, guided by assessment.	2	10	NPS, Private Landowners	
RC-CCCh-23.1.1.2	Action Step	Roads/Railroads	Decommission moderate to low risk roads, guided by assessment.	3	10	NPS, Private Landowners	
RC-CCCh-23.1.1.3	Action Step	Roads/Railroads	Maintain roads, guided by assessment.	3	10	NPS, Private Landowners	
RC-CCCh-23.1.1.4	Action Step	Roads/Railroads	Upgrade roads, guided by assessment.	3	10	NPS, Private Landowners	
RC-CCCh-25.1	**Objective**	**Water Diversion/ Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RC-CCCh-25.1.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
RC-CCCh-25.1.1.1	Action Step	Water Diversion/ Impoundment	Conduct a study to document extent of water diversions and the effects of these diversions on salmonids, which includes recommendations for amount of diversion that would not limit recovery.	2	5	CDFW, CWQCB	
RC-CCCh-25.1.1.2	Action Step	Water Diversion/ Impoundment	Reduce diversions to level that would not limit recovery of salmonids.	2	15	CDFW, CWQCB	

North Mountain-Interior Diversity Stratum

This stratum includes populations or parts of populations that spawn in watersheds that penetrate considerable distances inland, and (in most cases) attain sufficient elevations for snowmelt to contribute significantly to the annual hydrograph. Two northern tributaries to the lower Eel River, the Van Duzen River and Larabee Creek, exhibit these characteristics. While we consider Chinook salmon that spawn in these tributaries to be part of the Lower Eel River population, these basins represent important environmental diversity within that population. Thus, we consider that a viable population of fall-run Chinook salmon in the Lower Eel River that included components in northern basins would contribute significantly to this diversity stratum.

The populations that have been selected for the recovery scenario are listed in the table below and their profiles, maps, results, and recovery actions are in the pages following. Populations are listed by alphabetical order within the diversity stratum:

CC Chinook Salmon North Mountain Interior Diversity Stratum Populations, Historical Status, Population's Role in Recovery, Current IP-km, and Spawner Density and Abundance Targets for Delisting. The Diversity Stratum recovery targets are only comprised of the essential populations because these are the populations that are expected to be viable (See Vol. 1 Chapter 5). The Chinook salmon Lower Eel River is one population divided between two diversity strata. *The Lower Eel River Chinook population is divided between two diversity strata, and as a result has one recovery target for the North Mountain Interior DS (Van Duzen and Larabee) and one for the North Coastal DS (Lower and South Fork Eel River).

Diversity Stratum	CC Chinook salmon Populations	Historical Population Status	Population's Role In Recovery	Current Weighted IP-km	Spawner Density	Spawner Abundance
North Mountain Interior	Lower Eel River ~ *Larabee Creek/ Van Duzen River**	I	Essential	144.0	20.0	2,900
	Upper Eel River	I	Essential	528.5	20.0	10,600
Diversity Stratum Recovery Target						**13,500**

CC Chinook salmon North Mountain Interior Diversity Stratum Populations selected for the recovery scenario. There are no Supporting populations within this Diversity Stratum.

Larabee Creek Subset of the Lower Eel River Population

CC Chinook Salmon Fall-Run

- Role within ESU: Role within ESU: A subset with the Lower Eel River Functionally Independent Population
- Diversity Stratum: North Mountain Interior
- Spawner Abundance Target: 2,900 adults (includes Van Duzen Subset)
- Current Intrinsic Potential: 144.0 IP-km (includes Van Duzen Subset)

For information regarding NC steelhead and SONCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the SONCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

Historical Chinook salmon abundance estimates for Larabee Creek are lacking, but insight as to how prolific the anadromous salmonid runs were at the start of European settlement within the watershed may be gleaned from early fishing records at the mouth of the Eel River (Yoshiyama and Moyle 2010). An estimated 585,000 Chinook salmon were caught and processed at the Eel River canneries during the peak harvest year of 1877, with average runs of 100,000 to 200,000 adults per year. Given the amount of habitat available historically within Larabee Creek, Chinook salmon runs likely numbered in the thousands prior to the habitat degradation and overfishing that began during the latter 19th century.

No man-made barriers exist on mainstem Larabee Creek, although a mile-long series of falls and cascades beginning near the confluence of Larabee Creek and Smith Creek may preclude upstream distribution of Chinook salmon (PALCO 2007). CDFW spawning surveys have reported spawning Chinook salmon in mainstem Larabee Creek and Carson Creek, a low-gradient tributary that enters Larabee Creek approximately 2.5 miles upstream from the Eel River (Becker and Reining 2009). Most tributaries are inaccessible to Chinook salmon due to steep gradients at their confluence with mainstem Larabee Creek.

History of Land Use

Historically, the Larabee Creek watershed contained primarily late-seral redwood/Douglas-fir (coniferous) forests, with limited open oak woodland/prairies farther inland at higher elevations (PALCO 2007). The first logging activities occurred in the 1900s and 1910s in the floodplain areas of lower Larabee Creek where timber was large and easily accessible (Pacific Lumber Company 2007). More than 60 percent of the lower Larabee Creek area, including significant portions of

the Chris, Carson, Smith, Balcom, Dauphiny, Scott, and Arnold creek drainages, was logged by the end of the 1920s (PALCO 2007). Following the initial logging, technological developments after World War II enabled logging and road building in steeper, more landslide prone areas, which caused excessive sediment delivery to streams. Massive erosion and instream sedimentation occurred following large floods in 1955 and 1964, filling in pools and widening stream channels. The remainder of the old-growth timber in the Larabee Creek watershed was harvested by the 1980s, and second-growth logging activities have occurred since (PALCO 2007). After settlement by ranchers in the early 1900s, the lower Larabee Creek area was burned repeatedly for cattle grazing (PALCO 2007).

Current Resources and Land Management

Ninety-nine percent of the Larabee Creek watershed is under private ownership, with much of the lower one-third of the watershed actively managed for timber production by the Humboldt Redwood Company (HRC; formerly PALCO). Timber holdings owned by HRC are managed according a Habitat Conservation Plan (HCP) that seeks to minimize adverse effects to aquatic and terrestrial habitat during timberland operations. The goals of the HRC HCP include trending towards properly functioning aquatic conditions and reducing sediment input by upgrading 1,500 miles of roads on their timberlands (HRC 2012). Other land uses occurring within the Larabee Creek watershed include rural residential, agriculture, and livestock grazing. There are several active watershed groups in the area: the Eel River Watershed Improvement Group, Friends of the Eel River, and the Eel River Restoration Project. The following are pertinent reports or plans for Larabee Creek:

- Humboldt Redwood Company HCP (HRC 2012);
- HRC Watershed Analyses for: Lower Eel/Eel Delta and Upper Eel (PALCO 2007);
- Eel River Salmon and Steelhead Restoration Action Plan (CDFG 1997); and
- Lower Eel River Total Maximum Daily Loads for Temperature and Sediment (USEPA 2007).

Salmonid Viability and Watershed Conditions

The following indicators were rated Poor through the CAP process for Chinook salmon: shelter rating, canopy cover, streamside road density, aquatic invertebrates, estuary quality and extent, water temperature, timber harvest, and riparian tree diameter. Recovery strategies will focus on ameliorating these habitat indicators, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed.

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Larabee Creek CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Viability: Density, Abundance, and Spatial Structure

The abundance of Chinook salmon in Larabee Creek is likely well below Low-risk abundance targets and is likely limiting their ability to successfully reproduce and increase in abundance. However, habitat conditions are improving in many areas and are currently adequate for Chinook to successfully complete their freshwater life history. Restoration of degraded habitat, combined with improved land management, should allow the Larabee Creek Chinook salmon population to increase in abundance.

Estuary: Quality and Extent

The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of all Eel River salmonid populations. The Eel River estuary is severely impaired because of past diking and filling of tidal wetlands for agriculture and flood protection. Please see the Chinook Salmon Eel River Overview for a complete discussion and recovery actions.

Habitat Complexity: Large Wood and Shelter

The habitat complexity condition has a Poor rating for pre-smolts and smolts. PALCO (2007) determined tree size resulting from young forest stands is currently the limiting factor for recruitment of functional large wood in the management unit that includes lower Larabee Creek. However, PALCO (2007) concluded that nearly 90 percent of the riparian forests in the management unit will meet or exceed riparian composition goals within 40 years. This condition is rated as Poor for summer rearing and winter rearing juveniles, and summer-run adults.

Sediment: Gravel Quality and Distribution of Spawning Gravels

Sediment conditions have an overall Fair rating for all life stages. Embeddedness levels are high within Larabee Creek tributaries and the upper mainstem (PALCO 2007). Suitable spawning gravel exists in some areas within the watershed but other areas are still impaired (*e.g.,* excess fine sediments) from past land use. Larabee Creek Chinook salmon rely on clean and stable spawning gravel in the mainstem for egg incubation and survival. Impaired gravel quality may reduce macro-invertebrate production that supports summer and seasonal rearing salmonids. Threats contributing to this stress include Logging and Wood Harvesting and Roads and Railroads.

Habitat Complexity: Percent Primary Pools and Pool/Riffle/Flatwater Ratios

PALCO (2007) determined pool complexity and pool: riffle ratio metrics for Larabee Creek mostly met properly functioning conditions, although distinct differences were observed between streams sampled in the lower watershed (Wildcat geology) versus upper watershed sites (Yager geology). Average pool depths are typically greater than 3 feet in the mainstem; however, tributary pools are shallower and average 1.5 feet (PALCO 2007). These stressors primarily affect pre-smolt Chinook salmon and adult Chinook salmon as holding or staging pools are limited. Due to contribution of fine sediment, the primary threats contributing to this stress are Logging and Wood Harvesting and Roads and Railroads.

Riparian Vegetation: Composition, Cover & Tree Diameter

Riparian Vegetation conditions have an overall Fair rating for the watershed processes in the Larabee Creek population area. Where data exist, streamside canopy cover shows a range of conditions, with some good to very good conditions (70 percent to 100 percent shade) in tributaries, and poor cover and shade conditions in the mainstem channel. For instance, over half of the channel length of lower Larabee Creek has less than 20 percent canopy cover. Even where streamside canopy cover is good, such as in first and second order channels of many Larabee Creek tributaries, riparian areas consist predominantly of hardwood species and immature conifers that are not yet of size to effectively function as LWD (PALCO 2007). The primary threat contributing to this stress is Logging and Wood Harvesting.

Sediment Transport: Road Density

Sediment Transport has an overall Poor rating due to roads in the Larabee Creek population area. The Eel River watershed is one of the most naturally erosive watersheds in the United States (Brown and Ritter 1971) because of the highly active tectonic setting, highly erodible soils in the area, and high precipitation. Anthropogenic activities in Larabee Creek, primarily legacy logging and associated road building, have exacerbated these naturally high sediment loads (USEPA 2007). Most subwatersheds in the Larabee Creek basin exhibit road densities much higher than 3 road miles per square mile of land, with up to 7.8 road miles per square mile in the mid-Larabee subcomplex of tributaries (PALCO 2007).

Landscape Patterns: Agriculture, Timber Harvest, and Urbanization

Major legacy and current landscape disturbance within Larabee Creek, primarily associated with timber harvest and associated road building results in a rating of Poor for Timber Harvest on watershed processes.

Water Quality: Turbidity or Toxicity

The combination of landscape disturbance and erosive soils in the Larabee Creek watershed results in increased turbidity, and this condition is considered a Fair rating to pre-smolt, particularly during storms. Threats contributing to this stress are Logging and Wood Harvesting and Roads and Railroads.

Very Good or Good Current Conditions

The floodplain connectivity condition has an overall Good rating for juveniles, smolts, and adults. Floodplains in Larabee Creek were determined to be fully functional (PALCO 2007), but excessive sediment loads and dysfunctional riparian processes (*i.e.,* poor LWD recruitment) in the mainstem Eel River below the confluence with Larabee Creek, and levees in the Eel River estuary limit floodplain access for Larabee Creek salmonids during outmigration. Barriers to fish passage do not present a major impediment to recovery of Chinook salmon in Larabee Creek, although a long-standing road-crossing barrier on Chris Creek and log-jams in several tributaries are believed to partially impede adult passage.

Threats

The following discussion focuses on those threats that rate as High or Very High (see Larabee Creek CAP results). Recovery strategies will likely focus on ameliorating High rating threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Larabee Creek CAP results.

Roads and Railroads

Roads constitute a High threat to watershed processes. Most subwatersheds in the Larabee Creek basin exhibit road densities much higher than 3 road miles per square mile of watershed, with up to 7.78 road miles per square mile in the mid-Larabee subcomplex of tributaries (PALCO 2007). Road storm proofing, reconstruction, and upgrading have occurred on a significant portion of HRC's roads (PALCO 2007) and will continue to occur under the HCP.

Logging and Wood Harvesting

Logging and wood harvesting is a High threat to watershed processes. Many of the changes that have occurred to instream and riparian conditions in Larabee Creek reflect legacy effects of more intensive harvest from previous decades. In the future, given the percentage of the watershed that is actively managed as timberland, and that most of the watershed has been logged in the past, continuing harvest on these areas will likely continue to affect habitat downstream by introducing more sediment than would occur naturally.

Channel Modification

Channel modification is rated as a High threat for Chinook salmon smolts. Channel modification is not pervasive in Larabee Creek, but the Eel River estuary and mainstem have been significantly channelized by dikes and levees and subsequent filling for ranching or livestock purposes. Please see the Chinook Salmon Eel River Overview for a complete discussion and recovery actions.

Disease, Predation and Competition

Competition and predation from non-native Sacramento pikeminnow (predation and competition) and California roach (competition) pose a High stress to pre-smolt and smolt Chinook salmon. These non-native species have the greatest impact in wide, low gradient mainstem reaches where degraded instream habitat and water quality conditions favor their production over indigenous Chinook salmon and increase their risk of predation by Sacramento pikeminnow.

Fishing and Collecting

Fishing and Collecting is rated a High threat to adult Chinook salmon. Although the fishery is catch-and-release only, the activity attracts hundreds, if not thousands, of anglers every season. Regulations do not currently protect these fish during the entire period of lower flow conditions that occur coincident with their spawning migration, particularly Chinook salmon. Currently, sport fishing in the mainstem Eel River is subject to a low flow fishing closure whenever the gage at Scotia is recording flows less than 350 cubic feet per second. However, the low flow season does not begin until October 1 of each year and expires on January 31, which allows anglers to target Chinook salmon staging in low flow conditions throughout September or after January. Adults are easy targets for both fishermen and poachers in these extremely low flows. Poor water quality in September contributes to the stress and likely results in increased hook-and-release mortalities (Clark and Gibbons 1991).

Bycatch of Chinook salmon occurs in ocean fisheries targeting Chinook salmon that are not protected under the Endangered Species Act. In a biological opinion on the effects of ocean fisheries managed under the Pacific Coast Salmon Plan, NMFS determined the bycatch impacts of these fisheries are likely to jeopardize the continued existence of CC Chinook salmon, and NMFS provided a Reasonable and Prudent Alternative under which the fisheries are managed to avoid the likelihood of jeopardizing the continued existence of CC Chinook salmon (NMFS 2000).

Low or Medium Rated Threats

Less than one percent of the Larabee Creek population area is currently used for agriculture, and residential development is sparse and low in density; therefore, these threats are a Low to Medium threat. Fuel management and fire suppression is a Medium threat because it may increase the potential for a catastrophic fire in the future, particularly in the interior portion of the watershed.

Currently, the extent of marijuana production in the Larabee Creek drainage is unknown; however it is likely to be increasing as it has in other sub-watersheds throughout the Eel River system. The potential implications of expanding marijuana production on stream flow quantity and quality and habitat availability in the Larabee Creek drainage should be assessed.

Limiting Stresses, Lifestages, and Habitats

Juvenile Chinook salmon pre-smolt productivity is likely limiting subsequent adult abundance within the Larabee Creek watershed. Inadequate stream shading, high water temperatures, impaired gravel quality (spawning and benthic food productivity), and reduced habitat complexity have reduced the quality and extent of rearing habitat.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating stresses and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. The general recovery strategy for the Larabee Creek population is discussed below with more detailed and site-specific recovery actions provided in Larabee Creek CAP Results, which provides the Implementation Schedule for this population.

Improve Riparian Habitat Function and Composition

Increase the quality and quantity of riparian vegetation through appropriate silvicultural prescriptions such as thinning (for release of conifers) and planting. Reestablishment of coniferous forests in the lower mainstem floodplain will improve canopy cover and instream temperatures.

Increase Habitat Complexity

Pools in Larabee Creek and mainstem Eel River are too simplified and shallow to adequately support juvenile Chinook salmon growth and survival. Large wood, boulders, or other instream structure should be added in proximity to cool water refugia in order to increase complexity and

sort sediment. Off-channel ponds, alcoves, and backwater habitat should be re-created in the low-gradient areas of the population area, as well as the lower mainstem Eel River.

Reduce Sediment Supply

Ongoing sediment loading from roads and unstable slopes contributes to poor salmonid habitat. Roads should be hydrologically disconnected from streams; road-stream connections should be assessed and prioritized, and this assessment should be used to determine which roads to decommission, upgrade, or maintain. A grading ordinance which minimizes effects on salmonid habitat should be developed for building and maintenance of private roads.

Reduce Abundance of Sacramento Pikeminnow

Explore how best to reduce the abundance of the Sacramento pikeminnow population. Provide increased refugia habitat for salmonids through the creation of cool and complex habitats, and make habitat less suitable for pikeminnow by managing to reduce water temperature.

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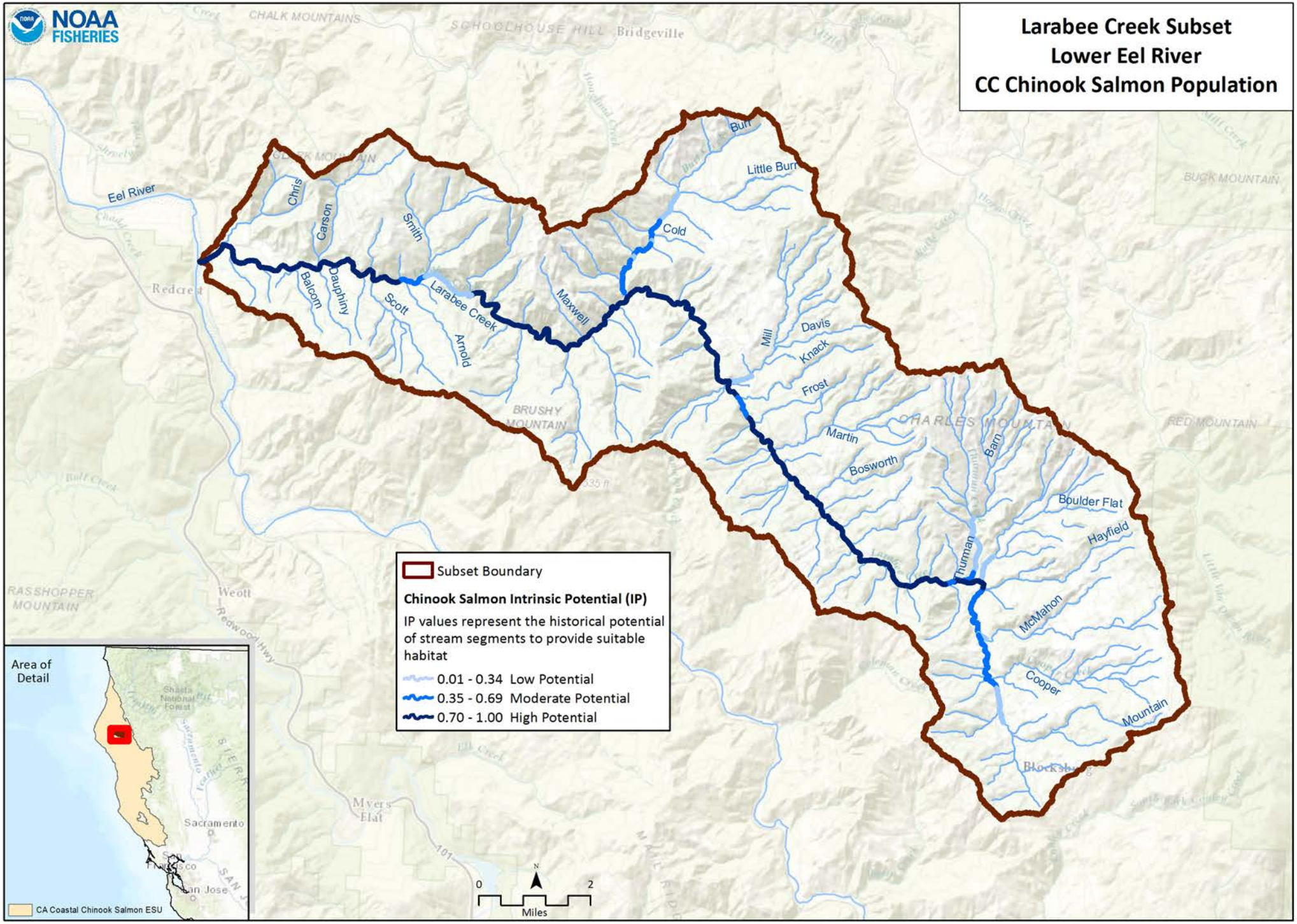
Larabee Creek Subset
Lower Eel River
CC Chinook Salmon Population
NOAA FISHERIES
Eel River
Chris
Carson
Smith
Balcom
Dauphiny
Scott
Larabee Creek
Arnold
Maxwell
Cold
Burn
Little Burn
Mill
Davis
Knack
Frost
Martin
Bosworth
Barn
Boulder Flat
Hayfield
McMahon
Cooper
Mountain
Thurman
CHALK MOUNTAINS
SCHOOLHOUSE HILL
Bridgeville
BUCK MOUNTAIN
BRUSHY MOUNTAIN
CHARLES MOUNTAIN
RED MOUNTAIN
GRASSHOPPER MOUNTAIN
Redcrest
Weott
Myers Flat
Subset Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Area of Detail
Sacramento
San Jose
CA Coastal Chinook Salmon ESU
0
2
Miles

CC Chinook Salmon Larabee Creek CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly functioning condition		Impaired/non-functional	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Fair
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-km (>49% average primary pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-km (>30% Pools; >20% Riffles)	Fair
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.22-0.35	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 67	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	34.69 Class 5 & 6 across IP-km	Poor

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	60 to 80	Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	>80% Response Reach Connectivity	Good
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No acute or chronic known	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	72.08	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	15	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	24	Poor
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		1-20 Spawners per IP-km	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 50	Good

			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 67	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	13.5% (0.85mm) and <30% (6.4mm)	Good
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-km (>50% stream average scores of 1 & 2)	Fair
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	60 to 80	Good
3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly functioning condition		Impaired/non-functional	Poor
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-km (>49% average primary pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-km (>30% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-km (>80 stream average)	Poor
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.22-0.35	Fair
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 83	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 67	Fair

Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.1 - 5 Diversions/10 IP km	Fair
Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 67	Fair
Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
Riparian Vegetation	Species Composition	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	34.69 Class 5 & 6 across IP-km	Poor
Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	60 to 80	Good
Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-km (>50% stream average scores of 1 & 2)	Fair
Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	>80% Response Reach Connectivity	Good
Water Quality	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	20 to 22 IP-km (>6 and <14 C)	Good
Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No acute or chronic known	Good
Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	72.08	Good

			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	15	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	24	Poor
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly functioning condition		Impaired/non-functional	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.1 - 5 Diversions/10 IP km	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 67	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	60-80	Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-km (>50% stream average scores of 1 & 2)	Fair

			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	20 to 22 IP-km (>6 and <14 C)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	>80% Response Reach Connectivity	Good
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No acute or chronic known	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	72.08	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	15	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	24	Poor
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.03% of Watershed in Impervious Surfaces	Very Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	10-19% of Watershed in Agriculture	Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	44.22% of Watershed in Timber Harvest	Poor

			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	0% of Watershed >1 unit/20 acres	Very Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	51-74% Intact Historical Species Composition	Good
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	6.83 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	5.01 Miles/Square Mile	Poor

CC Chinook Salmon Larabee Creek CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Medium	Low	Medium	Medium	Low	Medium
2	Channel Modification	Medium	Low	Medium	High	Low	Medium
3	Disease, Predation and Competition	Medium		High	High	Low	High
4	Fire, Fuel Management and Fire Suppression	Medium	Low	Medium	Medium	Medium	Medium
5	Fishing and Collecting	High		Medium	Low		Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Low	Medium
8	Logging and Wood Harvesting	Medium	Medium	Medium	Medium	High	Medium
9	Mining	Medium	Low	Medium	Medium	Low	Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Low	Medium
11	Residential and Commercial Development	Medium	Low	Medium	Medium	Low	Medium
12	Roads and Railroads	Medium	Medium	Medium	Medium	High	Medium
13	Severe Weather Patterns	Medium	Low	Medium	Medium	Low	Medium
14	Water Diversion and Impoundments	Medium	Low	Medium	Medium	Low	Medium

Larabee Creek Chinook Salmon (North Mountain Interior) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LbC-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LbC-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
LbC-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Assess watershed for areas to reconnect the floodplain.	2	1	Private	
LbC-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Construct off channel ponds, alcoves, backwater habitat, and old stream oxbows to re-connect the floodplain, guided by assessment.	2	5	Private	
LbC-CCCh-3.1	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**				
LbC-CCCh-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
LbC-CCCh-3.1.1.1	Action Step	Hydrology	Ensure sub-division of existing parcels does not result in increased water demand during low-flow season.	2	10	Counties, SWRCB	
LbC-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LbC-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
LbC-CCCh-5.1.1.1	Action Step	Passage	Remove road crossing barrier on Larabee Ranch.	2	1	Private	
LbC-CCCh-5.1.1.2	Action Step	Passage	Assess passage at logjam barriers in tributaries and provide passage if feasible.	2	5	Private	
LbC-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LbC-CCCh-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
LbC-CCCh-6.1.1.1	Action Step	Habitat Complexity	Assess habitat to determine location and amount of instream structure needed.	2	1	CDFW	Mainstem Larabee Creek and lower tributaries.
LbC-CCCh-6.1.1.2	Action Step	Habitat Complexity	Place LWD, boulders, or other instream structure, guided by assessment.	2	10	CDFW	Mainstem Larabee Creek and lower tributaries.
LbC-CCCh-7.1	**Objective**	**Riparian**	**Address the inadequacy of existing regulatory mechanisms**				
LbC-CCCh-7.1.1	Recovery Action	Riparian	Improve riparian conditions				
LbC-CCCh-7.1.1.1	Action Step	Riparian	Reduce detrimental environmental impacts of conversion of TPZ land to other uses.	2	10	NMFS, Calfire, BOF	
LbC-CCCh-7.1.1.2	Action Step	Riparian	Work with Calfire and BOF to minimize the number of conversions per landowner	2	10	NMFS, Calfire, BOF	
LbC-CCCh-7.1.1.3	Action Step	Riparian	Institute environmental review as part of TPZ conversions	2	10	Calfire, BOF	
LbC-CCCh-7.1.1.4	Action Step	Riparian	Work to ensure effects of activities on converted areas are minimized.	2	10	NMFS, Calfire, BOF	
LbC-CCCh-14.1	**Objective**	**Disease /Predation /Competition**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LbC-CCCh-14.1.1	Recovery Action	Disease /Predation /Competition	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
LbC-CCCh-14.1.1.1	Action Step	Disease /Predation /Competition	Conduct studies to determine distribution and habitat preferences of pikeminnow in the Eel River basin.	3	5	CDFW	
LbC-CCCh-14.1.1.2	Action Step	Disease /Predation /Competition	Conduct studies to determine how competition with pikeminnow alters the natural behavior and survival of juvenile salmonids.	3	5	CDFW	
LbC-CCCh-14.1.1.3	Action Step	Disease /Predation /Competition	Assess feasibility and benefits of various methods to eradicate or suppress Sacramento pikeminnow, including genetic technology methods (e.g., deleterious genes).	3	5	CDFW	
LbC-CCCh-14.1.1.4	Action Step	Disease /Predation /Competition	Take measures to eradicate or suppress fish species using genetic technology or other methods identified as feasible.	3	25	CDFW	
LbC-CCCh-16.1	**Objective**	**Fishing/Collecting**	**Address the inadequacy of existing regulatory mechanisms**				

Larabee Creek Chinook Salmon (North Mountain Interior) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LbC-CCCh-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
LbC-CCCh-16.1.1.1	Action Step	Fishing/Collecting	Change the low flow season for the mainstem Eel River to start on a date that minimizes incidental fishing impacts to ESA-listed salmonids.	1	5	CDFW	
LbC-CCCh-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LbC-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize adverse alterations to riparian species composition and structure				
LbC-CCCh-19.1.1.1	Action Step	Logging	Determine appropriate silvicultural prescription for benefits to listed salmonids.	2	1	Private	Lower mainstem Larabee Creek.
LbC-CCCh-19.1.1.2	Action Step	Logging	Thin, or release conifers, guided by prescription.	2	10	Private	Lower mainstem Larabee Creek.
LbC-CCCh-19.1.1.3	Action Step	Logging	Plant conifers, guided by prescription.	2	5	Private	Lower mainstem Larabee Creek.
LbC-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LbC-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
LbC-CCCh-23.1.1.1	Action Step	Roads/Railroads	Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective.	2	1	Private	
LbC-CCCh-23.1.1.2	Action Step	Roads/Railroads	Decommission roads, guided by assessment.	2	10	Private	
LbC-CCCh-23.1.1.3	Action Step	Roads/Railroads	Upgrade roads, guided by assessment.	2	10	Private	
LbC-CCCh-23.1.1.4	Action Step	Roads/Railroads	Maintain roads, guided by assessment.	2	25	Private	
LbC-CCCh-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
LbC-CCCh-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
LbC-CCCh-23.2.1.1	Action Step	Roads/Railroads	Develop grading ordinance which minimizes effects of road maintenance and construction on salmonid habitat.	2	1	County	

Upper Eel River Population

CC Chinook Salmon Fall-Run

- Role within ESU: Functionally Independent Population
- Diversity Stratum: North Mountain Interior
- Spawner Abundance Target: 10,600 adults
- Current Intrinsic Potential: 528.5 IP-km

For information regarding NC steelhead and SONCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the SONCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

The Chinook salmon population of the Upper Eel River includes all watersheds from the South Fork Eel River confluence upstream along the mainstem Eel River. Major subbasins included in this population are Dobbyn Creek, North Fork Eel River, Middle Fork Eel River, Outlet Creek, Tomki Creek, and the upper mainstem Eel River. The Middle Fork Eel is considered the anchor for production of Chinook salmon in the Upper Eel River (Bjorkstedt *et al.* 2005).

Late 1800s Cannery records for the Eel River system indicate that historic runs of Chinook salmon ranged between 300,000 and 800,000 annually, declining to roughly 50,000-100,000 year annual returning spawners in the first half of the 20th century (Yoshiyama and Moyle 2010). After the historic floods of 1955 and 1964, annual runs were generally considerably less than 10,000 Chinook (Yoshiyama and Moyle 2010). Monitoring efforts at the Van Arsdale Fish Station (VAFS) and some carcass index reaches occurring in the Tomki Creek watershed have shown that abundance of fall-run Chinook salmon in the Upper Mainstem Eel River was extremely low in the 1990s and 2000s. In the recent years 2009/10 and 2010/11 adult Chinook salmon abundance has improved in some Eel River watersheds and remained scant in other areas. For example, the VAFS averaged around 500 spawners in recent years, but have had record numbers in the last three spawning seasons. In 2010/11 a record 2,315 adults Chinook salmon pass the facility, with record numbers of spawners in 2011/12 (2,436) and in 2012/13 (3,471) (S. Harris, CDFG, personal communication, 2013). Based on Spence *et al*.(2008), and assessments by NMFS staff, the current habitat available in the Upper Eel River Chinook salmon population (including the habitat above Scott Dam) needs to produce a spawner abundance of 9,500 adults to be considered low risk of extinction.

Chinook salmon are present in most of the larger tributaries across the basin (NMFS 2005). Generally, CDFW conducts spot surveys during the fall and winter months to determine spawning distribution of adult salmon. Abundance estimates for juvenile or smolt Chinook salmon are not available for this population.

History of Land Use

Prior to the European intrusion in the 17th and 18th centuries, native Indians utilized the fishery resources of the Eel River. Native Americans also used fire in coastal areas to clear areas for tribal activities. It is very evident that the Eel River system has undergone profound changes in its physical and biological features since the initial Euro-American settlement in the region 150 years ago.

In 1908, construction of Cape Horn Dam was completed on the mainstem Eel River and water diversions to the Russian River for hydroelectric power and agriculture began via the Potter Valley Project (SEC 1998). Water diverted through the tunnel for power and not collected by the Potter Valley Irrigation District (PVID) continues down the East Fork of the Russian River. Scott Dam was built upstream in 1922, creating Pillsbury Reservoir to store water in order make the diversion continuous year around, along with hydropower production. According to some habitat assessments above Scott Dam, following construction approximately 35 to 100 miles of anadromous salmonid spawning and rearing habitat was blocked (VTNO 1982; USFS and USBLM 1995).

Following WWII, mechanized logging was conducted in many areas of the watershed. Due to the near-absence of regulations, large swaths were clear-cut and subject to highly-erodible road construction on steep hillsides. The watershed was then susceptible to massive erosion as the result of record rainfall and floods in 1955 and 1964 (USEPA 2005). The erosion resulted in 10-20 m of sediment being deposited in the main river channels, filling in most deep pools (Lisle 1982). River channels became wide and shallow, with little riparian vegetation for stabilization or shade. Following the massive 1964 flood, populations of anadromous fish did not recover, a recovery made even more difficult by the illegal introduction and explosive population expansion of the predatory Sacramento pikeminnow in 1979 (Brown and Moyle 1997).

In 1972, protection of the Eel River and its forks from new dams was more or less assured by declaring much of it as a California Wild and Scenic River, a status adopted by the Federal government in 1981. Headwaters of the Eel River were protected by designation by Congress of the Yolla Bolly Eel River Wilderness area in 1964, the North Fork Wilderness in 1984, and the South Fork Eel Wilderness in 2006 (http://www.fs.fed.us/r5/mendocino/recreation/). In addition

various stands of redwood forest were protected in state and national parks, as well as in preserves.

Salmon canneries operated on the Eel River during the late-19th and early-20th centuries, producing a peak output of 15,000 cases of canned salmon during 1883 (Yoshiyama and Moyle 2010). The cannery data can be roughly translated into minimal population estimates which average about 93,000 fish per year during the period 1857-1921 and evidently approached 600,000 fish in the peak year 1877, mostly Chinook salmon. Given that the cannery records result in a very conservative estimate of Chinook salmon numbers, the records suggest that historic runs of Chinook salmon probably ranged between 100,000 and 800,000 fish per year, declining to roughly 50,000-100,000 fish per year in the first half of the 20th century (Yoshiyama and Moyle 2010).

Steiner Environmental Consulting (SEC 1998) reports that, since the early 1900s, more than 39 million Chinook salmon fry have been planted in the Eel River system. The vast majority of these were eggs and fry of Sacramento River origin planted in the lower mainstem prior to 1920. Between 1921 and 1960, the number of Chinook salmon planted to the Eel River is unknown due to lack detailed planting records. From 1971 to 1980, most Chinook salmon plantings occurred at the Van Arsdale Fisheries Station (upper mainstem Eel River) or in the South Fork Eel River. The vast majority of these fish originated from Iron Gate Hatchery on the Trinity River. The South Fork Eel River and Outlet Creek were the sites of most planting between 1981 and 1990. All Chinook salmon planted after 1981 were of Eel River origin.

Current Resources and Land Management

Land use in the watershed is a mixture of private and public, including the Mendocino and Six Rivers National forests, BLM, and tribal land. There are four wilderness areas managed by the USFS and BLM in the watershed. The San Hedrin Wilderness (10,571 acres), Yolla Bolly Middle Eel Wilderness (approximately 180,000 acres), Snow Mountain Wilderness (60,076 acres) and the Yuki Wilderness area (53,887 acres) which is managed by the USFS and BLM. The USFS manages the upper watershed in the Middle Fork Eel River, Black Butte River, and Eel River (above Lake Pillsbury) under the Land and Resource Management Plan (LRMP) for the Mendocino National Forest. The Round Valley Indian Tribe (RVIT) manages their areas of the watershed under a Resource Management Plan.

Today the Potter Valley Project (PVP) is operated by the Pacific Gas & Electric Company (PG&E) and includes the mainstem Eel River from Scott Dam downstream to Van Arsdale Reservoir, (SEC 1998). The PVP is operated under the conditions set forth in NMFS' 2002 Biological Opinion (BO) and in the January 2004 FERC license. The BO requires prescribed flow releases from Scott Dam

targeting improved spawning, rearing, and passage flows for Chinook salmon and NC steelhead downstream of the dam.

The predominant land use is grazing and logging, with patches set aside for recreation, agriculture, and other uses. Conifers dominate only the upper watershed areas across the large area included that provides habitat for this salmon population. Much of the upper Eel River watershed is covered by shrub, grasslands, and oak woodlands. These areas consist of large ranches, many of which are increasingly divided into smaller parcels (USEPA 2005). Many of the smaller parcels are used to produce medical and commercial cannabis which there has been a dramatic increase in the last 10 years in the Outlet Creek watershed (LeDoux-Bloom and Downie 2008). The Round Valley area and the Willits Valley are interior valleys consisting of the main population centers within the Upper Eel River watershed.

Watershed and restoration groups such as the Friends of the Eel River which is a non-profit organization dedicated to restore the Eel River watershed to its natural function. Other groups, including the Eel River Watershed Improvement Group and the Willits Watershed Group, are focused more on community members or landowners that implement restoration projects in specific subbasins. In addition to these groups, the Round Valley Indian Tribe and the USFS Mendocino National Forest are actively engaged in watershed restoration projects which are predominately located in the Middle Fork Eel River and its tributaries, and the upper Mainstem Eel River below Scott Dam.

Salmonid Viability and Watershed Conditions

The following habitat indicators were rated Poor through the CAP process: LWD frequency, shelter rating, pool frequency, gravel embeddedness, and riparian vegetation for pre-smolts, smolts and adult lifestages. Gravel embeddedness for egg incubation was rated Poor and for watershed processes, road densities, and riparian road densities were rated as Poor. Viability for spawning Chinook salmon adults was rated as Fair based on recent spawning surveys conducted by CDFW.

Recovery strategies will typically focus on ameliorating these habitat indicators, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. Indicators that rated as Fair through the CAP process, but are considered important within specific areas of the watershed include passage barriers, and pike minnow predation on juvenile lifestages of Chinook salmon.

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Upper Eel River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Habitat Complexity: Large Wood and Shelter

Suitable shelter ratings are required by juvenile salmonids as well as adult spawners for protection from predators, partitioning of habitat from other fish, and providing areas of reduced velocity for energy conservation. Data from CDFW habitat inventories indicate shelter ratings throughout the Upper Eel River and its tributaries are poor with a few of surveyed 82 habitat surveyed reaches meeting suitability targets for shelter. Poor to fair LWD ratings were also documented within these drainages, due largely to a lack of functional riparian corridors and recruitment of large conifer and hardwoods species from adjacent upslope areas. Reduced shelter ratings in most stream reaches limit the quality of available habitat for juvenile salmon during the spring and early summer.

Habitat Complexity: Percent Primary/Staging Pools and Pool/Riffle/Flatwater Ratios

The frequency of primary pools is poor in most of the tributary streams habitat typed by CDFW. Most sampled streams have a high percentage of flatwater or run habitat which lacks depth, complexity and velocity refuge for juvenile rearing. The lack of pools in this basin likely limits the space available for juveniles attempting to maintain territory for feeding and protection from predators. Lack of pool habitats in the all surveyed stream in this basin may stem from high sediment production (pool filling) and loss of LWD recruitment from past land use practices and large flood events.

Sediment: Gravel Quality and Distribution of Spawning Gravels

Spawning habitat quality is poor in many streams due to road related and chronic mass wasting from slides that occur in the basin. Fifty-three of 82 surveyed reaches did not meet suitable targets for spawning gravel quality (LeDoux-Bloom and Downie 2008). While some recovery of large sediment pulses from the 1955 and 1964 flood events has occurred, road systems, high natural erosion rates, existing slides and grazing to some extent result in high sediment loads that continue to cause reduction in egg survival, and reduce food production and pool volume for rearing.

Landscape Patterns: Agriculture, Timber Harvest, and Urbanization

Sediment transport conditions in the Upper Eel River watershed have a Poor rating in relation to the overall watershed process. The USEPA TMDL, and other studies (GMA 1999) have identified

sediment delivery from roads a limiting factor for salmonids. Although the egg lifestage was not rated as Poor for impaired gravel quality, it was only rated as Fair, and therefore was not suitable in much of the available stream habitat.

Landscape Pattern conditions have an overall Fair rating with respect to overall watershed process. Disturbance from timber harvest and rural residential road development continue to increase sediment transport across the Upper Eel River Basin.

Very Good or Good Current Conditions

Changes in riparian species composition and structure has occurred due to past land use and natural events. The Riparian Vegetation, species composition condition has a Fair rating due to the recovery that has occurred from past land use and natural events such as the 1964 flood. The lack of large riparian species available for recruitment to stream channels throughout the watershed. Stress of altered riparian species composition results in reduced habitat complexity in tributary habitats used for both spawning and rearing. To determine the level of degradation of riparian corridors we relied on riparian shading information developed and used in analysis EPA TMDLs for the Eel River watershed as a surrogate. For example, in the Middle Fork Eel River, USEPA (2003) reports that small (2-3 percent) improvements in canopy in the tributaries and slightly larger (9 percent) in the mainstem reaches are needed to meet natural background levels for this basin. In general, stands are younger (120 years or less) and usually 18-24 inches in diameter (USEPA 2005) and are in the process of recovery.

Fish passage conditions have an overall Fair rating and should be addressed in this watershed. Although the majority of the potential habitat available for spawning and rearing is open to migration, many barriers in tributary streams continue to reduce migration of adult fish into historical habitat. Complete or partial barriers such as dams or road crossings identified in the CDFW passage assessment database may need further assessment to develop specific restoration plans at passage barriers. In addition, recreational fishing and poaching of adult Chinook salmon is known to be an impact on the abundance of adult fish in this population.

Threats

The following discussion focuses on those threats that rate as High or Very High (See Upper Eel CAP results). Recovery strategies will likely focus on ameliorating High rating threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in the Upper Eel CAP results.

Severe Weather Patterns

Large flood events and drought are the greatest threat to this highly erosive watershed. Past flood events in 1995 and 1964 have had devastating effects to salmonid habitat by reducing habitat quality for both salmon and steelhead. Drought conditions can reduce migration potential during the fall and early winter for adult Chinook salmon by reducing access into the upper mainstem Eel River, Middle Fork Eel River, Outlet Creek and Tomki Creek.

Roads and Railroads

High road densities exist throughout most of the Upper Eel River watershed. Roads on both private and public land have been identified in specific USEPA TMDL documents as a source of sediment through increased landslides and surface erosion. Riparian road densities associated with multiple land uses such as forest roads and private ownerships, including rural residential, continue to reduce salmonid habitat suitability by delivering fine sediment to spawning and rearing reaches. Road densities are high across the basin and within riparian areas are 7.0 miles per square mile, and 7.4 miles per square mile, respectively.

Fire, Fuel Management and Fire Suppression

Fire and fuel management associated with high fuel loads exists in the some areas of the watershed, such the Middle Fork Eel River. Due to past fire suppression actions, the watershed had the potential for large scale, high intensity stand replacing wildfires that can then result in increased sediment delivery to stream channels (USFS and BLM 1995). Since the late 1990s, the USFS has implemented prescribed burning to reduce the potential for high intensity fires on their lands in the upper portions of the Middle Fork Eel River. We rated fire management as a Medium threat in this watershed because fire mapping very high fuel loading and Very High threat of fire to occurs in the upper watershed area of the Middle Fork Eel River, the southern watershed area of Tomki Creek, scattered areas in the North Fork Eel River and Outlet Creek.

Water Diversion and Impoundments

Although adult passage across the watershed is good, there are watershed areas where improved passage would provide access to additional spawning and rearing opportunities. Since 1922 Scott Dam has blocked passage to approximately 35.7 miles of Chinook salmon spawning and rearing habitat in the upper mainstem Eel River (VTNO 1982). Passage at this facility would provide habitat for an estimated 1200 spawning adults (Spence *et al*. 2008) and provide additional viability for the Upper Eel River Chinook population. During the upcoming PVP FERC relicensing process, all options to increase Chinook salmon habitat availability above Scott Dam should be thoroughly investigated. Other passage barriers in the watershed include road or highway crossings that are partial barriers.

Channel Modification

Actions which modify or disrupt the natural channel-forming processes and morphology of the Lower Eel River and its estuary have degraded habitat utilized by Chinook salmon. Dikes and levees were constructed in the estuary in order to restrict flow and reclaim tide lands. Remaining streams and sloughs in confined channels have slower flow, allowing them to fill with sediment. The estuary is a fraction of its former size due to extensive channel modification that causes a reduction in available rearing habitat for Chinook salmon smolts.

Disease Predation and Competition

In the 1980s pike minnow were introduced Lake Pillsbury, these non-native species eventually colonized most of the Eel River system. Predation by large pike minnow on Chinook salmon pre-smolts produced in the Upper Eel River is likely an ongoing impact on the population. Quantitative information is not available regarding the level predation and effect on abundance of pre-smolt Chinook salmon. Therefore, a moderate threat level was assigned for loss in abundance and competition that these non-native species present to juvenile lifestages of Chinook salmon.

Fishing and Collecting

Upper Eel River salmon are susceptible to catch and release stress and potential mortality in the estuary and lower mainstem when they enter these reaches during the fall. Sport fishing in the mainstem Eel River is subject to a low flow fishing closure whenever the gage at Scotia is recording flows less than 350 cubic feet per second. However, the low flow season does not begin until October 1st of each year, which allows anglers to target Chinook salmon staging in low flow conditions during late August and September. Adult Chinook salmon are easy targets for both fisherman and poachers at these extremely low flows. Anglers are reported to catch and handle hundreds of adult salmon as these fish hold in the estuary and lower river prior to migrating with the first fall rains (Higgins 2010). Also, tributary areas throughout the basin have long been used by local residents as an opportunity to obtain salmon for food.

Low or Moderate Threats

Timber harvest has been conducted in the watershed for over 150 years. Methods of harvest and regulations have reduced the overall impact of this threat in recent decades. The rate of harvest in this basin has slowed in the last decade, but this threat will continue to exist in the future. For all but the adult lifestage, the threat of timber harvesting activities is rated as a Medium threat to lifestages of salmonids and overall watershed processes. Improved logging methods such as yarding of trees which reduces ground disturbance and reduction in harvesting within riparian zones could keep this threat from becoming a large contributor to habitat stresses throughout the basin.

Limiting Stresses, Lifestages, and Habitats

Based on the type and extent of stresses and threats affecting the population as well as the limiting factors influencing productivity, it is likely that the egg and the pre-smolt lifestage survival are most limited and that gravel quality and rearing habitat is lacking for this population. Pre-smolt rearing habitat is impaired by lack of instream shelter and overall lack of channel complexity instream reaches throughout the basin. Lack of channel complexity results in lack of pools and riffles, reduced cover, and reduce velocity refuge for young salmonids that emerge from the gravel. In addition, the egg lifestage is limited by elevated fine sediment that reduces survival to emergence in many spawning areas of the Upper Eel River and its tributaries. Adult salmon entering the system in late August and September are subjected to recreational fishing impacts in the estuary and lower river prior to low flow closures that begin in October. Adults fish are also subjected to some poaching in remote areas of the watershed.

General Recovery Strategy

Improve Habitat Complexity

Our strategy is to improve large woody debris (LWD) frequency across the Upper Eel River watershed. Improvement in tributary streams such as Outlet Creek, Tomki Creek, Dobbyn Creek and others is likely more realistic due to their size and importance as rearing areas. Riparian areas are in the process of recovery with stands of smaller diameter conifers and hardwoods that currently buffer stream areas. Addition of LWD will provide much needed complexity to stream channel until riparian areas reach maturity at which time they can begin to recruit LWD naturally to channels. LWD will improve instream habitat attributes such as pool and riffle frequency and habitat complexity. LWD will improve survival of Chinook salmon fry as they emerge from gravels and seek cover. Our strategy to improve overall productivity is to increase the extent, access, and quality of rearing areas and space (pools) throughout the basin. These areas will provide important refuge from high flow events and opportunity for increased growth and survival of juveniles during winter and spring. Increasing the LWD frequency is also expected to improve sediment routing by slowing transport and improving spawning gravel quality and cover for adult Chinook salmon.

Improve Habitat and Substrate Quality

Reduced sediment delivery from management caused sources of roads and timber harvest is likely to improve a number of key habitat attributes. Road related sediment delivery has increased in the recent past and must be reduced as part of the recovery in this basin. Upgrading or decommissioning of roads throughout the basin is expected to improve sediment quality for

improved egg survival, improve benthic macro-invertebrate production for juvenile feeding, and reduce pool filling for improved juvenile rearing and migration conditions.

Reduce Sediment Delivery from Road Systems

Many of the road systems on USFS lands, private timberlands, and tribal lands need to be upgraded or decommissioned. Road upgrades and stream crossing repair throughout the watershed will reduce fine sediment delivery to streams and reduce the probability of increasing landslide potential. The frequency of severe weather patterns is expected to increase, and therefore, roads in this basin must be disconnected from stream networks or decommissioned to provide additional resiliency to large flood events that have had devastating effects to salmonid habitat in the past.

Improve Canopy Cover and LWD Frequency

Tributaries streams within this watershed would benefit from improved riparian composition and structure, which would increase stream shading, improve LWD recruitment, and increase instream shelter for juvenile fish. General practices to improve riparian condition include increased number of riparian conservation easements (Covelo area), reduced harvest and improved protection of riparian areas, riparian planting and livestock exclusion fencing where appropriate.

Restore and Improve Fish Passage

Thirty to forty-five miles of historical Chinook habitat is blocked by Scott Dam. Of this, much of the highest quality spawning habitat is inundated by Lake Pillsbury. Therefore, a fish passage facility *only* providing access over Scott Dam may not yield desired productivity targets for Chinook salmon. Thorough investigations need to occur to determine if decommissioning of Scott Dam is a feasible options and if it is necessary to achieve long-term viability of the Upper Eel River Chinook population. If decommissioning of Scott Dam were to occur, the return of the natural hydrologic regime, sediment transport, and habitat availability would improve historical spawning habitat and flow regimes for the rearing and outmigration of juvenile Chinook salmon. The FERC re-licensing process for the Potter Valley Project begins in 2017 and will require thorough evaluations of all potential impacts associated with the Potter Valley Project. These evaluations may require additional measures than those that currently exist to ensure that the Upper Eel River Chinook population is on a viable long-term recovery trajectory. Additional areas to address Upper Eel River Chinook population barriers include impediments in Long Valley and Cave creeks as identified by CDFW passage assessment database.

Reduce Illegal Poaching and Recreation Fishing Pressure

Additional resources must be allocated to protect adult Chinook salmon from poaching during the fall migration and during spawning in smaller tributary streams. Reduction or halting recreational fishing for adult Chinook salmon in the lower mainstem Eel River and estuary should be considered to reduce incidental take from recreational fishing. Coordination with the RVIT to harvest sustainable levels of adult Chinook salmon on tribal lands will improve abundance and ensure future use by tribal members.

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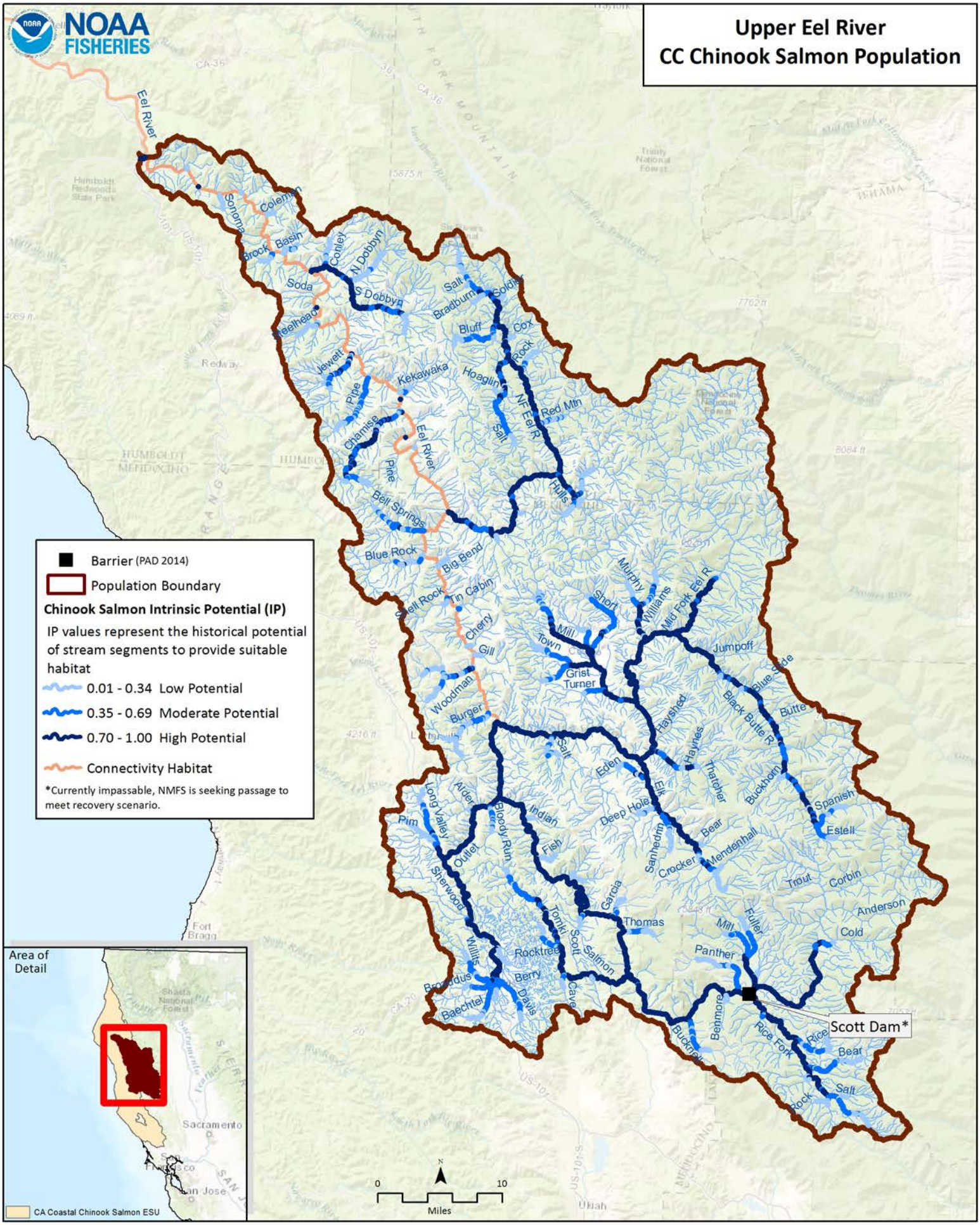
Upper Eel River
CC Chinook Salmon Population
NOAA FISHERIES
Barrier (PAD 2014)
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Connectivity Habitat
*Currently impassable, NMFS is seeking passage to meet recovery scenario.
Area of Detail
CA Coastal Chinook Salmon ESU
Scott Dam*
Eel River
Sonoma
Colemen
Brock
Basin
Conley
N Dobbyn
S Dobbyn
Soda
Steelhead
Salt
Bradburn
Soldier
Bluff
Cox
Rock
Jewett
Kekawaka
Hoaglin
Pine
Chamise
NF Eel R
Red Mtn
Salt
Eel River
Pine
Hulls
Bell Springs
Blue Rock
Big Bend
Tin Cabin
Shell Rock
Cherry
Gill
Woodman
Burger
Murphy
Short
Williams
Mid Fork Eel R
Mill
Town
Grist
Turner
Jumpoff
Blue Slide
Haywood
Black Butte R
Butte
Haynes
Thatcher
Buckhorn
Spanish
Estell
Salt
Eden
Elk
Deep Hole
Bear
Mendenhall
Sanhedrin
Crocker
Trout
Corbin
Anderson
Cold
Garcia
Thomas
Mill
Fuller
Panther
Alder
Long Valley
Pim
Bloody Run
Indian
Fish
Outlet
Sherwood
Tomki
Scott
Salmon
Rocktree
Willits
Berry
Cave
Broaddus
Baechtel
Davis
Benmore
Buckner
Rice Fork
Rice
Bear
Salt
Rock
Fort Bragg
Redway
Ukiah
Sacramento
San Jose
0
10
Miles
N

CC Chinook Salmon Upper Eel River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>20% average staging pool frequency)	51% to 74% of streams/ IP-Km (>20% average staging pool frequency)	75% to 89% of streams/ IP-Km (>20% average staging pool frequency)	>90% of streams/ IP-Km (>20% average staging pool frequency)	51% to 74% of streams/ IP-km (>20% average staging pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	2% streams/ 3% IP-km (>40% Pools; >20% Riffles)	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	20% Class 5 & 6 across IP-km	Poor

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		1-20 Spawners per IP-km: low risk spawner density per Spence (2008)	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	50-74% of Historical Range	Fair
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 67	Fair
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	Fair
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	35% streams/ 28% IP-km (>50% stream average scores of 1 & 2)	Poor

3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>40% average primary pool frequency)	51% to 74% of streams/ IP-Km (>40% average primary pool frequency)	75% to 89% of streams/ IP-Km (>40% average primary pool frequency)	>90% of streams/ IP-Km (>40% average primary pool frequency)	1% streams 17% IP-km (>40% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	2% streams/ 3% IP-km (>40% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	5% streams/ 4% IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.49 Diversions/10 IP-km	Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	20% % Class 5 & 6 across IP-km	Poor

			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	35% streams/ 28% IP-km (>50% stream average scores of 1 & 2)	Poor
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	50-74% of Historical Range	Fair
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	5% streams/ 4% IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.49 Diversions/10 IP-km	Good

			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100 of IP-km	Very Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	35% streams/ 28% IP-km (>50% stream average scores of 1 & 2)	Poor
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.093% of Watershed in Impervious Surfaces	Very Good

			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	0.153% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	4% of Watershed in Timber Harvest	Very Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	1% of watershed >1 unit/20 acres	Very Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	1.7 Miles/Square Mile	Good
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	1.6 Miles/Square Mile	Poor

CC Chinook Salmon Upper Eel River CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Low	Low	Low	Low	Low	Low
2	Channel Modification	Low	Low	Low	Low	Low	Low
3	Disease, Predation and Competition			Medium	Medium		Medium
4	Fire, Fuel Management and Fire Suppression	Low	Medium	Low	Low	Medium	Medium
5	Fishing and Collecting	High					High
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Low	Low	Low		Low	Low
8	Logging and Wood Harvesting	Low	Medium	Medium	Low	Low	Medium
9	Mining	Low	Low	Low	Low	Low	Low
10	Recreational Areas and Activities					Low	Low
11	Residential and Commercial Development	Low	Low	Low	Low	Low	Low
12	Roads and Railroads	Medium	High	High	Medium	High	High
13	Severe Weather Patterns	Medium	High	Medium	Medium	Medium	Medium
14	Water Diversion and Impoundments	Medium	Low	Low	Low	Low	Low

Upper Eel River, Chinook Salmon (North Mountain Interior) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
UER-CCCh-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
UER-CCCh-3.1.1	Recovery Action	Hydrology	Improve flow conditions				
UER-CCCh-3.1.1.1	Action Step	Hydrology	Restore unimpaired flows and access to historical spawning and rearing areas.	1	20	CDFW, FERC, NMFS, PG&E, RVIT	
UER-CCCh-3.1.1.2	Action Step	Hydrology	Investigate modifying operations of Van Arsdale Fish Station then consider the decommissioning of Scott Dam.	1	5	CDFW, FERC, NMFS, PG&E, RVIT	
UER-CCCh-3.1.1.3	Action Step	Hydrology	Investigate the effectiveness of current streamflow regimes associated with Chinook salmon and the PVP. Based on the investigation, make any necessary changes to flow requirements during the upcoming FERC relicensing process to ensure PVP effects on streamflow are consistent with recovery of CC Chinook salmon.	1	10	CDFW, FERC, NMFS, PG&E, RVIT	
UER-CCCh-3.1.1.4	Action Step	Hydrology	Investigate the feasibility of decommissioning and removing Scott Dam located on the mainstem Eel River.	1	5	CDFW, FERC, NMFS, PG&E, Sonoma County Water Agency, RVIT	
UER-CCCh-3.1.1.5	Action Step	Hydrology	Investigate the effectiveness of "block water" releases from Scott Dam.	1	5	CDFW, FERC, NMFS, PG&E, RVIT	
UER-CCCh-3.1.1.6	Action Step	Hydrology	Install flow gages at above Lake Pillsbury on the Eel River and the Rice Fork of the Eel River, and below the dam at Tomki Creek.	1	20	CDFW, FERC, NMFS, PG&E, RVIT	
UER-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
UER-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
UER-CCCh-5.1.1.1	Action Step	Passage	Evaluate volitional and non-volitional passage methodologies above Scott Dam (including the actions below) and prescribe the most effective passage methodology(ies).	1	5	CDFW, NMFS, PG&E	
UER-CCCh-5.1.1.2	Action Step	Passage	Determine the quantity and quality of historic habitat above Scott Dam.	1	3	CDFW, FERC, NMFS, PG&E, USFS	
UER-CCCh-5.1.1.3	Action Step	Passage	Investigate the current fish species composition and population dynamics above Scott Dam.	1	5	CDFW, FERC, NMFS, PG&E, USFS	
UER-CCCh-5.1.1.4	Action Step	Passage	Determine the potential for habitat restoration for Chinook salmon above Scott Dam.	1	2	CDFW, FERC, NMFS, PG&E, USFS	
UER-CCCh-5.1.1.5	Action Step	Passage	Provide passage over physical barriers that preclude Chinook salmon from accessing important habitat areas (list below indicates the locations with passage problems).	2	10	CDFW, NOAA RC	
UER-CCCh-5.1.1.6	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Salt Creek in the North Fork Eel River watershed (Passage Assessment ID 715446).	2	5	CDFW, Mendocino County RCD, NOAA RC	
UER-CCCh-5.1.1.7	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Island Mountain Bridge on Chamise Creek (Passage Assessment ID 722589).	2	5	CDFW, NOAA RC	
UER-CCCh-5.1.1.8	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at the culvert on Sonoma Creek on the Whitlow Road Bridge (Passage Assessment ID 715488).	2	5	CDFW, NOAA RC	
UER-CCCh-5.1.1.9	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Bluft Creek (Passage Assessment ID 707894).	2	5	CDFW, NOAA RC	
UER-CCCh-5.1.1.10	Action Step	Passage	Evaluate, design, and implement appropriate fish passage on Long Valley Creek at Highway 101 at three sites (Passage Assessment ID 707090, 707091, and 707094).	2	5	CDFW, NOAA RC	
UER-CCCh-5.1.1.11	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at nine road crossings on Cave Creek in the Tomki Creek watershed.	2	5	CDFW, NOAA RC	
UER-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
UER-CCCh-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
UER-CCCh-6.1.1.1	Action Step	Habitat Complexity	Implement a large woody debris or other large roughness elements supplementation program to increase stream complexity to improve pool frequency and depth.	2	20	CDFW, NRCS, Private Landowners, USFS	
UER-CCCh-6.1.1.2	Action Step	Habitat Complexity	Develop a plan or priority list that identifies specific stream reaches that would suitable for conducting instream habitat complexity projects.	2	1	CDFW, NMFS, Round Valley Indian Tribe, USFS	
UER-CCCh-6.1.1.3	Action Step	Habitat Complexity	Encourage landowners (private, USFS, and Round Valley Indian tribe) to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	20	CDFW, Private Landowners, USFS	

Upper Eel River, Chinook Salmon (North Mountain Interior) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
UER-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
UER-CCCh-7.1.1	Recovery Action	Riparian	Improve canopy cover				
UER-CCCh-7.1.1.1	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers.	2		CDFW, Mendocino County RCD, NMFS, Private Landowners	
UER-CCCh-7.1.1.2	Action Step	Riparian	Protect existing riparian areas from timber harvest, rural residential, and grazing activities to maintain LWD supply and canopy recovery.	1	60	CalFire, CDFW, County of Mendocino, CDFW, NMFS	
UER-CCCh-7.1.1.3	Action Step	Riparian	Prioritize and fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream).	2	10	CDFW, Mendocino County RCD, NOAA RC, NRCS, Private Landowners	
UER-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
UER-CCCh-10.1.1	Recovery Action	Water Quality	Reduce turbidity and suspended sediment				
UER-CCCh-10.1.1.1	Action Step	Water Quality	Develop and fund a feasibility study to address the significant turbidity issues from Lake Pilsbury/Scott Dam outlet	2	2	CDFW, NMFS, PGE	
UER-CCCh-10.1.1.2	Action Step	Water Quality	Fund and implement recommendations from proposed feasibility study to address significant turbidity issues from the Lake Pilsbury/Scott Dam outlet.	2	5	CDFW, NMFS, PGE	
UER-CCCh-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
UER-CCCh-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure and diversity				
UER-CCCh-11.1.1.1	Action Step	Viability	Evaluate the potential loss of habitat above Scott dam relative to the potential contribution to the overall Chinook recovery population target in the Eel river watershed.	1	5	CDFW, NMFS, PG&E, USFS	
UER-CCCh-11.1.1.2	Action Step	Viability	Investigate juvenile Chinook migratory patterns through the Van Arsdale diversion facility. Consider utilizing radio telemetry equipment to conduct study.	1	5	CDFW, NMFS, PG&E	
UER-CCCh-11.1.1.3	Action Step	Viability	Conduct spawning surveys to determine habitat use above the Van Arsdale Fish station.	1	5	CDFW, PG&E, USFS	
UER-CCCh-11.1.1.4	Action Step	Viability	Continue and conduct annual monitoring of adult and juvenile Chinook salmon at the Van Arsdale Fish Station.	1	10	CDFW, FERC, NMFS, PG&E	
UER-CCCh-11.1.1.5	Action Step	Viability	Develop and implement a robust fisheries monitoring program for the Eel River watershed including all species of salmonids. Salmonid population trends are critical for achieving recovery criteria and ensuring proper management of in-river and ocean fisheries.	1	5	CDFW, FERC, NMFS, PG&E	
UER-CCCh-14.1	**Objective**	**Disease/Predation/Competition**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
UER-CCCh-14.1.1	Recovery Action	Disease/Predation/Competition	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
UER-CCCh-14.1.1.1	Action Step	Disease/Predation/Competition	Reduce predation and competition of pike minnow on juvenile Chinook salmon.	1	20	CDFW, FERC, NMFS, PG&E, Sonoma County Water Agency	
UER-CCCh-14.1.1.2	Action Step	Disease/Predation/Competition	Implement the most cost effective methods or programs of pike minnow control in the Upper Eel River watershed.	1	20	CDFW, FERC, NMFS, PG&E	
UER-CCCh-14.1.1.3	Action Step	Disease/Predation/Competition	Support investigations that determine the most effective methods to control the pike minnow population.	1	20	CDFW, NMFS, PG&E	
UER-CCCh-15.1	**Objective**	**Fire/Fuel Management**	**Address the inadequacies of regulatory mechanisms**				
UER-CCCh-15.1.1	Recovery Action	Fire/Fuel Management	Prevent or minimize increased landscape disturbance				
UER-CCCh-15.1.1.1	Action Step	Fire/Fuel Management	Identify historical fire frequency, intensities and durations and manage fuel loads in a manner consistent with historical parameters.	3	5	NMFS, USFS	
UER-CCCh-15.1.1.2	Action Step	Fire/Fuel Management	Work with Calfire to reduce fuel loads on private lands ranked as Very High within the Middle Fork Eel River, Tomki Creek, and the mainstem Eel River upstream of Dos Rios.	2	10	CalFire, Private Landowners, USFS	

Upper Eel River, Chinook Salmon (North Mountain Interior) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
UER-CCCh-15.1.1.3	Action Step	Fire/Fuel Management	Work with USFS to reduce fuel loads in the Mendocino National Forest through prescribed burns or other methods.	2	10	NMFS, USFS, USFWS	
UER-CCCh-16.1	**Objective**	**Fishing/Collecting**	**Address the inadequacy of existing regulatory mechanisms**				
UER-CCCh-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
UER-CCCh-16.1.1.1	Action Step	Fishing/Collecting	Work with CDFW to modify Eel River regulations at 14 CCR Section 7.50(b)(63)(A)-(C), to reduce mortality of sport catch and release Chinook salmon in the lower mainstem Eel River.	1	5	CDFW, NMFS	
UER-CCCh-16.1.1.2	Action Step	Fishing/Collecting	Reduce poaching of adult Chinook salmon by increasing law enforcement.	1	10	CDFW Law Enforcement, NMFS OLE	
UER-CCCh-16.1.1.3	Action Step	Fishing/Collecting	Investigate the potential to develop a State-Tribal agreement governing Indian Fishing under California Fish and Game Code Sections 16000-16011 with the RVIT to promote the recovery of Chinook and steelhead in the Eel River watershed.	1	10	CDFW Law Enforcement, NMFS OLE, Pomo Tribe, Round Valley Indian Tribe	
UER-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
UER-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
UER-CCCh-23.1.1.1	Action Step	Roads/Railroads	Develop a Riparian Road Sediment Reduction Plans for private landowners or associations that prioritizes sites and outlines implementation and a time line to complete necessary actions.	2	5	CDFW, Mendocino County Department of Public Works, NMFS, Private Landowners	
UER-CCCh-23.1.1.2	Action Step	Roads/Railroads	Implement road upgrades at high priority sites or systems.	2	10	CDFW, Mendocino County RCD, NMFS, NRCS, Private Landowners	
UER-CCCh-23.1.1.3	Action Step	Roads/Railroads	Implement road upgrades and/or decommissioning on industrial timberland in the upper Black Butte watershed.	2	10	CDFW, NOAA RC, Private Landowners	
UER-CCCh-23.1.1.4	Action Step	Roads/Railroads	Upgrade USFS roads that are used for public or administrative use. Decommission roads in the Mendocino National Forest based on USFS prioritization.	2	10	CDFW, NOAA RC, USFS	
UER-CCCh-23.1.1.5	Action Step	Roads/Railroads	Fund project development and implementation of upgrades to crossings on County of Mendocino road on Cave Creek, tributary to Tomki Creek.	2	10	CDFW, NMFS, USFS	
UER-CCCh-23.1.1.6	Action Step	Roads/Railroads	Work with the County of Mendocino DOT to upgrade existing high priority riparian road segments identified by the county.	2	5	CDFW, County of Mendocino, NMFS	
UER-CCCh-23.1.1.7	Action Step	Roads/Railroads	Work with private landowners to upgrade existing high priority roads, or those identified in a sediment reduction plan.	2	10	CDFW, County of Mendocino, NMFS, Private Landowners	

Van Duzen River Subset of the Lower Eel River Population

CC Chinook Salmon Fall-Run

- Role within ESU: Role within ESU: A subset with the Lower Eel River Functionally Independent Population
- Diversity Stratum: North Mountain Interior
- Spawner Abundance Target: 2,900 adults (includes Larabee Subset)
- Current Intrinsic Potential: 144.0 IP-km (includes Larabee Subset)

For information regarding NC steelhead and SONCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the SONCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Salmon Abundance and Distribution

There are two natural barriers on the mainstem of the Van Duzen River that limit passage of adult Chinook salmon (CDFG 2012a): Salmon Falls, at River Mile 36.7 near the confluence of Bloody Run Creek, and Eaton Roughs located at River Mile 46. Salmon Falls usually blocks all upstream access to adult Chinook salmon. One steelhead has been documented upstream of Eaton Roughs, based on genetic sampling (Brett Harvey, USFS, personal communication, May 12, 2016). There are limited data documenting Chinook salmon abundance in the Van Duzen River, and existing data are inconclusive (CDFG 2012b). Increased numbers of adult fall-run Chinook salmon have returned to the Van Arsdale Fishery Station (VAFS) on the Upper Eel River since 2010. Although the relationship between returns to Eel River tributaries such as the Van Duzen River and VAFS counts in the Upper Eel River is unknown, a record number of Chinook salmon were counted at the VAFS in 2010, 2011, and 2012 with 2,315 Chinook salmon in 2010; 2,436 returning in 2011; and 3,471 in 2012 (CDFG 2012b; CDFW 2016). It is likely that the Van Duzen River has experienced a similar upward trend in recent years. On October 28, 2012, divers observed an estimated 800 to 1,200 adult fall-run Chinook salmon in a pool at the mouth of the Van Duzen River (Higgins 2012). The proportion of these fish which ultimately spawned in the Van Duzen River population area is unknown.

History of Land Use

Historically, the Van Duzen River basin consisted primarily of late-seral redwood/Douglas-fir (coniferous) forests with limited open oak woodland/prairies farther inland at higher elevations. Beginning near the turn of the twentieth century, logging led to development of hardwood-dominated forests and reduced large wood recruitment potential to streams (CDFG 2012a). In addition, floodplain and estuarine wetland areas were cleared, diked, and drained to provide

land for agriculture and urban development. Technological developments after World War II enabled logging and road building in steeper, more landslide prone areas. This caused excessive sediment delivery to streams, especially following large floods in 1955 and 1964, resulting in shallow pools and wide streams. Past gravel mining in the Lower Eel River likely contributed to braiding and flattening of the Eel River between the confluence with the Van Duzen River to one mile downstream of Fernbridge (Humboldt County Department of Public Works 1992).

Rural residences, small ranches, and agriculture have increased the demand for water. Currently, much of this demand is accommodated through instream diversions or shallow wells, which have lowered streamflows during summer low-flow periods.

Current Resources and Land Management

About 18 percent of the Van Duzen River basin is under Federal ownership, and the remaining 82 percent is owned by private entities. Of this 82 percent, 15 large ranches make up 30 percent of the land, industrial timberlands make up 27 percent, and small private rural developments make up 25 percent (CDFG 2012a).

Several watershed groups are active in the basin: the Eel River Watershed Improvement Group, Friends of the Eel River, Friends of the Van Duzen River, Eel River Recovery Project, and the Yager/Van Duzen Environmental Stewards. NMFS considered the following existing management plans and other documents, which identify actions to improve conditions in the Van Duzen River basin, during preparation of this document.

- Recovery Strategy for California CCC Coho Salmon (CDFG 2004);
- Eel River Salmon and Steelhead Restoration Action Plan (CDFG 1997);
- Van Duzen Basin Assessment Report (CDFG 2012a);
- Lower Eel River Watershed Assessment (CDFG 2010);
- Van Duzen River and Yager Creek Total Maximum Daily Load for Sediment (USEPA 1999);
- Lower Eel River Total Maximum Daily Loads for Temperature and Sediment (USEPA 2007);
- Green Diamond Resource Company (GDRC) Aquatic Habitat Conservation Plan (GDRC 2006);
- Humboldt Redwood Company Habitat Conservation Plan (HRC 2012); and
- Yager-Lawrence Watershed Analysis (HRC 2009).

Viability and Watershed Conditions

NMFS ranked the following indicators as Poor for Chinook salmon through the CAP process (see Van Duzen CAP results, Volume III, this plan): quality and extent of estuary habitat, diversions, canopy cover, primary and staging pools, passage flows and passage at the confluence with the Eel River, baseflow, gravel quality, gravel embeddedness, shelter, turbidity, extent of timber harvest, road density, and streamside road density. Other indicators that warrant habitat restoration because they are rated fair include the following: passage flows, frequency of large wood, the ratio of pools to riffles and flatwater, tree diameter, spawning gravels, floodplain connectivity, toxicity, population density, the species richness of aquatic invertebrates, redd scour, instantaneous flow conditions, passage flows, passage at the mouth for smolts, floodplain connectivity, water temperature, and smolt and adult abundance.

The recovery strategy focuses on improving the habitat conditions described by these indicators. Strategies that address other indicators are developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed.

Current Conditions

The following discussion elaborates on those conditions that are rated Fair or Poor as a result of our CAP viability analysis (see Volume III of this plan). The Van Duzen River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Population and Habitat Conditions

Unless otherwise noted, conditions are assessed in all areas utilized by Chinook salmon in the Van Duzen River, including the lower Eel River downstream of the confluence with Van Duzen River and the Eel River estuary.

Sediment: Gravel Quality and Distribution of Spawning Gravels

The EPA listed the Van Duzen River and the Lower Eel rivers as impaired by sediment (USEPA 1999 and 2007). The Eel River is one of the most erodible watersheds in the United States (Brown and Ritter 1971) because of the active tectonic setting, highly erodible soils, and high precipitation. The Eel River carries 15 times as much sediment as the Mississippi River, and more than four times as the Colorado River (Brown and Ritter 1971). Anthropogenic activities in the Eel and Van Duzen rivers have exacerbated these naturally high sediment loads. A study of the continental shelf deposits offshore from the mouth of the Eel River indicates that there has been a sudden, three-fold increase in the rate of sedimentation since 1954 (USEPA 2007).

Fine sediment loads are very high in much of the Van Duzen (USEPA 1999; HRC 2009; CDFG 2012a) and Lower Eel rivers (USEPA 2007; CDFG 2010), leading to embedded gravels and a small

average particle size. Sedimentation of spawning gravel throughout much of the Van Duzen River watershed is a limiting factor to Chinook salmon production (CDFG 2012a).

Sediment conditions have a Poor rating for eggs and pre-smolts and a Fair rating for adults and smolts. Eggs may fail to hatch if excessive sediment loads keep oxygen from reaching them (CDFG 2012a). Insect production can be impaired by excess sedimentation on these riffles (CDFG 2012a). Aggradation has interrupted the connectivity of surface flow in several areas. The Van Duzen River is often isolated from the Eel River by subsurface flows in late summer and early fall, affecting movement of juveniles and migrating adults. An overabundance of sediment is deposited at the confluence of the Van Duzen and Eel rivers each year, which results in sub-surface flows and dry channels (CDFG 2010).

The naturally highly erosive soil in the Van Duzen watershed, combined with steep slopes and dormant landslides resulting from prior land use, leads to higher risk of shallow landslides and debris slides (CDFG 2012a). Treatment of past landslides, and prevention of future ones, is important to reduce sediment delivery to the Van Duzen River and its tributaries. Unstable banks are also sources of sediment delivery.

Habitat Complexity: Large Wood and Shelter

Available data indicate that there are not enough suitable juvenile rearing pools or adult holding pools in the Van Duzen River (CDFG 2012a) and the Yager and Lawrence Creek watersheds of the Van Duzen River (HRC 2009). Many pools are too shallow due to excessive sediment inputs (CDFG 2012a), and those pools available for juvenile use provide insufficient number and diversity of cover elements such as undercut banks, woody debris, and root masses (SEC 2012). Pools in the Van Duzen River are often shallower than is optimal for Chinook salmon use, likely due to excessive sediment loading (CDFG 2012a). Surveys conducted by CDFW indicate that large wood and shelter ratings are Poor throughout the population area, with 3 percent of surveyed streams meeting desired levels for shelter and LWD (SEC 2012). Habitat, large wood and shelter conditions have an overall Poor rating for the pre-smolt and smolt lifestages. Habitat complexity is reduced by a deficit of large wood and a large supply of sediment (CDFG 2012a).

Viability: Density, Abundance, and Spatial Structure

The distribution and abundance of Chinook salmon in the Van Duzen River is unknown but likely slightly reduced compared to historical levels, based on poor habitat conditions in much of the watershed (USEPA 1999; HRC 2009; CDFG 2010; SEC 2012). Although recent trends indicate improved abundance of Chinook salmon in the mainstem Eel River (CDFG 2012b and S. Harris, CDFW, personal communication, January 14, 2013), and some of these fish likely returned to the

Van Duzen River, longer-term data sets (CDFG 2012b) suggest that abundance is well below that needed for the Van Duzen River to be at low risk of extinction (2,186 adults).

Habitat Complexity: Percent Primary Pools and Pool/Riffle/Flatwater Ratios

Available data indicate that there are not enough suitable juvenile rearing pools or adult holding pools in the Van Duzen River (CDFG 2012a) and the Yager and Lawrence Creek watersheds of the Van Duzen River (HRC 2009). Many pools are too shallow due to excessive sediment inputs (CDFG 2012a), and those pools available for juvenile use provide insufficient number and diversity of cover elements such as undercut banks, woody debris, and root masses (SEC 2012). Pools in the Van Duzen River are often shallower than is optimal for Chinook salmon use, likely due to excessive sediment loading (CDFG 2012a). The impacts of reduced pool volume and complexity are exacerbated by the presence of predatory Sacramento pikeminnow, which further limit the use of pools by rearing juvenile Chinook salmon.

Water Quality: Temperature

High water temperature is common during the spring and summer in the mainstem Van Duzen River and many of its tributaries (SEC 2012), which affects rearing juvenile Chinook salmon (CDFG 2012a). Water temperature is also a problem in the summer in the mainstem Eel River and estuary (USEPA 2007; CDFG 2010) affecting juveniles and smolts that utilize this area for rearing and passage. The Lower Eel River is listed as temperature-impaired under section 303(d) of the Clean Water Act (USEPA 2007). Water quality concerns in the Lower Eel River are further described in the profile for the South Fork Eel/Lower Eel River in this document. Poor water quality and quantity also affect adult Chinook salmon, which migrate into and stage in the lower rivers as early as August.

Estuary: Quality and Extent

The Eel River estuary was once a highly complex and extensive habitat area that played a vital role in the health and productivity of Eel River Chinook salmon populations. The Eel River estuary is currently severely impaired because of past diking and filling of tidal wetlands for agriculture and flood protection. Please see the CC Chinook salmon Eel River Overview for a complete discussion of estuarine conditions and needed recovery actions for this area.

Riparian Vegetation: Composition, Cover & Tree Diameter

Tree diameter rated as Fair overall because much of the Van Duzen River is forested with moderate-sized trees, and the species composition is rated Very Good because the watershed is estimated to have 75 percent intact historical riparian species. Riparian conditions have a Fair rating, however many areas of the lower Eel River have poor canopy cover, which falls short of

the 80 percent shade canopy target value used by CDFW (CDFG 2010) to assess habitat condition relative to the target leading to a Poor rating for watershed processes.

Sediment Transport: Road Density

Sediment Transport from road density conditions was rated as Poor. There is an average of 6.8 miles of road per square mile of land in the Van Duzen watershed. Most of these roads are associated with timber harvest activities and rural residences. USEPA (2009) found that half of the human-caused sediment loading in the watershed was due to roads.

Landscape Patterns: Agriculture, Timber Harvest, and Urbanization

The effect of landscape disturbance on watershed conditions has an overall Poor rating because at least one land-disturbing activity occurs in all areas of the watershed: Road density is high across the watershed, forestry occurs over much of watershed, and ranching occurs in some areas. The impact of this disturbance is compounded by the highly erosive soil in the Van Duzen River watershed (CDFG 2012a).

Passage/Migration: Mouth or Confluence and Physical Barriers

Passage/Migration conditions have an overall Poor rating for adults. Passage into the Van Duzen River by adults is severely limited by aggraded sediment at the confluence with the Eel River until flows increase late in the year (CDFG 2012a). These fish must endure poor mainstem conditions while waiting for passage flows, leaving them vulnerable to poaching and predation as well as degrading their condition and health. Sediment accumulation at the mouths of Hely and Root creeks impairs adult fish passage into these tributaries by reducing surface flow (CDFG 2012a).

Water Quality: Turbidity or Toxicity

Extended periods of high turbidity after rain events have been documented in Cummings Creek, Grizzly Creek, Wolverton Gulch, and other areas of the Van Duzen basin (CDFG 2012a). Turbidity levels high enough to affect SONCC coho salmon health (>25 NTU) were documented in several tributaries of the Van Duzen River from 2000 to 2003 (Harkins 2004). Turbidity conditions were rated as Poor for Chinook salmon. Wastewater treatment facilities affect the Lower Eel downstream of the Van Duzen (CDFG 2010). The Loleta wastewater treatment facility accepts both municipal wastewater and wastewater from the Humboldt Creamery and the Loleta Cheese Factory. This facility discharges into percolation/evaporation ponds on the Eel River, and in the winter, these ponds overflow into the Eel River (CDFG 2010).

Hydrology: Impervious Surfaces and Diversions and Impoundments

The proportion of the Van Duzen River watershed covered by impervious surfaces is low (SEC 2012). The number of diversions in the Van Duzen River is unknown but likely increasing due to the medical marijuana industry (see rating of threat of diversions as High). Given that one plant uses 900 gallons of water per season (Humboldt Growers Association 2010), the impacts of water diversions for this industry are likely significant.

Hydrology: Baseflow and Passage Flows

Baseflow and Passage Flows conditions have an overall rating of Fair for all life stages. Chinook salmon are not typically in the river during summer low flow conditions. In early fall or winter, shallow riffles limit upstream migration of adults until sufficient runoff has produced conditions suitable for migration. Erosion and subsequent deposition during larger storm events may be the primary cause for the shallow riffles, rather than the flow conditions present during periods of low stream flow (CDFG 2010).

Hydrology: Redd Scour

Hydrology, redd scour conditions have a Fair rating for eggs in the Van Duzen River. CDFG (2012a) found that peak flows may be more extreme in the Van Duzen River than in past due to timber harvest and other land alterations which may have accelerated the rate at which rainwater runs off the land.

Threats

The following discussion focuses on those threats that rate as High or Very High (see Van Duzen CAP Results). Recovery strategies will likely focus on ameliorating High rating threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Van Duzen CAP Results.

Unless otherwise noted, threats are assessed in all areas utilized by fish originating in the Van Duzen River, including the lower Eel River (downstream of the confluence with Van Duzen River) and the Eel River estuary.

Population and Habitat Threats

Channel Modification

Actions which modify or disrupt the natural channel-forming processes and morphology of the Lower Eel River and its estuary have degraded habitat utilized by Chinook salmon. Dikes and

levees were constructed in the estuary in order to restrict flow and reclaim tide lands. Please see the CC Chinook salmon Eel River Overview for a complete discussion and recovery actions.

Water Diversion and Impoundments

Water diversion and impoundments pose a High threat to adult and presmolt Chinook salmon. As of July 2010, there were 25 licensed, permitted, or pending water rights within the Lower Eel basin (estuary to River Mile 21) and lower Van Duzen River (CDFG 2012a); this is not a complete number of diversions because it does not include users of riparian rights and other diversions that are not registered with the State Division of Water Rights. Water is diverted to water row crops and home gardens, for watering cattle, and for domestic and municipal use by the cities of Fortuna and Rio Dell. Marijuana cultivation has become locally abundant in the Van Duzen River (CDFG 2012a), and the water diversion required to support these plants is placing a high demand on a limited supply of water (S. Bauer, CDFW, personal communication, January 17, 2013). Based on an estimate from the medical marijuana industry, each marijuana plant may consume 900 gallons of water per season (Humboldt Growers Association 2010). Diversions affect flow in the Eel River and Van Duzen River, and impact Chinook salmon by degrading instream habitat conditions. The effects of reduced flow on Chinook salmon is described under the stress "Hydrology: Baseflow and Passage Flows."

Disease, Predation and Competition

The invasive Sacramento pikeminnow is common in some areas of the lower Eel River basin (CDFG 2010) and is abundant in some locations of the mainstem Van Duzen River and in Yager Creek (CDFG 2012a). This species preys upon and competes with juvenile Chinook salmon. The lifestages most affected are presmolt and smolt Chinook salmon. Removal of pikeminnow has been unsuccessful in the Eel River (CDFG 2012a). Pikeminnow prefer warmer water than Chinook salmon do (Bettelheim 2001), so reducing water temperature to match Chinook salmon habitat requirements would make the habitat less suitable to pikeminnow and may help control the species.

Roads and Railroads

As described under the "Sediment Transport: Road Density" stress in this document, high road density in the Van Duzen River and the lower Eel River is problematic for recovery of Chinook salmon in these areas due to its effects on watershed processes. Roads can also alter the hydrology of stream systems resulting in higher peak flows (Ziegler *et al.* 2002).

Fishing and Collecting

Fishing is a High threat to adult Chinook salmon and summer adult steelhead. There is a popular catch-and-release fishery targeting Chinook salmon and steelhead in the Eel River which attracts

hundreds, if not thousands, of anglers every season. California sport fishing regulations do not currently protect these fish during the entire period of lower flow conditions that occur coincident with their spawning migration. Sport fishing in the mainstem Eel River is subject to a low flow fishing closure whenever the gage at Scotia is recording flows less than 350 cubic feet per second. However, the low flow season does not begin until October 1st of each year, which allows anglers to target Chinook salmon and summer adult steelhead staging in low flow conditions during September. The low flow season expires on January 31, which also leaves adults vulnerable to fishing pressure during low flows occurring after February 1. Adult Chinook salmon are easy targets for both fishermen and poachers in these extremely low flows. Poor water quality in September stresses the fish and likely results in increased hook-and-release mortality (Clark and Gibbons 1991).

Bycatch of Chinook salmon occurs in ocean fisheries targeting Chinook salmon stocks that are not protected under the Endangered Species Act. In a biological opinion on the effects of ocean fisheries managed under the Pacific Coast Salmon Plan, NMFS determined that bycatch impacts of these fisheries are likely to jeopardize the continued existence of CC Chinook salmon, and NMFS provided a Reasonable and Prudent Alternative under which the fisheries are managed to avoid the likelihood of jeopardizing the continued existence of CC Chinook salmon (NMFS 2000).

Low or Medium Rated Threats

Livestock Farming and Ranching

The irreversibility of the stresses (*e.g.*, Habitat Complexity: Percent Primary Pools and Pool/Riffle/Flatwater ratios; Habitat Complexity: Large Wood and Shelter; Sediment: Gravel Quality and Distribution of Spawning Gravels) that result from this threat is generally Low, leading to an overall Medium threat rating. Cattle grazing, the predominant land use in the delta grasslands has been a major factor in the degradation of habitat and reduced floodplain connectivity in the Lower Eel and estuary. Ongoing impacts include degradation of water quality by cattle waste and erosion of stream banks and damage to riparian vegetation where cattle have unrestricted access to streams. Diversions associated with livestock watering are considered in the 'Water Diversions and Impoundments' threat.

Logging and Wood Harvesting

Timber harvest is a dominant land use in the basin (CDFG 2012a). The rate of timber harvest on California's north coast has generally decreased over the last 25 years, but in the Van Duzen River basin, the acreage harvested has increased since 1990 (CDFG 2012a). Timber harvest has numerous effects on Chinook salmon habitat, including reducing recruitment of large wood into streams, reduced instream habitat complexity, reducing shade, which can lead to increased water

temperature, and increasing sedimentation. USEPA (1999) found that half of the anthropogenic sediment loading there was due to timber harvest. Much of the forested lands are managed under Habitat Conservation Plans held by Humboldt Redwood Company and Green Diamond Resource Company. The conservation measures in these HCPs (GDRC 2006, HRC 2012) are generally more protective of Chinook salmon habitat than the regulations that would otherwise apply at the time the HCPs were finalized. California's Forest Practice Rules (CFPR) regulate timber harvest on all private lands. NMFS is working collaboratively with the California Board of Forestry to limit the effects of forestry operations on threatened and endangered salmonid populations in California through the CFPR. At this time, however, the rules do not fully address the limiting factors for Chinook salmon.

Agriculture

Agriculture, as defined for this plan, excludes ranching, which is a separate threat. Some row crops are planted and pasture grasses are bailed for winter feed in the lower Eel River (CDFG 2012a), and marijuana cultivation has become locally abundant in the Van Duzen River (CDFG 2012a), but aside from associated water diversions agricultural impacts are of minor impact to Chinook salmon and their habitat. Water diversions to support this agriculture are considered under the 'Water Diversions and Impoundments' threat.

Residential and Commercial Development

Several small towns lie within the Eel River watershed downstream of the Van Duzen River, and the town of Fortuna is the population center in the area. About 12,500 people lived in this area (represented by the principal communities of Ferndale and Fortuna) when the 2004 census was conducted (CDFG 2010). Rural residences also occur elsewhere in the basin. Diversions to support these communities are considered under the 'Water Diversions and Impoundments' threat, and roads associated with these communities are considered under the 'Roads' threat, both elsewhere in this document.

Hatcheries and Aquaculture

There are currently no hatcheries or fish collecting operations in the Eel River or Van Duzen River basin. Adult steelhead originating from hatcheries elsewhere (*e.g.*, Mad River) sometimes stray to the Eel River and the Van Duzen River and are caught by recreational anglers (F. Bajjaliya, CDFG, personal communication, July 24, 2012). These hatchery fish likely have a minor effect on Chinook salmon and steelhead in the Van Duzen River.

Mining

Past gravel mining in the Lower Eel River likely contributed to braiding and flattening of the Eel River between the confluence with the Van Duzen River to one mile downstream of Fernbridge

(Humboldt County Department of Public Works 1992). A shallow, wide channel provides less cover from predation, less food, and higher water temperatures for juvenile fish as the channel is often decoupled from riparian vegetation. Braiding reduces water depth and can become a migration barrier for adult fish, sometimes leading to stranding on shallows and mortality. Gravel extraction occurs in the Lower Eel River and in the Van Duzen River from the mouth upstream to Eaton Falls. These operations are conducted with State and Federal oversight. The Medium threat rating reflects sensitivity of the channel to additional disturbances (*i.e.*, lack of floodplain and channel structure). However, certain gravel extraction trenching methods have been used successfully to address some of the problems associated with the high sediment load in the lower Eel River, including the adult migration barrier that develops at the Van Duzen/Eel River confluence. Current gravel mining methodologies accommodate the narrowing and deepening of channels by using wet trenching techniques.

Recreational Areas and Activities

Recreational activities such as biking, hiking, and equestrian uses occur in the Van Duzen watershed but have a minimal impact on Chinook salmon habitat. In 2010, the U.S. Forest Service approved a motorized travel management plan for the Six Rivers National Forest, including land in the headwaters of the Van Duzen River (USFS 2010). This plan minimizes potential resource damage resulting from use of motorized vehicles in the national forest. Fishing is considered under the "Fishing and Collecting" threat.

Severe Weather Patterns

Floods and droughts constitute a low threat to Chinook salmon in the Van Duzen River basin and the lower Eel River areas they utilize. Sea-level rise associated with climate change is likely to affect Van Duzen River Chinook salmon by reducing the amount of habitat available to Chinook salmon in the Eel River estuary. The amount of sea-level rise expected to occur in the next ten years poses a low threat to Chinook salmon.

Limiting Stresses, Lifestages, and Habitats

Juvenile Chinook salmon are limited by poor rearing conditions during the summer months caused by high water temperature in the lower Eel River and estuary, inadequate pools throughout the Van Duzen River and lower Eel River which don't have enough cover and are too shallow, and much-reduced and degraded estuarine habitat. Fine sediments negatively impact existing habitat throughout both basins. Further, water diversions reduce instream flow in the lower Eel River, exacerbating water temperature issues and limiting passage of juvenile and adult Chinook salmon.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating stresses and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions. The recovery strategy for the Van Duzen River populations is discussed below with more detailed and site-specific recovery actions provided in the Implementation Schedule (see Van Duzen CAP results).

Restore Access to Habitat

Barriers to fish passage do not present a major impediment to restoration and recovery, as reflected by their low stress ranking. Many tributaries to the mainstem Eel River become disconnected and inaccessible in the summer months due to sediment deposition and the resulting sub-surface flows. If the tributaries were accessible, they may provide refuge which is very limited in the Eel River mainstem reaches.

Investigate and Address Water Diversion and Groundwater Extraction and Ensure Instream Flows Are Sufficient

In the Lower Eel and Van Duzen rivers, diversions likely limit Chinook salmon production by impeding passage and degrading habitat. Instream flows should be increased during the summer months by providing incentives to reduce diversions during the summer, establishing a forbearance program using water storage tanks to decrease diversions during periods of low flow, creating water budgets to avoid over allocating water diversions, and ensuring that General Plan or City ordinances account for salmonid habitat needs. Increased enforcement effort may also assist in reducing the extent and magnitude of diversions during critical periods for salmonids.

Increase Habitat Complexity

Pools in the Van Duzen and Lower Eel rivers are too simplified and shallow to support Chinook salmon growth and survival. Large wood, boulders, or other instream structure should be added (especially in areas with cool water) in order to increase complexity and sort sediment. Off-channel ponds, alcoves, and backwater habitat should be restored in the Van Duzen River and its tributaries and in lower Eel River tributaries.

Reduce Water Temperature

High water temperatures limit growth and survival of juvenile Chinook salmon. In streams with insufficient stream canopy, riparian vegetation should be managed to increase shade. Livestock fencing should be used to protect riparian vegetation from cattle to maintain existing shade from

this vegetation. Instream flows should be sufficient so that they do not contribute to excessive water temperature.

Reduce Sediment Supply

Ongoing sediment loading from roads and unstable slopes contributes to poor Chinook salmon habitat conditions. Roads should be hydrologically disconnected from streams; road-stream connections should be assessed and prioritized, and this assessment should be used to determine which roads to decommission, upgrade, or maintain. Local government should develop a grading ordinance for building and maintenance of private roads that minimizes effects on Chinook salmon habitat.

Improve Fishing Regulations

The recreational fishery for Chinook salmon and steelhead on the Eel River is likely impacting both species. The effects of this fishery on these species should be determined, and regulators should consider changes to regulations to protect these species during low flows.

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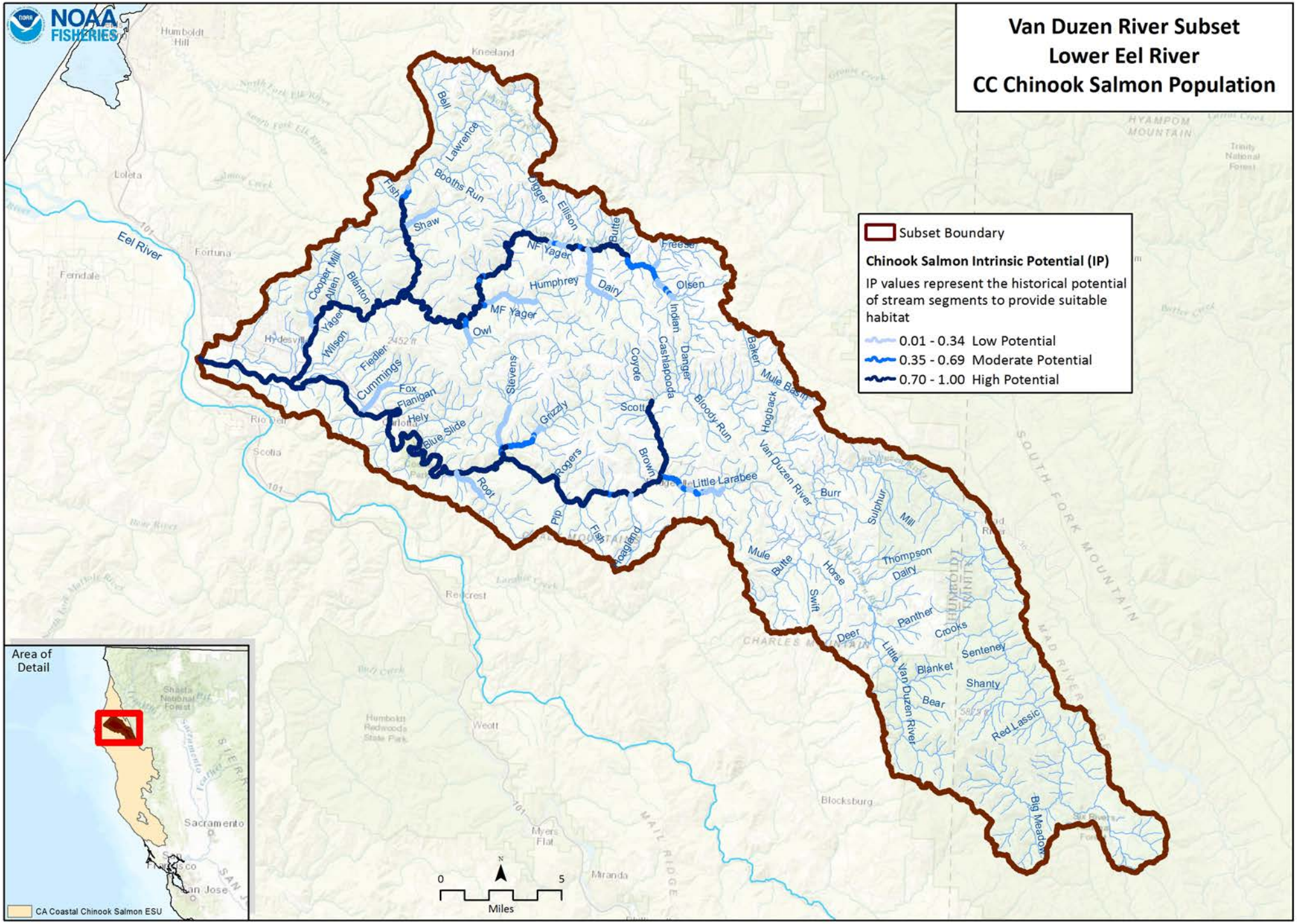

Van Duzen River Subset
Lower Eel River
CC Chinook Salmon Population
Subset Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Area of Detail
CA Coastal Chinook Salmon ESU
0
5
Miles
Eel River
Van Duzen River
Little Larabee
Bell
Lawrence
Booths Run
Fish
Shaw
Digger
Ellison
Butte
Freese
NF Yager
Humphrey
Dairy
Olsen
MF Yager
Owl
Cooper Mill
Allen
Blanton
Yager
Wilson
Fiedler
Cummings
Fox
Flanigan
Hely
Blue Slide
Stevens
Grizzly
Coyote
Scott
Indian
Cashapooda
Danger
Bloody Run
Baker
Mule Basin
Hogback
Rogers
Brown
Root
Pip
Fish
Roagland
Burr
Sulphur
Mill
Mule
Butte
Horse
Swift
Thompson
Dairy
Panther
Crooks
Deer
Senteney
Blanket
Shanty
Bear
Red Lassic
Big Meadow
Humboldt Hill
Kneeland
Loleta
Fortuna
Ferndale
Hydesville
Rio Dell
Scotia
Redcrest
Weott
Blocksburg
Myers Flat
Miranda
Sacramento
San Jose
SOUTH FORK MOUNTAIN
MAD RIVER
CHARLES MOUNTAIN
HYAMPOM MOUNTAIN
MAIL RIDGE

CC Chinook Salmon Van Duzen River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Fair
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	0% of streams/ IP-Km (>49% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	76% of streams/ IP-km (>30% Pools; >20% Riffles)	Fair
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.22-0.35	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-km accessible	Poor
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	41.45% Class 5 & 6 across IP-km	Fair

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	38-50 & 110-128	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	69.17	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	17.35	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	28.92	Fair
		Size	Viability	Density	<1 spawner per IP-km (Spence et al. 2008)	>1 and <20 spawners per IP km	There should be 20 Spawners per IP-km to achieve a low risk of extinction (Spence et al. 2008)		1-20 Spawners per IP-km	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good

			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	18.15	Poor
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	43% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	38-50 & 110-128	Fair
3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	51% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	<50% of streams/ IP-km (>49% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	76% of streams/ IP-km (>30% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	1% of streams/ IP-km (>80 stream average)	Poor
			Habitat Complexity	VStar	>0.35	0.22-0.35	0.15 - 0.21	<0.15	0.22-0.35	Fair
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75.	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair

Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	>5 Diversions/10 IP km	Poor
Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-km accessible	Fair
Riparian Vegetation	Species Composition	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	41.45% Class 5 & 6 across IP-km	Fair
Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	38-50 & 110-128	Fair
Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	43% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
Water Quality	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	69.17	Good
Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	17.35	Fair

			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	28.92	Fair
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	1% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	>5 Diversions/10 IP km	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km.	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Good
			Sediment (Food Productivity)	D50 (mm)	<38 >128	38-50 & 110-128	50-60 & 95-110	60-95	38-50 & 110-128	Fair
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	43% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair

			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
			Water Quality	Aquatic Invertebrates (B-IBI NorCal)	0-40	40-60	60-80	80-100	69.17	Good
			Water Quality	Aquatic Invertebrates (EPT)	<=12	12.1-17.9	18-22.9	>=23	17.35	Fair
			Water Quality	Aquatic Invertebrates (Rich)	<25	25-30	30-40	>40	28.92	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.12% of Watershed in Impervious Surfaces	Very Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	20-30% of Watershed in Agriculture	Fair
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	>35% of Watershed in Timber Harvest	Poor
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	2% of Watershed >1 unit/20 acres	Very Good

			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	>75% Intact Historical Species Composition:	Very Good
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	6.76 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	5.68 Miles/Square Mile	Poor

CC Chinook Salmon Van Duzen River CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Medium	Low	Medium	Medium	Low	Medium
2	Channel Modification	Medium	Low	High	High	Medium	High
3	Disease, Predation and Competition	Medium	Low	High	High		High
4	Fire, Fuel Management and Fire Suppression	Medium	Low	Medium	Medium	Low	Medium
5	Fishing and Collecting	High		Low	Low		Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium
8	Logging and Wood Harvesting	Medium	Medium	Medium	Medium	Medium	Medium
9	Mining	Low	Medium	Medium	Medium	Medium	Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Low	Medium
11	Residential and Commercial Development	Medium	Medium	Medium	Medium	Medium	Medium
12	Roads and Railroads	Medium	Medium	Medium	Medium	High	Medium
13	Severe Weather Patterns	Medium	Low	Medium	Medium	Low	Medium
14	Water Diversion and Impoundments	High	Low	High	Medium	Medium	High

Van Duzen River, Chinook Salmon (North Mountain Interior) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
VDR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
VDR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
VDR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Develop plan to recreate off-channel ponds, alcoves, and backwater habitat.	1	5	NGO	
VDR-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Recreate habitat guided by plan.	1	5	NGO	
VDR-CCCh-3.1	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**				
VDR-CCCh-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
VDR-CCCh-3.1.1.1	Action Step	Hydrology	Ensure sub-division of existing parcels does not result in increased water demand during low-flow season.	2	10	Counties, SWRCB	
VDR-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
VDR-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
VDR-CCCh-5.1.1.1	Action Step	Passage	Evaluate annually if plan addressing the sediment barrier at mouth of Van Duzen River is working effectively and modify if needed.	2	10	NGO	
VDR-CCCh-5.1.1.2	Action Step	Passage	Develop and implement plan to address sediment barrier at mouth of Hely Creek.	2	10	NGO	
VDR-CCCh-5.1.1.3	Action Step	Passage	Develop and implement plan to address sediment barrier at mouth of Root Creek.	2	10	NGO	
VDR-CCCh-5.1.1.4	Action Step	Passage	Develop and implement plan to address barrier at Wolverton Gulch.	2	10	CDFW	
VDR-CCCh-5.1.1.5	Action Step	Passage	Develop and implement plan to address barrier at confluence of Van Duzen River with Cummings Creek.	2	10	NGO	
VDR-CCCh-5.1.1.6	Action Step	Passage	Develop and implement plan to address barrier at confluence of Van Duzen River with Fiedler Creek.	2	10	NGO	
VDR-CCCh-5.1.1.7	Action Step	Passage	Develop and implement plan to address culvert on Highway 36.	2	10	CalTrans	
VDR-CCCh-5.1.1.8	Action Step	Passage	Develop and implement plan to address culvert on Rohnerville Road.	2	10	County	
VDR-CCCh-5.1.1.9	Action Step	Passage	Restore passage to all life stages.	2	100	NGO	
VDR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
VDR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD, and shelters.				
VDR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Develop plan to add large wood, boulders, or other instream structure to specific areas in specific quantities.	2	5	NGO	
VDR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Add structure, guided by plan.	2	5	NGO	
VDR-CCCh-6.2	**Objective**	**Habitat Complexity**	**Address the inadequacy of existing regulatory mechanisms**				
VDR-CCCh-6.2.1	Recovery Action	Habitat Complexity	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
VDR-CCCh-6.2.1.1	Action Step	Habitat Complexity	Reduce removal of instream large wood (i.e., wood poaching)	2		NPS, CDFW, County	
VDR-CCCh-7.1	**Objective**	**Riparian**	**Address the inadequacy of existing regulatory mechanisms**				
VDR-CCCh-7.1.1	Recovery Action	Riparian	Improve riparian conditions				
VDR-CCCh-7.1.1.1	Action Step	Riparian	Reduce detrimental environmental impacts of conversion of TPZ land to other uses.	2	10	NMFS, Calfire, BOF	
VDR-CCCh-7.1.1.2	Action Step	Riparian	Work with Calfire and BOF to minimize the number of conversions per landowner	2	10	NMFS, Calfire, BOF	
VDR-CCCh-7.1.1.3	Action Step	Riparian	Institute environmental review as part of TPZ conversions	2	10	Calfire, BOF	
VDR-CCCh-7.1.1.4	Action Step	Riparian	Work to ensure effects of activities on converted areas are minimized.	2	10	NMFS, Calfire, BOF	

Van Duzen River, Chinook Salmon (North Mountain Interior) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
VDR-CCCh-16.1	**Objective**	**Fishing/Collecting**	**Address the overutilization for commercial, recreational, scientific or educational purposes**				
VDR-CCCh-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance and diversity based on the biological viability criteria				
VDR-CCCh-16.1.1.1	Action Step	Fishing/Collecting	Continue to work with the state, to improve the low flow fishing closures.	1	5	CDFW, NMFS	
VDR-CCCh-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
VDR-CCCh-18.1.1	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
VDR-CCCh-18.1.1.1	Action Step	Livestock	Identify areas where livestock have access to riparian vegetation, develop plan to fence livestock from areas.	3	5	NGO	
VDR-CCCh-18.1.1.2	Action Step	Livestock	Install fence, guided by plan.	2	5	NGO	
VDR-CCCh-19.1	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
VDR-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize adverse alterations to riparian species composition and structure				
VDR-CCCh-19.1.1.1	Action Step	Logging	Develop plan that identifies areas in need of more shade that currently supports Chinook salmon and describes timber management methods that will increase shade overtime.	3	5	NGO	
VDR-CCCh-19.1.1.2	Action Step	Logging	Manage forests in identified areas to increase shade, guided by plan.	3	5	Private	
VDR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of habitat or range**				
VDR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
VDR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Assess and prioritize road-stream connection, and identify appropriate treatment to meet objective.	2	5	NGO	
VDR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Decommission roads, guided by assessment.	2	5	NGO	
VDR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Upgrade roads, guided by assessment.	2	5	NGO	
VDR-CCCh-23.1.1.4	Action Step	Roads/Railroads	Maintain roads, guided by assessment.	3	5	NGO	
VDR-CCCh-23.1.1.5	Action Step	Roads/Railroads	Develop and implement a plan to stabilize hillslope at Hely Creek 1,440 feet above Highway 36.	3	2	NGO	
VDR-CCCh-23.1.1.6	Action Step	Roads/Railroads	Assess and prioritize bank stabilization needs and stabilize banks at Grizzly Creek.	3	4	NGO	
VDR-CCCh-23.1.1.7	Action Step	Roads/Railroads	Assess and prioritize bank stabilization needs and stabilize banks at Cummings Creek.	3	4	NGO	
VDR-CCCh-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
VDR-CCCh-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
VDR-CCCh-23.2.1.1	Action Step	Roads/Railroads	Develop grading ordinance for maintenance and building of private roads that minimizes the effects to Chinook salmon.	3	5	County	
VDR-CCCh-25.1	**Objective**	**Water Diversion /Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
VDR-CCCh-25.1.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
VDR-CCCh-25.1.1.1	Action Step	Water Diversion /Impoundment	Provide incentives to reduce diversions during the summer.	2	5	NGO	
VDR-CCCh-25.1.1.2	Action Step	Water Diversion /Impoundment	Document reduction in diversions and effects on salmonid habitat.	2	5	NGO	

Van Duzen River, Chinook Salmon (North Mountain Interior) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
VDR-CCCh-25.1.1.3	Action Step	Water Diversion /Impoundment	Implement forbearance program.	2	5	NGO	
VDR-CCCh-25.1.1.4	Action Step	Water Diversion /Impoundment	Create water budgets to avoid over-allocating water diversions.	2	5	CDFW	
VDR-CCCh-25.1.1.5	Action Step	Water Diversion /Impoundment	Utilize water budgets when allocating diversions.	3	5	RWQCB	
VDR-CCCh-25.1.1.6	Action Step	Water Diversion /Impoundment	Conduct a study to document extent of water diversions and the effects these diversions have on salmonids, which includes recommendations for amount of diversions that would not limit recovery of salmonids.	2	5	RWQCB	
VDR-CCCh-25.1.1.7	Action Step	Water Diversion /Impoundment	Reduce diversions to level that would not limit recovery of salmonids.	2	5	RWQCB	
VDR-CCCh-25.2	**Objective**	**Water Diversion /Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
VDR-CCCh-25.2.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
VDR-CCCh-25.2.1.1	Action Step	Water Diversion /Impoundment	Revise County General Plan as needed to account for salmonid habitat needs.	3	5	County	
VDR-CCCh-25.2.1.2	Action Step	Water Diversion /Impoundment	Revise City ordinances as needed to account for salmonid habitat needs.	3	5	City	
VDR-CCCh-25.2.1.3	Action Step	Fishing/Collecting	Reduce poaching of adult salmonids by increasing law enforcement.	2	5	CDFW	

North-Central Coastal Diversity Stratum

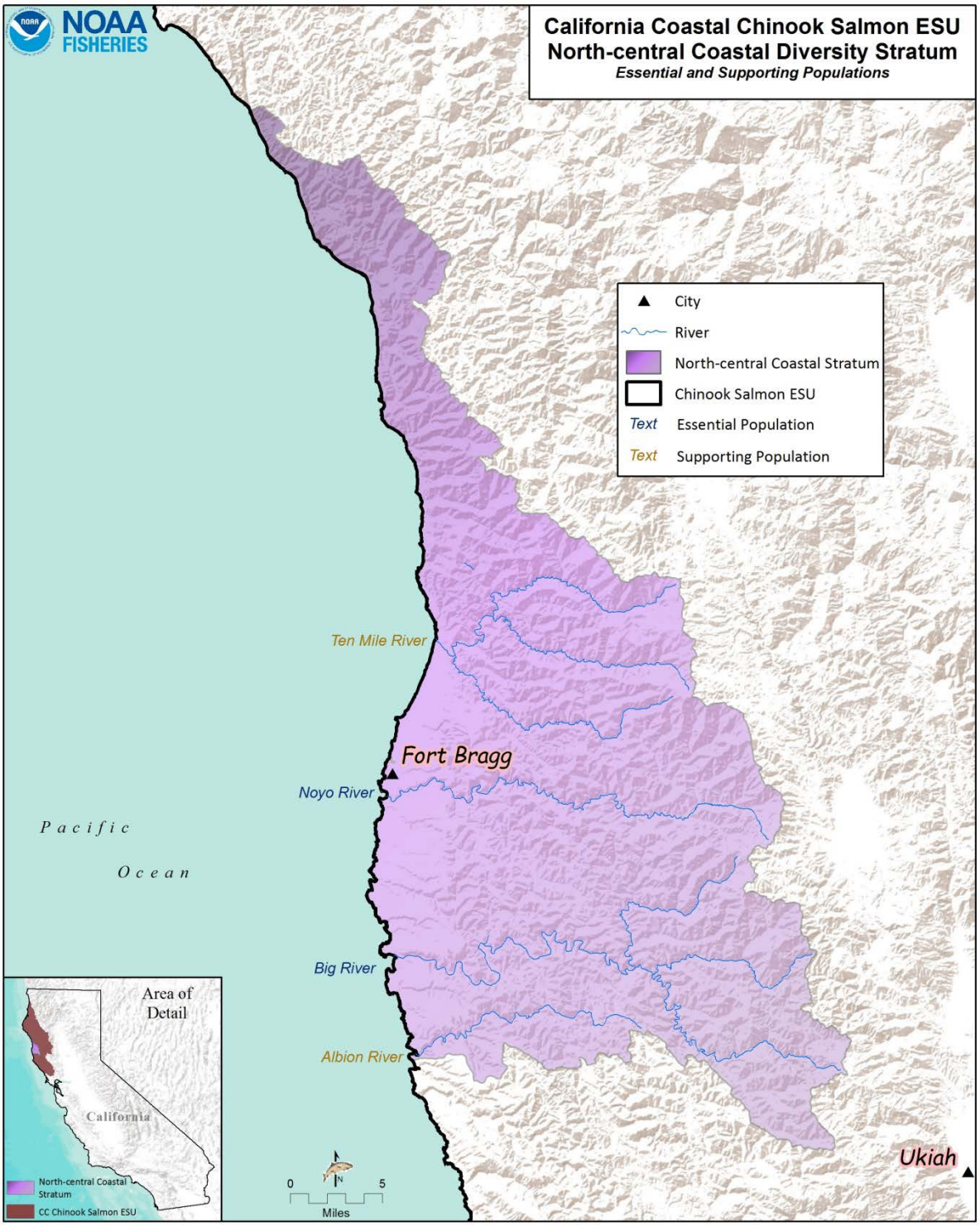
This stratum includes populations that spawn in watersheds of small to moderate size along the coast between Cape Mendocino and the Albion River (inclusive). Watersheds along this coast, including the larger basins, exhibit a more comprehensive "coastal" character than those to the south, and lack extensive areas that experience warmer, drier conditions.

The populations that have been selected for the recovery scenarios are listed in the table below and their profiles, maps, results, and recovery actions are in the pages following. Essential populations are listed by alphabetical order within the diversity stratum, followed by the Rapid Assessment of the Supporting populations:

- Big River,
- Noyo River
- North-Central Coast Diversity Stratum Rapid Assessment
    - Albion River
    - Ten Mile River

CC Chinook North-Central Diversity Stratum, Populations, Historical Status, Population's Role in Recovery, Current IP-km, and Spawner Density and Abundance Targets for Delisting. The Diversity Stratum recovery targets are only comprised of the essential populations because these are the populations that are expected to be viable (See Vol. 1 Chapter 5).

Diversity Stratum	CC Chinook salmon Populations	Historical Population Status	Population's Role In Recovery	Current Weighted IP-km	Spawner Density	Spawner Abundance
North-Central Coastal	Albion River	D	Supporting	17.6	6-12	104-209
	Big River	I	Essential	104.3	30.6	3,200
	Noyo River	I	Essential	62.2	35.3	2,200
	Ten Mile River	I	Supporting	67.2	6-12	401-804
Diversity Stratum Recovery Target						**5400**



CC Chinook salmon North-Central Coastal Diversity Stratum Populations selected for the recovery scenario.

Big River Population

CC Chinook Salmon Fall-Run

- Role within ESU: Functionally Independent Population
- Diversity Stratum: North Central Coastal
- Spawner Abundance Target: 3,200 adults
- Current Intrinsic Potential: 104.3 IP-km

For information regarding NC steelhead and CCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the CCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

In their 1965 analysis of Big River, the California Department of Fish and Game (CDFG) noted that Chinook salmon were occasionally reported, but did not support a population of any importance (CDFG 1965). The most recent counts from adult spawner surveys, estimate a total of 26 adult Chinook salmon spawning in Big River (D. Wright, personal communication 2010). Spence *et al.* (2008) report the status of Chinook salmon in coastal watersheds in Mendocino County, which includes Big River, as highly uncertain, and may reflect the fact that early logging had a tremendous impact on populations due to splash damming and log drives down mainstem reaches that Chinook salmon utilize. Also, Spence *et al*. (2008) estimates a population abundance of 3,200 spawners, and approximately 31 Chinook salmon per-IP-km to meet the low risk of extinction population abundance criteria.

Juvenile salmonid distribution has been documented by private timber companies and resource agencies throughout the watershed in the recent past. Chinook salmon have only been reported sporadically, with limited information on current distribution or abundance (Downie *et al.* 2006). Downie *et al*. (2006) report stocking of Big River and its tributaries with salmonids for over 100 years. Juvenile steelhead were reportedly stocked in James Creek in 1904; and CDFW attempted to establish a Chinook salmon run in the 1940s and 1950s due to a depleted CCC coho salmon population.

History of Land Use

Prior to the European intrusion in the 17th and 18th centuries, Pomo Indians utilized the Big River fishery resources. Native Americans also used fire in coastal areas to clear land for tribal activities. Starting in 1852, timber harvest began in the lower Big River area with a mill in the town now known as Mendocino. From the beginning of this timber harvesting in the 1850s to

about 1940, logs were either driven down stream channels with the use of splash dams or where taken out with the use of railroad cars. In the 1940s, truck transport of logs began with the use of tractor yarding and the construction of roads, skid trails and log landings (GMA 2001). By the 1960s, some harvesting of second growth timber had begun, with poor timber harvesting practices continuing in the 1980s, although the Forest Practice Act (1973) has progressively improved road and yarding systems. The majority of the watershed has been harvested more than once, 79 percent of the acres have been harvested twice, 34 percent harvest three times, and eight percent seeing activities four times (Downie *et al.,* 2006).

Roads and railroads associated with timber harvesting have been in the watershed since the 1800s, and in the 1940s railroads were converted to truck roads. Of the 1,242 miles of roads in this basin, 64 percent were built prior to 1979, 32 percent are rocked surface, and less than five percent are paved highways or county roads (Downie *et al*., 2006). Although newer roads tend to generate less surface erosion, USEPA (2001) reports that aerial photo analysis shows that in the last decade roads account for 16 percent of the road surface erosion in the watershed, whereas older roads (1921-1936) accounting for only one percent of the surface erosion for that period. The sheer number of roads in the watershed today is believed to be the reason for the increased sediment production that currently exists.

Current Resources and Land Management

Due to the remote location and large public ownership of the Big River watershed, a small number of programs and management plans guide land use activities within the basin. Private timber management companies are the largest landowners within the watershed, with Mendocino Redwood Company (MRC) owning 29.4 percent (34,114 acres), Strategic Timber Trust owning 15.4 percent (17,850 acres), and Lyme Redwood Timberlands owning eight percent (9,700 acres) of the watershed. Jackson State Forest accounts for 19.6 percent (22,714 acres) of the watershed and a new state park, Big River State Park (7,342 acres) and the majority of the remaining property is owned by 31 property owners (GMA 2001).

Salmonid Viability and Watershed Conditions

The following indicators are rated Poor through the CAP process: LWD frequency, shelter rating, primary pools, pool/riffle ratio for juvenile and adult salmonids. Gravel quality for the egg lifestage rate as Poor for this watershed. Indicators for watershed processes that are rated Poor through the CAP process include watershed road densities and riparian road densities.

All population viability attributes for Chinook salmon are rated Poor due to the extremely low abundance in this watershed.

Recovery strategies will typically focus on ameliorating Poor habitat indicators although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed.

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Big River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Habitat Complexity: Large Wood and Shelter

Data from the Coastal Watershed Planning Assessment (Downie *et al.*, 2006) show that one of 58 streams meet target values for shelter. Past splash damming and timber harvest activities have reduced large woody debris loading instream reaches across this watershed. Forest canopy has begun to recover with most stream reaches in the watershed approaching or meeting target values, however, current riparian conditions are unlikely to deliver woody debris to provide high quality habitat in the near future. Poor habitat complexity and low LWD volume are expected to limit salmonid rearing and migration by reducing cover and velocity refuge required during freshwater residency.

Habitat Complexity: Percent Primary Pools and Pool/Riffle/Flatwater Ratios

The majority of stream reaches sampled in Big River do not meet target conditions for pools and the ratio of pools to riffles. Stream reaches with greater than 40 percent pools and 20 percent riffles are considered suitable for salmonid rearing, migration and feeding. In the Big River watershed, only 21 percent of the streams sampled met the target for primary pool frequency, and no stream reaches met the target for pool/riffle ratio. Streams within this basin have low large woody debris loading, which affects pool frequency and increases the amount of flat water, or glide type habitat. Current pool/riffle habitat conditions limit rearing space, velocity refuge, and food availability for juvenile salmonids.

Other Conditions

Although substrate condition is rated as a Fair condition for the egg lifestage, there is conflicting information regarding the current condition of instream habitat with respect to fine sediment. Downie *et al*. (2006), report that less than 50 percent of the pools sampled in the basin have good embeddedness ratings (low fine sediment in spawning gravel). GMA (2001) suggests that the presence of fine sediment in spawning gravels is currently not limiting fish production in the Big River basin. We rated this stress Medium to indicate that the basin is likely in a state of recovery,

yet given the number of roads, and slides in the basin there is much work to be implemented to reduce erosion in the watershed. The estuary is also reported to be in the early stages of recovery from past logging practices (Downie *et al.* 2006) and was rated to be in Fair condition.

The Viability condition has an overall Poor rating. At very low densities, adult spawners have difficulty finding mates and increased predation rates can occur. Low population abundance can further reduce population productivity and increase extinction risk (Spence *et al.* 2008).

Threats

The following discussion focuses on those threats that rate as High or Very High (see Big River CAP Results). Recovery strategies will likely focus on ameliorating High rating threats; however, some strategies may address Medium and Low threats when the strategy is more frequent flood and mass wasting events, which will be especially significant in this area due to the steep terrain, high road densities and unstable geology.

Roads and Railroads

Road density throughout the Big River watershed was identified as a High rating threat that, unless abated, will continue to limit fish production in the basin. Although sediment quality is not rated as Poor in the basin currently, roads continue to be the largest source of anthropogenic sediment delivery in the basin (GMA 2001). Road-related slides and surface erosion account for 30 percent of the sediment budget delivered to stream channels, 49 percent of the sediment is from natural processes, and timber harvest activities contribute the remaining 20 percent. GMA (2001) found the recent (1989-1999) spike in road construction has increased sediment yields from surface erosion, while road-related mass wasting and harvest-related surface erosion have decreased.

Severe Weather Patterns

Future impacts of severe weather patterns pose a High threat to watershed processes. The impacts of climate change in this region will have the greatest impact on overall watershed process that may affect all lifestages by reducing habitat conditions such as pool frequency and increasing fine sediment in spawning areas. Overall, the range and degree of temperature and precipitation variability is likely to increase across all watersheds in California. Dry weather patterns that affect migration of adults could reduce abundance for individual year classes impacted by these conditions.

Other Threats

Timber harvest and the threat of fire are Medium threats to watershed processes within Big River. Improved forest practices and the implementation of the Mendocino Redwood Company's HCP were the basis for rating timber harvest as a Medium future threat in this watershed. The Mendocino Redwood Company is the largest industrial timberland owner in the watershed. With reduced fire frequency over the last few decades, understory fuel loads have likely increased and have increased the threat of large fires that could increase soil destabilization and future erosion. However, because of the current fire suppression capability available, this threat rates as a Medium future threat. Although channelization from past splash damming continues to affect instream habitat, it has not been conducted for decades and is not a future threat.

Limiting Stresses, Lifestages, and Habitats

All lifestages are limited by the lack of channel complexity instream reaches throughout the basin. Poor channel complexity alters pool/riffle ratios, reduces cover and pool volume, and reduces velocity refuge. In addition, the egg lifestage is likely limited by elevated fine sediment that reduces survival to emergence in many spawning areas of Big River.

General Recovery Strategy

Habitat Complexity: Large Wood and Shelter

Restoration actions should focus on improving large woody debris (LWD) frequency across the Big River watershed, including the estuary reach of this basin. Riparian areas are in the process of recovery with stands of smaller diameter conifers that currently buffer stream areas. Adding LWD will provide much needed complexity to stream channels until riparian areas reach maturity and begin to recruit LWD naturally to channels. LWD will improve instream habitat attributes, such as pool and riffle frequency and habitat complexity, as well as improve over wintering habitat for salmonids. These areas will provide important refuge from high flow events and for increased growth and survival for juveniles during the summer. Increasing the LWD frequency is also expected to improve sediment routing by sorting gravels and improving habitat quality in spawning areas.

The estuary has been identified as an important refugia area for rearing and smolt lifestages of salmonids (Downie *et al.* 2006), therefore we recommend assessing the potential for improving complexity within this important habitat area.

Improve Habitat and Substrate Quality

Reducing sediment delivery from roads and timber harvest will improve a number of key attributes for salmonids in Big River. Slides and surface erosion resulting from road failures and timber harvest currently account for approximately 50 percent of the sediment budget in the watershed. The inland subbasins tend to have steeper slopes and a higher number and volume of slides than coastal and middle areas of the watershed. Reducing management-related sediment delivery to stream channels is expected to improve juvenile rearing habitat conditions by improving gravel quality, egg survival, benthic macro-invertebrate production, and pool volume.

Improve Population Abundance for Chinook Salmon

Chinook salmon population abundance is extremely low, with the possibility of population extinction in the watershed. In order to improve abundance in this basin, the potential for a conservation hatchery program, or other type of enhancement program in the near future needs investigation. Adult monitoring should be conducted to determine the potential for using natural origin broodstock for such a program. If Chinook salmon are not available from Big River, fishery managers should investigate the availability of other North-Central Coastal populations for use in rebuilding a population in this watershed. If determined that sufficient numbers of Chinook salmon are not available within the North-Central Coastal stratum, then efforts to determine the potential use of other populations within the ESU need to be explored.

Literature Cited

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Downie, S., B. deWaard, E. Dudik, D. McGuire, and R. Rutland. 2006. Big River Basin Assessment Report. North Coast Watershed Assessment Program. California Resources Agency, and California Environmental Protection Agency, Sacramento, California.

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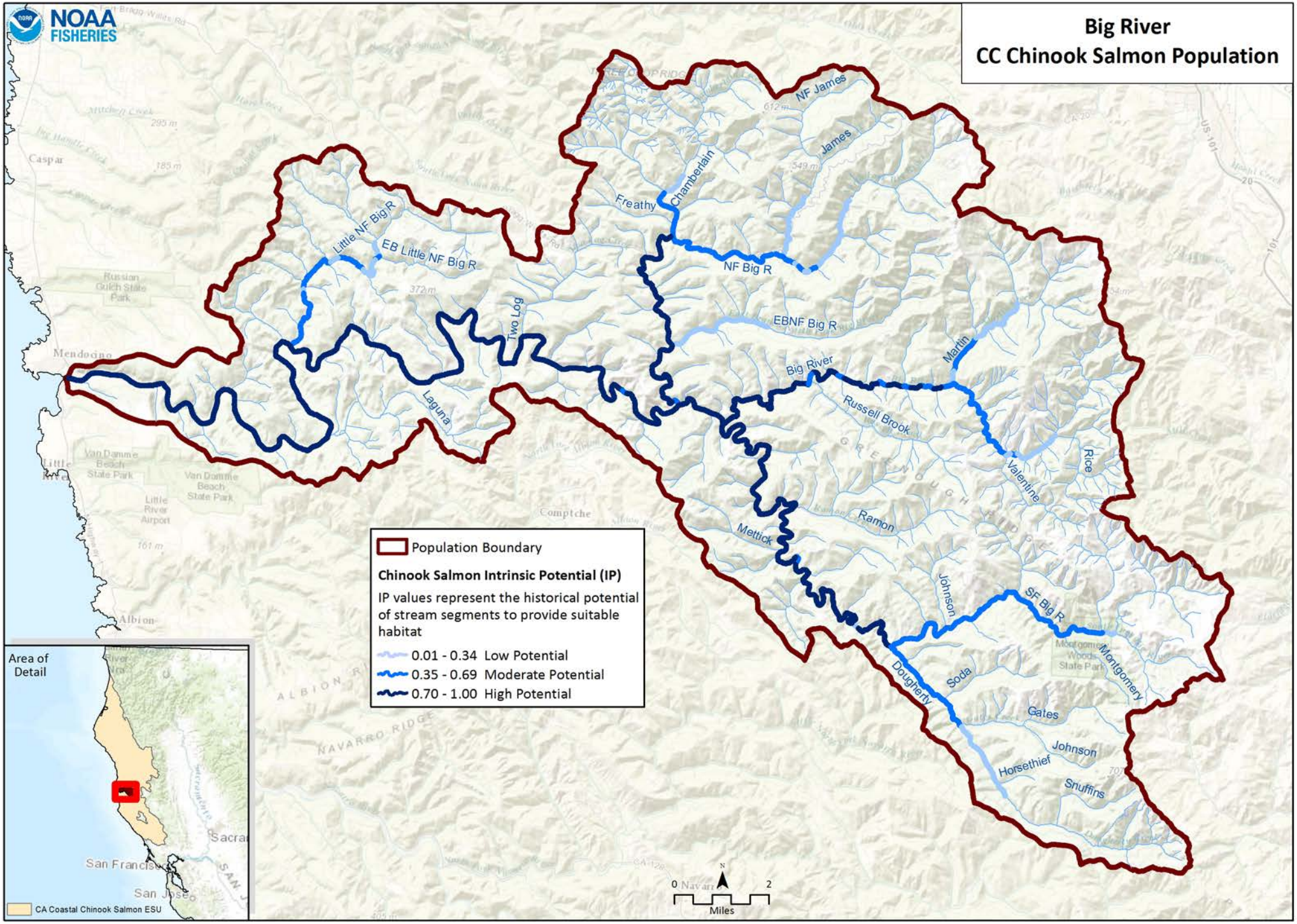
NOAA FISHERIES
Big River
CC Chinook Salmon Population
NF James
James
Chamberlain
Freathy
Little NF Big R
EB Little NF Big R
NF Big R
EBNF Big R
Two Log
Laguna
Big River
Martin
Russell Brook
Rice
Valentine
Ramon
Mettick
Johnson
SF Big R
Montgomery
Dougherty
Soda
Gates
Johnson
Horsethief
Snuffins
Mendocino
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Area of Detail
CA Coastal Chinook Salmon ESU
0
2
Miles

CC Chinook Salmon Big River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>20% average staging pool frequency)	51% to 74% of streams/ IP-Km (>20% average staging pool frequency)	75% to 89% of streams/ IP-Km (>20% average staging pool frequency)	>90% of streams/ IP-Km (>20% average staging pool frequency)	19% streams/ 45% IP-km (>40% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	37% streams/ 48% IP-km (>40% Pools; >20% Riffles)	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100 of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	40% Class 5 & 6 across IP-km	Fair

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	> 75% of IP-km	Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		<1 spawners per IP-km	Poor
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	<50% of Historical Range	Poor
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 42	Good
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	Fair
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	59% streams/ 51 % IP-km (>50% stream average scores of 1 & 2)	Fair

3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>40% average primary pool frequency)	51% to 74% of streams/ IP-Km (>40% average primary pool frequency)	75% to 89% of streams/ IP-Km (>40% average primary pool frequency)	>90% of streams/ IP-Km (>40% average primary pool frequency)	19% streams/ 45% IP-km (>40% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	37% streams/ 48% IP-km (>40% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	7% streams/ 1% IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 75	Fair
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 42	Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0 Diversions	Very Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	40% Class 5 & 6 across IP-km	Fair

			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	59% streams/ 51 % IP-km (>50% stream average scores of 1 & 2)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Good
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-km maintains severity score of 3 or lower	Very Good
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	<50% of Historical Range	Poor
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	7% streams/ 1% IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 42	Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0 Diversions	Very Good

			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100 of IP-km	Very Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	59% streams/ 51 % IP-km (>50% stream average scores of 1 & 2)	Fair
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		<10,400 = Smolt abundance which produces high risk spawner density per Spence (2008)	Poor
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.075% of Watershed in Impervious Surfaces	Very Good

			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	<10% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	14% of Watershed in Timber Harvest	Very Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	<1% of watershed >1 unit/20 acres	Very Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	2.4 Miles/Square Mile	Good
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	>1 Miles/Square Mile	Poor

CC Chinook Salmon Big River CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture						
2	Channel Modification	Low	Low	Low	Low	Medium	Low
3	Disease, Predation and Competition						
4	Fire, Fuel Management and Fire Suppression	Low	Low	Low	Low	Low	Low
5	Fishing and Collecting	Medium					Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching						
8	Logging and Wood Harvesting	Low	Low	Medium	Medium	Medium	Medium
9	Mining						
10	Recreational Areas and Activities	Low	Low				Low
11	Residential and Commercial Development		Low	Low	Low	Low	Low
12	Roads and Railroads	Low	Medium	Medium	Medium	High	Medium
13	Severe Weather Patterns	Medium	Medium	Low	Low	High	Medium
14	Water Diversion and Impoundments	Low	Low	Low	Low	Low	Low

Big River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
BR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
BR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	10	CDFW, MMWD, SPAWN	
BR-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	3	10	California Coastal Conservancy, CDFW, Jackson Demonstration State Forest, Mendocino Redwood Company, NMFS, Private Landowners, RWQCB, State Parks	
BR-CCCh-2.1.1.3	Action Step	Floodplain Connectivity	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	20	California Coastal Conservancy, CDFW, Jackson Demonstration State Forest, Mendocino Redwood Company, NOAA RC, Private Landowners, State Parks, Trout Unlimited	Initiate projects should target stream reaches with high IP-km values, however, consideration should be also given to mainstem Big River, particularly mainstem reaches above the estuary.
BR-CCCh-2.1.1.4	Action Step	Floodplain Connectivity	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, and use streamway concept where appropriate.	2	25	California Coastal Conservancy, CDFW, Jackson Demonstration State Forest, Mendocino Redwood Company, NOAA RC, Private Landowners, State Parks, Trout Unlimited	
BR-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BR-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
BR-CCCh-5.1.1.1	Action Step	Passage	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	2	20	CalTrans, NMFS, CDFW	
BR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD, and shelters				
BR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Identify historic salmonid habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover.	2	10	California Coastal Conservancy, CDFW, Mendocino Land Trust, Mendocino Redwood Company, NOAA RC, Private Landowners, State Parks	These data would be most effective if combined into a central repository and restoration projects were prioritized according to highest restoration priority.
BR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Fund a watershed coordinator.	2	10	California Coastal Conservancy, CDFW, Jackson Demonstration State Forest, Mendocino County, Mendocino County Fish and Wildlife Advisory Board, RCD, RWQCB, State Parks, Trout Unlimited	Currently, Big River is managed by five or six larger landowners - including State, private, and non-profit. A coordinator is likely necessary to focus actions and resources in key areas and to apply for grants that will span multiple landowners.
BR-CCCh-6.1.1.3	Action Step	Habitat Complexity	Install properly sized large woody debris to meet targets specified in recovery plan.	2	20	California Coastal Conservancy, CDFW, Jackson Demonstration State Forest, Mendocino Land Trust, Mendocino Redwood Company, NOAA RC, Private Landowners, State Parks, UC Extension	
BR-CCCh-6.1.1.4	Action Step	Habitat Complexity	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	CalFire, CDFW, Mendocino County, Mendocino County Department of Public Works, Mendocino Land Trust, Mendocino Redwood Company, NOAA RC, Private Landowners, RWQCB, State Parks	
BR-CCCh-6.1.1.5	Action Step	Habitat Complexity	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (CDFG 2004).	2	20	CalFire, CDFW, Mendocino County, Mendocino County Department of Public Works, Mendocino Land Trust, Mendocino Redwood Company, NOAA RC, Private Landowners, RWQCB, State Parks	

Big River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
BR-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BR-CCCh-7.1.1	Recovery Action	Riparian	Improve canopy cover				
BR-CCCh-7.1.1.1	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004).	3	20	CDFW, Coastal Ridges, Conservation Fund, Mendocino Redwood Company, Private Landowners, Redwood Forest Foundation, State Parks, The Nature Conservancy	
BR-CCCh-7.1.1.2	Action Step	Riparian	Ensure that adequate streamside protection measures are implemented to provide shade canopy and reduce heat inputs to the North and South Forks Big River, mainstem Big River, and Daugherty Creek.	2	20	CalFire, Private Landowners	
BR-CCCh-7.1.1.3	Action Step	Riparian	Develop riparian improvement projects along James Creek to increase canopy levels.	2	20	CDFW, Jackson Demonstration State Forest, NOAA RC, Trout Unlimited	Recommendation from CDFW coastal watershed report.
BR-CCCh-7.1.1.4	Action Step	Riparian	Conserve and manage forestlands for older forest stages.	2	20	CDFW, Coastal Ridges, Conservation Fund, Mendocino Redwood Company, Private Landowners, Redwood Forest Foundation, State Parks, The Nature Conservancy	
BR-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BR-CCCh-8.1.1	Recovery Action	Sediment	Improve instream gravel quality and distribution for macro-invertebrate productivity (food)				
BR-CCCh-8.1.1.1	Action Step	Sediment	Develop a Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with survey focused on slides and other non-road related sediment sources in the watershed.	2	5	CalFire, Coastal Ridges, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino Redwood Company, NMFS, Private Landowners, RWQCB, USEPA	This sediment reduction plan could be part of a larger road and sediment reduction plan. This plan should tier off recommendations in the Big River TMDL.
BR-CCCh-8.1.1.2	Action Step	Sediment	Treat high priority slides and landings identified in credible landowner assessments. Focus efforts in the South Daugherty and Chamberlain Creek subbasins.	2	5	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
BR-CCCh-8.1.1.3	Action Step	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	2	60	CDFW, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino County Department of Public Works, RWQCB, State Parks	
BR-CCCh-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BR-CCCh-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity				
BR-CCCh-11.1.1.1	Action Step	Viability	Measure or estimate the condition of key habitat attributes across the watershed. Prioritize tributaries that have been habitat typed in the past.	2	5	CalFire, California Department of Mines and Geology, CDFW, Conservation Fund, Jackson Demonstration State Forest, Mendocino Land Trust, Mendocino Redwood Company, NMFS, NRCS, Private Landowners, RPFs, RWQCB, SWRCB, UC Extension	
BR-CCCh-11.1.1.2	Action Step	Viability	Implement standardized assessment protocols (i.e., CDFW habitat assessment protocols) to ensure ESU-wide consistency.	3	60	CalFire, California Department of Mines and Geology, CDFW, Conservation Fund, Jackson Demonstration State Forest, Mendocino Land Trust, Mendocino Redwood Company, NMFS, NRCS, Private Landowners, RPFs, RWQCB, SWRCB, UC Extension	

Big River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
BR-CCCh-11.1.1.3	Action Step	Viability	Monitor population status for response to recovery actions.	2	100	CalFire, California Department of Mines and Geology, CDFW, Conservation Fund, Jackson Demonstration State Forest, Mendocino Land Trust, Mendocino Redwood Company, NMFS, NRCS, Private Landowners, RPFs, RWQCB, SWRCB, UC Extension	
BR-CCCh-11.1.1.4	Action Step	Viability	Conduct monitoring activities to determine the abundance of adult and smolt salmonids in Big River.	2	12	CDFW, Conservation Fund, Jackson Demonstration State Forest, Mendocino Redwood Company, NMFS, Private Landowners, State Parks	
BR-CCCh-11.1.1.5	Action Step	Viability	Determine the appropriate agencies and technical staff to evaluate the potential for Chinook conservation hatchery program on Big River.	2	10	CDFW, NMFS	
BR-CCCh-11.1.1.6	Action Step	Viability	Convene a technical committee that produces a decision document on the potential for using a conservation hatchery program to increase Chinook salmon abundance.	2	2	CDFW, Lyme Timber, Mendocino Redwood Company, NMFS, NOAA SWFSC	
BR-CCCh-19.1	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
BR-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
BR-CCCh-19.1.1.1	Action Step	Logging	Establish greater oversight for pre and post-harvest monitoring by the permitting agency for operations.	3	20	CalFire, NMFS, State	
BR-CCCh-19.1.1.2	Action Step	Logging	Assign NMFS staff to conduct THP reviews of the highest priority areas.	2	20	CalFire, NMFS, State	
BR-CCCh-19.1.1.3	Action Step	Logging	Extend the monitoring period and upgrade THP road maintenance after harvest.	3	20	CalFire, NMFS, State	
BR-CCCh-19.1.1.4	Action Step	Logging	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	3	20	CalFire, Counties NMFS, State	
BR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
BR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
BR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions.	2	10	CalFire, California Geological Survey, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino Land Trust, Mendocino Redwood Company, RWQCB, State Parks	
BR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Continue efforts such as road improvements, and decommissioning to reduce sediment delivery to Big River and its tributaries. CDFW stream surveys indicated Kidwell Gulch, Two Log Creek, and Saurkraut Creek have road sediment inventory and control as a top tier tributary improvement recommendation.	3	10	CalFire, California Geological Survey, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino Land Trust, Mendocino Redwood Company, RWQCB, State Parks	
BR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (CDFG 2004).	2	10	CalFire, California Geological Survey, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino Land Trust, Mendocino Redwood Company, RWQCB, State Parks	
BR-CCCh-23.1.1.4	Action Step	Roads/Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized users to decrease fine sediment loads.	3	10	CalFire, California Geological Survey, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino Land Trust, Mendocino Redwood Company, RWQCB, State Parks	

Big River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
BR-CCCh-23.1.1.5	Action Step	Roads/Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Weaver and Hagans, 1994; Sommarstrom et al., 2002; Oregon Department of Transportation, 1999).	3	100	CalFire, California Geological Survey, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino Land Trust, Mendocino Redwood Company, RWQCB, State Parks	
BR-CCCh-23.1.1.6	Action Step	Roads/Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	10	CalFire, California Geological Survey, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino Land Trust, Mendocino Redwood Company, RWQCB, State Parks	
BR-CCCh-23.1.1.7	Action Step	Roads/Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	2	20	CalFire, California Geological Survey, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino Land Trust, Mendocino Redwood Company, RWQCB, State Parks	
BR-CCCh-24.1	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
BR-CCCh-24.1.1	Action Step	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
BR-CCCh-24.1.1.1	Action Step	Severe Weather Patterns	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).	2	50	Counties	
BR-CCCh-24.2	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species' continued existence**				
BR-CCCh-24.2.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
BR-CCCh-24.2.1.1	Action Step	Severe Weather Patterns	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.	3	20	CDFW, NMFS, Private Landowners	

Noyo River Population

CC Chinook Salmon Fall-Run

- Role within ESU: Functionally Independent Population
- Diversity Stratum: North-Central Coastal
- Spawner Abundance Target: 2,200 adults
- Current Intrinsic Potential: 62.2 IP-km

For information regarding NC steelhead and CCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the CCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

Chinook salmon have only been reported sporadically in the Noyo River watershed, with CDFW spawning surveys documenting low numbers of adults in the basin. Gallagher *et al*. (2010) reported a mean escapement of four adult Chinook salmon with an estimated population range of 2-157 spawners. Spence *et al.* (2008) reports the status of Chinook salmon in coastal watersheds in Mendocino County, as highly uncertain, and may reflect the fact that early logging had a tremendous impact on mainstem reaches that Chinook salmon utilize. Based on Spence *et al.* (2008), 62 km of potential habitat results in a Chinook salmon population target of 2,200 spawners for this watershed.

History of Land Use

Prior to the European intrusion in the 17th and 18th centuries, Pomo Indians likely utilized the fishery resources of the Noyo River. Native Americans also used fire in coastal areas to clear land for tribal activities. In 1853, timber harvest began in the Noyo River area with the first water-powered mill in the lower Noyo River. Harvesting of old growth timber continued in the Noyo River watershed until the early part of the 20th century (USEPA 1999). In 1940, tractors were used throughout the basin to yard fallen timber, and roads, skid trails and log landings were constructed to ease transport of the logs to sawmills. By the 1960s, some harvesting of second growth timber had begun, with poor timber harvesting practices continuing into the 1980s, although the Forest Practice Act (1973) has progressively improved road and yarding systems.

Roads and railroads associated with timber harvesting have been in the watershed since the 1800s, and in the 1940s railroads were converted to truck roads. Railroad operations began in 1886 in the Noyo River watershed, with railroad tracks operating east from Fort Bragg to the Little North Fork. Railway service was completed from Fort Bragg to Willits in 1911, including the

construction of an extensive set of trestles that cross the Noyo River. Spur tracks were developed to increase logging opportunities in the North and South Fork Noyo subbasins and were later converted into truck roads (GMA 1999). This railroad line remains in use today as the Skunk Railroad, a popular tourist attraction in Mendocino County.

Current Resources and Land Management

Due to the remote location and large public ownership of the Noyo River watershed, a small number of programs and management plans guide land use activities within the basin. Private timber management companies are the largest landowners in the watershed, with Mendocino Redwood Company (MRC) owning the majority of the upper watershed, and Lyme Redwood Company owning much of the lower Noyo River along the mainstem. Jackson State Forest accounts for 19 percent of the ownership located in the South Fork subbasin.

Salmonid Viability and Watershed Conditions

The following habitat indicators were rated Poor through the CAP process: LWD frequency, shelter rating, primary pools, pool/riffle ratio for juvenile rearing, smolts and adult lifestages of salmonids. Stream temperature was also rated as Poor for juvenile summer rearing. Indicators for watershed processes that were rated as Poor through the CAP process included watershed road densities, and riparian road densities. Due to the extremely low numbers of Chinook salmon in this basin, all viability attributes were rated Poor.

Recovery strategies will typically focus on ameliorating these habitat indicators, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. Indicators that rated as Fair through the CAP process, but are considered important within specific areas of the watershed include gravel quality for eggs, baseflow conditions for summer rearing and the estuary.

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Noyo River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Habitat Complexity: Large Wood and Shelter

The best available data, including CDFW habitat typing surveys, indicate that no streams within the Noyo River watershed currently meet target values for shelter. Past timber harvest activities and LWD removal programs in the 1970s through the early 1990s have reduced large woody

debris loading across stream reaches in this watershed. Forest canopy has begun to recover, with most stream reaches in the watershed approaching or meeting target values; however, riparian trees that make up the riparian corridor are not of sufficient size and age to deliver woody debris that will provide shelter in the near future. Unsuitable large woody debris volume is expected to limit salmonids during rearing and migration lifestages by reducing pool frequency and volume, cover habitat, and velocity refuge areas required during freshwater residency.

Landscape Patterns: Agriculture, Timber Harvest, and Urbanization

Sediment transport load in the Noyo River watershed was identified as a stress to overall watershed process. The USEPA TMDL and other studies (GMA 1999) have identified sediment delivery from roads a limiting factor for salmonids. Although the egg lifestage was not rated as Poor for impaired gravel quality, the Fair rating it received suggests gravel quality was not suitable in many reaches of the watershed.

Landscape Patterns: Agriculture, Timber Harvest, and Urbanization have an overall rating of Good with respect to overall watershed process. Disturbance in the form of timber harvest and roads across the basin, which act to alter sediment transport through the basin, have been and continue to cause landscape disturbance in the Noyo River watershed.

Other Conditions

Although substrate conditions were rated as a Fair for the egg lifestage, information suggests that many reaches within this basin do not meet target values for fine sediment in spawning gravels. We rated this condition as Fair to indicate that the basin is likely in a state of recovery, yet given the number of roads in the basin there is much work to be implemented to reduce fine sediment delivery to stream channels in the watershed.

The majority of streams sampled in the Noyo River watershed do not meet target conditions for percent of stream reach with pools and the ratio of pools to riffles. Stream reaches with greater than 40 percent pools and 20 percent riffles are considered suitable for salmonid rearing, migration and feeding. Many of the stream reaches, including the mainstem Noyo River, have a high percentage of flat water habitat types, which are not as suitable for salmonid rearing as pool habitat. Poor large woody debris loading across the basin affects pool frequency, and results in increased levels of flat water, or glide-type habitat.

Threats

The following discussion focuses on those threats that rate as High or Very High (see Noyo River CAP results). Recovery strategies will likely focus on ameliorating High rating threats; however,

some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Noyo River CAP results.

Roads and Railroads

Road density throughout the Noyo River watershed was identified as the Highest rating threat, and unless abated will continue to limit fish production in the basin. Although sediment quality is not rated as Poor in the basin currently, roads continue to be the largest source of anthropogenic sediment delivery in the basin (USEPA 1999). Road densities are high both across the basin and within riparian areas (7.0 miles per square mile, and 7.4 miles per square mile, respectively).

Graham Matthews & Associates (GMA 1999) found an increase over time in road construction, which has increased sediment yield from surface erosion. Of the 838 miles of roads in the basin, approximately 83 percent are seasonal dirt roads (GMA 1999). GMA (1999) states that improved management practices since 1974 have decreased road-related mass wasting and harvest surface erosion. However, significant new road construction has increased sediment yields through increased road surface erosion, despite improved road management practices (GMA 1999). According to USEPA (1999), aggressive actions are required to reduce sediment delivery from roads to meet the TMDL allocation for road related sediment, which is the greatest source of management related sediment delivery in the Noyo River watershed. Estimated road-related sediment production for the Noyo River watershed is 183 tons/square mile/year, which is estimated to be an 8 fold increase over 1942 rates.

Logging and Wood Harvesting

Timber has been harvested in the watershed for over 150 years. Improved harvest methods and regulations have reduced the overall impact of this threat in recent decades. However, although the rate of harvest in this basin has slowed in the last decade, this threat will continue to exist in the future. For all salmonid lifestages except adults, and overall watershed processes, the threat of timber harvesting activities is rated as a Medium threat. Improved logging methods, such as tree yarding that reduces ground disturbance and reduced harvesting within riparian zones, could keep this threat from returning as a large contributor to habitat stress in the future.

Limiting Stresses, Lifestages, and Habitats

Based on the type and extent of stresses and threats affecting the population, as well as the limiting factors influencing productivity, the juvenile lifestage appears to be the most limited.

Poor channel complexity can alter pool/riffle ratios, reduce instream cover volume, and reduce velocity refuge for salmonids. In addition, the egg lifestage is moderately limited by elevated

fine sediment that reduces egg survival to emergence in many spawning areas of the Noyo River and its tributaries.

Low adult abundance of Chinook salmon that return to this system sporadically likely limits the viability of this population. Genetic samples taken from juvenile Chinook salmon in the Noyo River from 2000-2003 show substantially lower mean number of allelic richness which correlates with a lower effective population size as compared to other Chinook salmon ESU populations (Bjorkstedt *et al.* 2005).

General Recovery Strategy

Improve Habitat Complexity

Restoration actions should improve large woody debris (LWD) frequency across the Noyo River watershed. Riparian areas are in the process of recovery, with stands of smaller diameter conifers that currently buffer stream areas. Strategically adding LWD will provide much needed complexity to stream channels until riparian areas reach maturity, at which time they can begin to recruit LWD naturally to channels. Increasing LWD volumes will improve instream habitat attributes such as pool and riffle frequency and habitat complexity. LWD will improve over wintering and summer survival of salmonids. The recovery strategy to improve overall productivity is to increase the extent, access, and quality of rearing areas and space (pools) throughout the basin. These areas will provide important refuge from high flow events and opportunity for increased growth and survival of juveniles during winter and summer. Increasing the LWD frequency is also expected to improve sediment sorting thereby improving spawning habitat. .

Improve Habitat and Substrate Quality

Reducing sediment delivery from roads and timber harvest is likely to improve a number of key habitat attributes for salmonids in the Noyo River. Road-related sediment delivery has increased in the recent past and must be reduced. Upgrading or decommissioning roads throughout the basin will lower erosion rates and improve sediment quality, which will in turn improve egg survival, benthic macro-invertebrate production, and juvenile salmonid rearing conditions.

Improve Population Abundance of Chinook Salmon

Chinook salmon population abundance is extremely low within the Noyo River, with the possibility of population extinction in the watershed. To improve abundance of the wild population in this basin, Federal and state biologists should investigate developing a conservation hatchery program or other augmentation program in the near future. Adult

Chinook salmon monitoring should be conducted to determine the potential for using natural origin broodstock in such a program. If Chinook salmon are extinct in the Noyo River, agencies need to determine if Chinook salmon from other North-Central Coastal populations are available and appropriate for use in rebuilding this population. If it is determined that sufficient numbers of Chinook salmon are not available in the North-Central Coastal Diversity stratum, the potential use of broodstock from other populations within the CC Chinook salmon ESU should be investigated.

Investigate current condition to Noyo River Estuary

Estuaries are complex ecosystems where ocean and freshwater interface and are sources of significant biological productivity. The current function of Noyo River estuary for providing suitable juvenile rearing conditions is poorly understood. Due to the importance of estuaries for juvenile rearing (Kjelson *et al.* 1982), a thorough assessment of salmonid use and habitat suitability in the estuary actions should be implemented.

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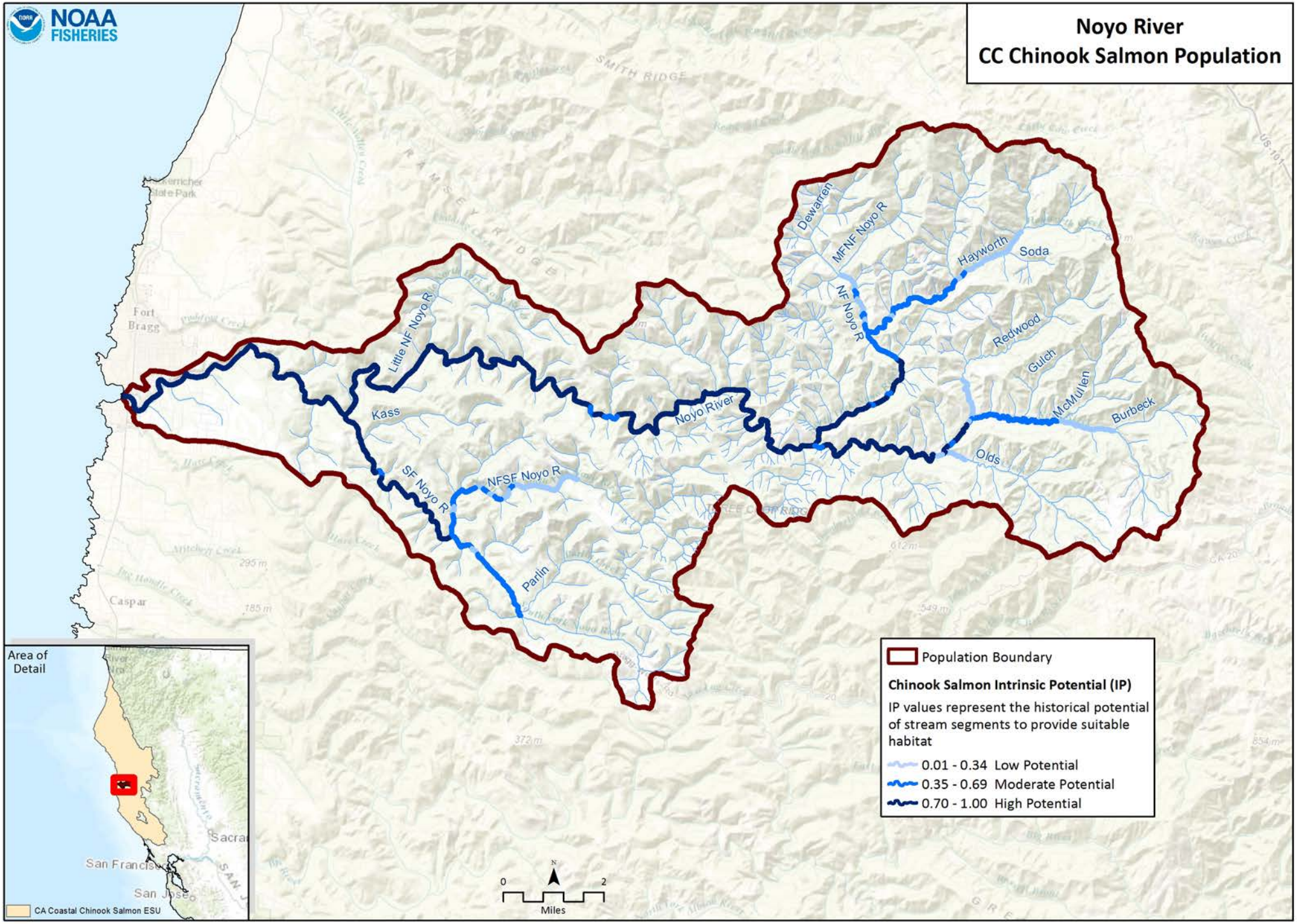
NOAA FISHERIES
Noyo River
CC Chinook Salmon Population
Dewarren
MFNF Noyo R
NF Noyo R
Hayworth
Soda
Redwood
Gulch
McMullen
Burbeck
Olds
Noyo River
Little NF Noyo R
Kass
SF Noyo R
NFSF Noyo R
Parlin
Fort Bragg
Caspar
Area of Detail
San Francisco
San Jose
CA Coastal Chinook Salmon ESU
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
0
2
Miles

CC Chinook Salmon Noyo River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>20% average staging pool frequency)	51% to 74% of streams/ IP-Km (>20% average staging pool frequency)	75% to 89% of streams/ IP-Km (>20% average staging pool frequency)	>90% of streams/ IP-Km (>20% average staging pool frequency)	50% of streams/ IP-km (>20% average staging pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	<50% of streams/ IP-km (>40% Pools; >20% Riffles)	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score <35	Very Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	47% Class 5 & 6 across IP-km	Fair

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		<1 spawners per IP-km	Poor
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	<50% of Historical Range	Poor
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	Fair
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	37% streams/ 59% IP-km (>50% stream average scores of 1 & 2)	Fair

3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>40% average primary pool frequency)	51% to 74% of streams/ IP-Km (>40% average primary pool frequency)	75% to 89% of streams/ IP-Km (>40% average primary pool frequency)	>90% of streams/ IP-Km (>40% average primary pool frequency)	11% streams/ 64 % IP-km (>40% average primary pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	63% streams 90% IP-km (>40% Pools; >20% Riffles)	Good
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-Km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0 Diversions/10 IP-km	Very Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	47% Class 5 & 6 across IP-km	Fair

			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	37% streams/ 59% IP-km (>50% stream average scores of 1 & 2)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Good
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	<50% of Historical Range	Poor
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0 Diversions/10 IP-km	Very Good

			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	>90% of IP-km	Very Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	37% streams/ 59% IP-km (>50% stream average scores of 1 & 2)	Fair
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces high risk spawner density per Spence (2008)	Poor
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.251% of Watershed in Impervious Surfaces	Very Good

			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	0.018% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	Fair
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	2% of Watershed >1 unit/20 acres	Very Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	7.2 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	2.3 Miles/Square Mile	Poor

CC Chinook Salmon Noyo River CAP Viability Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture			Low			Low
2	Channel Modification	Low	Low	Low	Low	Low	Low
3	Disease, Predation and Competition						
4	Fire, Fuel Management and Fire Suppression	Low	Low	Low	Low	Low	Low
5	Fishing and Collecting	Medium					Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching						
8	Logging and Wood Harvesting	Low	Medium	Medium	Medium	Medium	Medium
9	Mining						
10	Recreational Areas and Activities					Low	Low
11	Residential and Commercial Development	Low	Low	Low	Low	Low	Low
12	Roads and Railroads	Low	Medium	Medium	Low	High	Medium
13	Severe Weather Patterns	Medium	Medium	Medium	Low		Medium
14	Water Diversion and Impoundments	Low		Low	Low		Low

Noyo River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
NR-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NR-CCCh-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat				
NR-CCCh-1.1.1.1	Action Step	Estuary	Evaluate enhancement opportunities for Noyo River estuary.	3	5	California Coastal Conservancy, CDFW, County of Mendocino, NMFS	
NR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
NR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Delineate unconfined reaches possessing or having potential for winter rearing habitat restoration.	2	3	CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Private Landowners	
NR-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	20	CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Private Landowners	
NR-CCCh-2.1.1.3	Action Step	Floodplain Connectivity	Focus off-channel restoration actions in the lower mainstem Noyo River and areas with high IP-km values (> 0.7).	2	10	CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Private Landowners	
NR-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NR-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
NR-CCCh-5.1.1.1	Action Step	Passage	Assess and restore passage at barriers associated with the California Western Railroad.	2	10	Cal Western Railroad, CDFW, Mendocino Redwood Company	
NR-CCCh-5.1.1.2	Action Step	Passage	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	2	10	CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Private Landowners	
NR-CCCh-5.1.1.3	Action Step	Passage	Restore passage in high priority areas of the Noyo River Watershed as identified in existing fish passage databases.	2	10	CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Private Landowners	
NR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD, and shelters				
NR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Encourage retention and recruitment of large woody debris for all historic salmonid streams to maintain and enhance current stream complexity, pool frequency, and depth.	3	50	Cal Western Railroad, CalFire, California Coastal Conservancy, California Department of Mines and Geology, CDFW, City of Fort Bragg, Lyme Timber, Mendocino Redwood Company, NMFS, Private Landowners, RWQCB, USACE	
NR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Maintain current LWD, boulders, and other structure providing features to maintain current stream complexity, pool frequency, and depth (CDFG 2004).	2	60	Cal Western Railroad, CalFire, California Coastal Conservancy, California Department of Mines and Geology, CDFW, City of Fort Bragg, Lyme Timber, Mendocino Redwood Company, NMFS, Private Landowners, RWQCB, USACE	
NR-CCCh-6.1.1.3	Action Step	Habitat Complexity	Install or enhance existing LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (CDFG 2004). Use information, where germane, from MRC Noyo Watershed Analysis to determine stream locations with high instream LWD demand, and utilize CDFW stream habitat data to help determine reaches for LWD placement. High IP areas of the South Fork Noyo, Little North Fork Noyo and Redwood Creek are priorities for restoration of LWD.	2	10	Cal Western Railroad, CalFire, California Coastal Conservancy, CDFW, City of Fort Bragg, Jackson Demonstration State Forest, Lyme Timber, Mendocino Redwood Company, NMFS, NOAA RC, Pacific States Marine Fisheries Commission, Private Landowners, RWQCB, Trout Unlimited	
NR-CCCh-6.1.1.4	Action Step	Habitat Complexity	Work with the railroad (California Western Railroad) to stop removal of LWD from the Noyo River.	2	10	Cal Western Railroad, CDFW, NMFS, NOAA RC	

Noyo River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
NR-CCCh-6.1.1.5	Action Step	Habitat Complexity	Develop and implement LWD projects in the Noyo River watershed using guidance from Albin (2006), Noyo River Watershed Enhancement Plan, or other credible watershed assessments.	2	10	Cal Western Railroad, CDFW, NMFS, NOAA RC	
NR-CCCh-6.1.1.6	Action Step	Habitat Complexity	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	3	60	CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Private Landowners	
NR-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NR-CCCh-7.1.1	Recovery Action	Riparian	Improve canopy cover				
NR-CCCh-7.1.1.1	Action Step	Riparian	Implement riparian canopy projects in the Noyo River watershed using Albin (2006) as guidance. Tributaries to have riparian canopy restoration are: Hayshed Gulch, middle Noyo River, Duffy Gulch, Hayworth Creek, Olds Creek and its tributaries.	2	20	CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Private Landowners	
NR-CCCh-7.1.2	Recovery Action	Riparian	Improve tree diameter				
NR-CCCh-7.1.2.1	Action Step	Riparian	Conserve and manage forestlands for older forest stages.	2	60	CalFire, California Coastal Conservancy, CDFW, Lyme Timber, Mendocino Redwood Company, NMFS, NOAA RC, Private Landowners	
NR-CCCh-7.1.2.2	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian no harvest buffers.	2	60	CalFire, California Coastal Conservancy, CDFW, Lyme Timber, Mendocino Redwood Company, NMFS, NOAA RC, Private Landowners, Trout Unlimited	
NR-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NR-CCCh-8.1.1	Recovery Action	Sediment	Improve instream gravel quality				
NR-CCCh-8.1.1.1	Action Step	Sediment	Treat high priority slides and landings identified in the MRC Noyo River Watershed Analysis or the Jackson Demonstration State Forest Road Management Plan.	2	5	CalFire, Lyme Timber, Mendocino Redwood Company, Private Landowners	
NR-CCCh-8.1.1.2	Action Step	Sediment	NMFS and landowners will work with RCD or NRCS to encourage sediment reduction assessments.	2	10	CalFire, CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Private Landowners, RCD	
NR-CCCh-8.1.1.3	Action Step	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	2	60	CalFire, Lyme Timber, Mendocino Redwood Company, Private Landowners	
NR-CCCh-8.1.1.4	Action Step	Sediment	Permitting agencies (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	2	2	CalFire, CDFW, Mendocino County Department of Public Works, NMFS	
NR-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NR-CCCh-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions				
NR-CCCh-10.1.1.1	Action Step	Water Quality	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004).	2	20	Hawthorne Timber Co., Mendocino Redwood Company, NOAA RC	
NR-CCCh-10.1.2	Recovery Action	Water Quality	Improve stream water quality conditions				
NR-CCCh-10.1.2.1	Action Step	Water Quality	Implement riparian canopy projects in the Noyo River watershed using Albin (2006) as guidance. Tributaries to have riparian canopy restoration are: Hayshed Gulch, middle Noyo River, Duffy Gulch, Hayworth Creek, Olds Creek and its tributaries.	2	40	CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Private Landowners	
NR-CCCh-10.1.2.2	Action Step	Water Quality	Improve riparian and instream conditions in rearing habitats by establishing riparian protection zones that extend the distance of a site potential tree height from the outer edge of a channel, and by adding LWD.	3	30	CalFire, CDFW, Jackson Demonstration State Forest, Lyme Timber, Mendocino Redwood Company, NMFS, Private Landowners	
NR-CCCh-10.1.2.3	Action Step	Water Quality	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004).	2	20	CDFW, Lyme Timber, Mendocino Land Trust, Mendocino Redwood Company, NMFS, NOAA RC, NRCS, Private Landowners	

Noyo River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
NR-CCCh-10.1.2.4	Action Step	Water Quality	Work with landowners to purchase easements on water rights to encourage the maintenance of surface flows.	3	20	CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Private Landowners, SWRCB	
NR-CCCh-10.1.2.5	Action Step	Water Quality	See hydrology, riparian, and temperature sections				
NR-CCCh-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NR-CCCh-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity				
NR-CCCh-11.1.1.1	Action Step	Viability	Continue and improve upon monitoring activities to determine the population status of adult and smolt salmonids in the watershed and its tributaries.	3	20	Jackson Demonstration State Forest, Lyme Timber, Mendocino Redwood Company, Private Landowners	
NR-CCCh-11.1.1.2	Action Step	Viability	Continue funding the life cycle monitoring station	2	5	Jackson Demonstration State Forest, Lyme Timber, Mendocino Redwood Company, Private Landowners	
NR-CCCh-11.1.1.3	Action Step	Viability	Continue juvenile monitoring efforts initiated by Burns (1972) and continued by Valentine and Jamison (CDFW 1992) and Georgia-Pacific Corp. and Campbell Timberland Management (1994-1998) in Little North Fork Noyo River.	2	30	CDFW, Lyme Timber, Mendocino Redwood Company, Private Landowners	
NR-CCCh-11.1.1.4	Action Step	Viability	Determine the need for a conservation hatchery/supplementation/augmentation program.	2	10	CDFW, NMFS	
NR-CCCh-11.1.1.5	Action Step	Viability	Identify if the population is at short-term or immediate risk of extinction.	2	5	CDFW, NMFS	
NR-CCCh-11.1.1.6	Action Step	Viability	Identify whether a conservation hatchery/supplementation/ augmentation program will complement the overall recovery effort.	2	10	CDFW, NMFS	
NR-CCCh-11.1.1.7	Action Step	Viability	Identify the biological or DPS significance of the subject population.	2	10	CDFW, NMFS	
NR-CCCh-11.1.1.8	Action Step	Viability	Identify population viability goals and the expectations of a conservation hatchery/supplementation/augmentation program.	2	10	CDFW, NMFS	
NR-CCCh-11.1.1.9	Action Step	Viability	Investigate the current population dynamics and viability status..	2	10	CDFW, NMFS	
NR-CCCh-11.1.1.10	Action Step	Viability	Investigate the current status of the population genetic diversity.	2	10	CDFW, NMFS	
NR-CCCh-11.1.1.11	Action Step	Viability	If determined necessary, identify an out-of-basin source population that could be used to start a population augmentation/supplementation/broodstock program.	2	20	CDFW, NMFS	
NR-CCCh-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NR-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
NR-CCCh-19.1.1.1	Action Step	Logging	Complete comprehensive assessment/implementation of erosion control measures in the entire North Fork River basin (CDFG 2004).	2	5	CDFW, Lyme Timber, Mendocino Redwood Company, NOAA RC, Trout Unlimited	
NR-CCCh-19.1.1.2	Action Step	Logging	Encourage all permanent and year-round access roads beyond the THP parcel be surfaced after harvest completion with base rock and road gravel, asphalt, or chipseal, and disconnected from the stream network as appropriate.	2	40	CDFW, Lyme Timber, Mendocino Redwood Company, NMFS, NOAA RC, Private Landowners	
NR-CCCh-19.1.1.3	Action Step	Logging	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	2	10	CalFire, CDFW, Mendocino Redwood Company, Private Landowners, Trout Unlimited	
NR-CCCh-19.1.1.4	Action Step	Logging	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	2	100	Board of Forestry, CalFire, CDFW, Mendocino Redwood Company, NMFS	
NR-CCCh-19.1.1.5	Action Step	Logging	Develop a California Forest Practice monitoring protocol to determine whether specific practices are effectively meeting intended objectives and are providing for the protection of salmonids.	3	20	Board of Forestry, CalFire, CDFW, Mendocino Redwood Company, NMFS	
NR-CCCh-19.1.1.6	Action Step	Logging	Continue the activities of the North Coast Watershed Assessment /Coastal Watershed Program.	3	20	CDFW	
NR-CCCh-19.1.1.7	Action Step	Logging	Consider the development of a Watershed Database (similar to the CDFW Northern Spotted Owl database) for salmonids that provides watershed data and information in a consistent fashion to all foresters for consideration in their harvest plans.	3	5	CalFire, CDFW, Jackson Demonstration State Forest, Lyme Timber, Mendocino Redwood Company, NMFS	

Noyo River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
NR-CCCh-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
NR-CCCh-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
NR-CCCh-19.2.1.1	Action Step	Logging	Assign NMFS staff to conduct THP reviews of the highest priority areas within the Noyo River watershed.	2	60	CalFire, CDFW, Mendocino County, NMFS, RWQCB	
NR-CCCh-19.2.1.2	Action Step	Logging	Establish greater oversight and post-harvest monitoring by the permitting agency of operations within salmonid areas.	2	40	Board of Forestry, CalFire, Mendocino Redwood Company, NMFS	
NR-CCCh-19.2.1.3	Action Step	Logging	NMFS staff should provide recommendations on potential restoration projects that could be incorporated into timber harvest plans.	2	10	CalFire, Lyme Timber, NMFS, Private Landowners	
NR-CCCh-19.2.1.4	Action Step	Logging	Provide information to BOF regarding salmonid priorities and recommend upgrading relevant forest practices.	2	60	CalFire, Lyme Timber, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners	
NR-CCCh-19.2.1.5	Action Step	Logging	The priorities in this recovery plan should serve as a guide for independent Forest Certification.	2	100	CalFire, Lyme Timber, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners	
NR-CCCh-19.2.1.6	Action Step	Logging	Investigate opportunities to programmatically permit the forest certification program to authorize incidental take for landowners through Endangered Species Act Section 10(a)(1)(B).	3	5	NMFS	
NR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
NR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	2	5	Lyme Timber, Mendocino Redwood Company, NMFS, Private Landowners, Trout Unlimited	
NR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	2	20	CalTrans, CDFW, Lyme Timber, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners	
NR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	2	20	CalFire, CDFW, Lyme Timber, Mendocino Redwood Company, Private Landowners	
NR-CCCh-23.1.1.4	Action Step	Roads/Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	3	10	Lyme Timber, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners	
NR-CCCh-23.1.1.5	Action Step	Roads/Railroads	Encourage County of Mendocino to address and adequately maintain the Sherwood Ridge Road. Encourage County of Mendocino to completely close and monitor gates and barriers during the winter period.	2	10	Lyme Timber, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners	
NR-CCCh-23.1.1.6	Action Step	Roads/Railroads	Design and implement a program of BMPs for road maintenance on private roads similar to the program for public roads (Sommarstrom et al., 2002).	2	20	Mendocino County Department of Public Works, NOAA RC, Private Landowners	
NR-CCCh-23.1.1.7	Action Step	Roads/Railroads	Restoration projects that upgrade or decommission high risk roads in high priority areas should be considered an extremely high priority for funding (e.g., PCSRF).	2	10	Lyme Timber, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners	
NR-CCCh-23.1.1.8	Action Step	Roads/Railroads	Fully implement the Noyo River TMDL.	3	30	CDFW, Lyme Timber, Mendocino Redwood Company, Private Landowners, RWQCB	
NR-CCCh-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
NR-CCCh-23.1.2.1	Action Step	Roads/Railroads	Continue education of County road engineers, timber company, and railroad maintenance staff regarding watershed processes and the adverse effects of improper road/railroad construction and maintenance to salmonids and their habitats.	2	60	CalFire, Lyme Timber, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners	

Noyo River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
NR-CCCh-23.1.2.2	Action Step	Roads/Railroads	Develop a Salmon Certification Program for road maintenance staff.	3	10	CalTrans, Lyme Timber, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners	
NR-CCCh-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
NR-CCCh-23.1.3.1	Action Step	Roads/Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	2	5	CalFire, Lyme Timber, Mendocino Redwood Company, Private Landowners	
NR-CCCh-23.1.3.2	Action Step	Roads/Railroads	Stream crossings should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	3	60	Cal Western Railroad, California Department of Mines and Geology, Lyme Timber, Mendocino Redwood Company, Private Landowners	
NR-CCCh-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanism**				
NR-CCCh-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
NR-CCCh-23.2.1.1	Action Step	Roads/Railroads	Minimize to the extent feasible new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	100	CalFire, CDFW, Lyme Timber, Mendocino County, Mendocino Redwood Company, NMFS, Private Landowners	
NR-CCCh-23.2.1.2	Action Step	Roads/Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	3	100	CalFire, Lyme Timber, Mendocino County, Mendocino Redwood Company, NMFS, Private Landowners	
NR-CCCh-23.2.1.3	Action Step	Roads/Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	2	60	Cal Western Railroad, CalFire, California Department of Mines and Geology, Lyme Timber, Mendocino Redwood Company, NRCS, Private Landowners, RWQCB	
NR-CCCh-23.2.1.4	Action Step	Roads/Railroads	Ensure all existing and new road and railway crossings minimize potential sediment delivery to the stream environment and allow upstream and downstream passage of adult and juvenile salmonids.	2	20	Cal Western Railroad, CDFW, NMFS, NOAA RC	
NR-CCCh-24.1	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
NR-CCCh-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
NR-CCCh-24.1.1.1	Action Step	Severe Weather Patterns	Develop and implement critical flow levels for the mainstem Noyo River impacted by water diversions for the City of Fort Bragg.	3	10	CDFW, NMFS, Private Landowners, SWRCB	
NR-CCCh-24.1.1.2	Action Step	Severe Weather Patterns	If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated by municipal water suppliers and other users in the watershed through conservation programs.	3	60	CDFW, NMFS, Private Landowners, SWRCB	
NR-CCCh-24.1.1.3	Action Step	Severe Weather Patterns	Identify and work with water users to minimize depletion of summer base flows during drought years.	3	10	City of Fort Bragg, Lyme Timber, Mendocino Redwood Company, Private Landowners	

CC Chinook Salmon ESU Rapid Assessment Profile: North-Central Coastal Diversity Stratum Populations

Ten Mile River

- Role within ESU: Independent Population
- Spawner Abundance Target: 401– 804 adults
- Current Intrinsic Potential: 67.2 IP-km

Albion River

- Role within ESU: Dependent Population
- Spawner Abundance Target: 104 – 209 adults
- Current Intrinsic Potential: 17.6 IP-km

For information regarding NC steelhead and CCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the CCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

Historically, the Ten Mile River Basin was known to have productive salmonid fishery resources. While overall fish numbers have diminished, the basin still maintains important runs of CCC coho salmon and CC Chinook salmon and NC steelhead (CWPAP 2013). Surveys of juveniles from the early 1990s through 2000 suggest NC steelhead are the most numerous salmonid species in the watershed, and CC Chinook salmon are present in very low numbers (Ambrose and Dreier 1994; Ambrose *et al.* 1996; Ambrose and Hines 1997; Ambrose *et al.* 1997; Ambrose and Hines 1998).

Starting in 1989, spawning surveys were sporadically conducted in the Ten Mile River (Salmon Trollers Marketing Association Inc. 1990; Maahs and Gilleard 1994; Maahs 1996; Maahs 1997). These surveys focused on documenting CC Chinook salmon and CCC coho salmon presence and abundance, and were not focused at estimating NC steelhead abundance. The surveys documented very low numbers of CC Chinook salmon, mainly via carcass surveys. Spence *et al*. (2008) noted over the last 10-15 years, there have been sporadic reports of CC Chinook salmon in the Ten Mile River. They also noted that the lack of reliable information on abundance in the Ten Mile River (and five other coastal watersheds between the Russian River and the Mattole River historically supporting CC Chinook salmon) suggests CC Chinook salmon were extirpated from this Diversity Stratum (Spence *et al*. 2008). However, more recent

sampling in 2013 documented many young of the year CC Chinook salmon in outmigrant traps, and CC Chinook salmon redds in the watershed (D. Wright, Campbell Timber, personal communication, 2013)(Photo 1).

Photo 1. Juvenile CC Chinook salmon captured on the South Fork Ten Mile River in Spring 2013. *Photo Courtesy: Campbell Timberland Management*.

The current salmonid resources of the Albion Basin include CCC coho salmon and winter-run NC steelhead and incidental reports and anecdotal information also record CC Chinook salmon and pink salmon (*Oncorhynchus gorbuscha*). The Albion River appears to have sustainable CCC coho salmon and NC steelhead populations due to the suitable stream temperatures, year-round open river mouth, and large estuary (CWPAP 2013). As a historically dependent population, the Albion River likely supported only small or sporadic populations of CC Chinook salmon. However, these smaller populations provide genetic material and protection

from stochastic events and, therefore, contribute to overall ESU viability in addition to meeting connectivity and occupancy criteria necessary for recovery in the Diversity Stratum.

History of Land Use, Land Management and Current Resources

The Ten Mile River is located approximately eight miles north of Fort Bragg in Mendocino County and drains a forested, coastal watershed of approximately 120 square miles. Elevation in the watershed ranges from sea level to 3,205 feet. The watershed experiences a Mediterranean-type climate and is dominated by coastal conifer forests of redwood and Douglas-fir. The mouth of the river is semi-enclosed by a sandbar which forms a tidal estuary.

The Ten Mile watershed is largely defined by timber harvest, which began in the lower basin about 1870. Major portions of the watershed were harvested between the mid-1940s and the mid-1960s using tractor yarding, with its associated road, skid trails, log layouts, and landing construction. Second growth logging began in the 1960s and continues today using about a 60 year average rotation age. The Ten Mile River watershed is almost entirely privately owned, with Lyme Redwood Timberland the successor to Hawthorne Timber Company, LLC, , owning about 85 percent of the watershed. There are three small non-industrial timber owners and a handful of other residences within the watershed. The 2010 census estimated the human population in the watershed at about 191 people.

Numerous restoration projects have occurred in the Ten Mile River, including barrier modifications (generally culvert upgrades), upslope sediment remediation, and instream habitat enhancement. Until recently, most restoration actions were focused on reducing sediment input from upslope roads associated with ongoing timber management. In the past few years, Campbell Timberland Management has conducted, with funding through FRGP, significant effort to improve instream habitat complexity for salmonids through the addition of large woody material.

The EPA listed the Ten Mile River as having water quality impaired by sediment in 1998. The listing determined sediment was impairing the migration, spawning, reproduction and early development of CC Chinook salmon, and identified non-point source silviculture as the probable cause. Since then, the EPA has established a TMDL for the watershed (USEPA 2000).

The Albion River watershed is located in central Mendocino County and encompasses approximately 43 square miles. Most of the watershed is managed by the Mendocino Redwood Company. Its headwaters are located approximately 12 miles inland and reach an elevation of 600 feet. The Albion Basin also has a Mediterranean climate and is also dominated by conifers,

primarily redwood, and Douglas fir. About 90 percent of the precipitation in this area falls between October and April, with the highest average precipitation in January. The watershed has a large estuary with tidal influence extending as much as five miles upstream (Downie *et al.* 2004).

The EPA listed the Albion River as having water quality impaired by sediment in 2001 (USEPA 2001). The listing determined that sediment was impairing the migration, spawning, reproduction, and early development of CC Chinook salmon, and identified non-point source silviculture as the probable cause.

There are two post office towns in the Albion Basin: Comptche near the headwaters and Albion near the mouth. The total Albion Basin resident population in the year 2010 census was estimated at about 938 people.

Salmonid Viability and Habitat Conditions

Currently impaired conditions resulting directly or indirectly from human activities, are expected to continue until restored and/or the threat acting on these condition is abated. The majority of conditions evaluated for the Diversity Stratum rated as minor effects to most lifestages. Overall, the Ten Mile and Albion watersheds are subject to fewer conditions than many other watersheds in the Diversity Stratum due to a singular land use (timber harvest) and a general lack of urban or rural residential impacts.

The following discussion focuses on those conditions that rated as Poor or Fair to CC Chinook salmon life history stages (see North-Central Coastal Diversity Stratum Rapid Assessment). These were: Habitat Complexity: Percent Primary/Staging Pools and Pool/Riffle/Flatwater Ratios; Habitat Complexity: Large Wood and Shelter; Sediment: Gravel Quality and Distribution of Spawning Gravels; Viability: Density, Abundance and Spatial Structure; and Water Quality: Turbidity or Toxicity. Recovery strategies will focus on improving these conditions as well as those needed to ensure population viability and functioning watershed processes.

Habitat Complexity: Percent Primary Pools/Staging and Pool/Riffle/Flatwater Ratios

Complexity: Percent Primary Pools/Staging and Pool/Riffle/Flatwater Ratios is rated as Good for adults and smolts, but is rated as Fair for pre smolt lifestage. This indicates that this factor is potentially limiting for that lifestage. Of reaches sampled in the Ten Mile River and Albion River, data from CDFW habitat inventories indicate pool complexity and pool/riffle ratios are in

generally poor condition. Threats that have caused, are causing, or may contribute to this condition include Logging, and Roads/Railroads.

Habitat Complexity: Large Wood and Shelter

Lack of habitat complexity in the form of wood and high levels of instream sediment is rated as Fair and is having a moderate adverse effect on the adult and pre smolt lifestages. The lack of instream complexity is likely the result of long term land uses related to timber harvest in both watersheds, particularly impacts associated with mechanized logging practices prior to the California Forest Practice Rules. Of reaches sampled in the Ten Mile River and Albion River, data from CDFW habitat inventories indicate large wood is lacking. However, since these surveys were conducted, extensive efforts to improve instream habitat conditions have been conducted in the mainstem portions of the Ten Mile River (South Fork, Clark Fork and North Fork)(Photo 2).

Photo 2. LWD on Ten Mile Creek. *Photo Courtesy: Campbell Timberland Management.*

To date 18 miles (29 km) of the Ten Mile have been augmented with LWD and another 19 miles (30.5 km) are targeted in the near future by Campbell Timberland Management (CTM) (D. Wright, Campbell Timber, personal communication, 2011). While significant efforts have occurred, it is likely that instream habitat conditions overall (including some of the tributaries and properties not managed by CTM) are not at the viability targets for these attributes.

Threats that have caused, are causing, or may cause this condition to continue to impair CC Chinook salmon life history targets include Logging and Roads/Railroads.

In the Albion watershed, the Mendocino Redwood Company is also continuing to implement projects to improve habitat complexity by installing large wood through FRGP funding.

Sediment: Gravel Quality and Distribution of Spawning Gravels

Gravel quality and quantity is rated as Fair and has had a moderate adverse effect on the egg and pre smolt lifestages, and is potentially limiting for those lifestages. This factor is rated as Good and has only had a minor effect on the adult and smolt lifestages. These ratings reflect the generally high sediment loads in the Diversity Stratum. Threats that have caused, are causing, or may cause this condition to continue to impair CC Chinook salmon life history targets include the Logging and Roads/Railroads.

Viability: Density, Abundance and Spatial Structure

Viability: Density, Abundance and Spatial Structure are rated as Poor and have had major effects on the target lifestages. CC Chinook salmon populations are severely depressed across the Diversity Stratum, and are currently not viable. These very small populations are at high risk of extinction (Spence *et al*. 2008).

Water Quality: Turbidity or Toxicity

Water Quality: Turbidity or Toxicity is rated as Good and has only had a minor effect on pre smolts and smolts. High levels of instream sediment are having a moderate effect on the adult lifestage and rated as Fair. While some herbicides are used to control tan oak or other plant competitors, they are typically directly applied to cuts or stumps, and offer little risk of adverse impacts to the aquatic environment.

Threats

Most threats in this Diversity Stratum were rated as Very Good or Good and were negligible or minor contributors to the conditions. The following discussion focuses on those threats that rate as a primary (Poor) or secondary concern (Fair) (see North-Central Coastal Diversity Stratum Rapid Assessment). Recovery strategies will focus on ameliorating primary threats; however, some strategies may address other threat categories when the strategy is essential to recovery efforts. Two potentially increasing threats are timberland conversion to rural residential uses, and cultivation of marijuana. The figures and tables that display data used in this analysis are provided in North-Central Coastal Diversity Stratum Rapid Assessment.

Agriculture

Agriculture comprises less than 0.1 percent of the land acreage in the Diversity Stratum, and is rated as Very Good and is considered a negligible or minor contribution to the conditions. However, should native forests be converted through forestland conversions, to vineyards or other crops, many of the resulting impacts can disproportionally adversely affect salmonids and their habitat, especially the increase of sediment sources from bare slopes, removal of riparian vegetation and water diversion for irrigation.

As in many watersheds in California, illegal marijuana cultivation occurs in some areas, and has the potential to severely degrade juvenile rearing conditions by diverting water and introducing toxic quantities of fertilizers and pesticides into the stream environment. It is unknown to what degree marijuana cultivation may be impacting listed salmonid populations in this Diversity Stratum; however, it is likely to increase the adverse impacts associated with agriculture to some degree.

Fire, Fuel Management and Fire Suppression

This threat is rated as Very Good and is considered a negligible or minor contribution to all but one of the conditions. It is considered to be a moderate contributor to the condition of Water Quality: Turbidity or Toxicity and is rated as Fair due to the potential use of toxic fire retardant materials and increased rates of sediment input following runoff in response to winter rainfall. According to CalFire data, some areas in the Ten Mile River watershed have high fire hazard rating. A major fire, particularly if located in areas with a High erosion hazard rating, could result in major increases in fine sediment and further compromise the rate of large wood recruitment in stream channels. Furthermore, if existing riparian areas were lost to fire, increases in instream temperatures would likely result.

Livestock Farming and Ranching

There is little or no livestock, farming or ranching in this Diversity Stratum, and this threat is rated as Very Good and is considered a negligible or minor contribution to the conditions. The one exception is rated as Fair and is a moderate contribution to the condition of Estuary: Quality and Extent in the Ten Mile River estuary where cattle-grazing currently occurs.

Logging and Wood Harvesting

Timber harvest is rated as Fair and remains a moderate contributor to four conditions for CC Chinook salmon habitat in both the Ten Mile and Albion watersheds, but at diminished levels compared to historical practices. It is considered a moderate contributor to the conditions of Habitat Complexity: Percent Primary/Staging Pools and Pool/Riffle/Flatwater; Habitat Complexity: Large Wood and Shelter; Sediment: Gravel Quality and Distribution of Spawning

Gravels; and Water Quality: Turbidity or Toxicity. Even with application of new California Forest Practice Rules this threat is anticipated to continue into the foreseeable future.

Residential and Commercial Development

As noted above, as a result of extensive private land ownership, there is little if any development ongoing in the Diversity Stratum, and this threat is rated as Very Good and considered a negligible or minor contribution to the conditions. The one exception is rated as Fair and is a moderate contribution to the condition of Estuary: Quality and Extent. This development includes California Highway 1, a 22 acre campground and small boat harbor, and is illustrated in Photo 3.

Photo 3. Development around the Albion River estuary. Photo provided by Friends of the Gualala River, photographer Rixanne Wehren, and is used with permission. All rights reserved.

Roads and Railroads

Roads are rated as Good and are a minor contributor to four conditions, and rated as Fair and are a moderate contributor to four others. Legacy roads from past logging activity continue to adversely impact habitat quality for salmonids in the Diversity Stratum. Road densities are high throughout the watershed and are estimated for the Tem Mile River at 2.5 miles of road per square mile of watershed area, and at 3.7 miles per square mile of riparian area. In the Albion River, there is an estimated 7.7 miles of road per square mile of watershed area, and at 6.4 miles per square mile of riparian area. Many of these roads were poorly situated and constructed[1], improperly maintained, and many have been abandoned rather than properly decommissioned. Both major landowners, CTM and the Mendocino Redwood Company have

[1] The majority of these roads were constructed prior to the passing of the California Forest Practices Rules in 1973.

upgraded many roads, and conditions are improving, particularly along the mainstems in both watersheds and South Fork Albion River.

Severe Weather Patterns

The potential for severe weather to affect flows is rated as Fair and is considered a Medium threat to Hydrology: Redd Scour, and Hydrology: Baseflow and Passage Flows.

Extreme rainfall events could result in major input of sediment from upslope locations, particularly from legacy roads. This could contribute to Sediment: Gravel Quality and Distribution of Spawning Gravels. The high road density in the watershed increases the likelihood of major sediment input during wet weather periods. Targeting High risk roads for closure and appropriate restoration actions will reduce the magnitude of this threat.

Hatcheries and Aquaculture

No fish hatcheries currently operate within the Ten Mile or Albion watersheds. In the past the Salmonid Restoration Association operated a small NC steelhead hatchery in the Ten Mile watershed, near Vallejo Gulch. This operation was discontinued in approximately 2000 and the remaining infrastructure was removed about five years ago. As a result, this was not rated.

Limiting Conditions, Lifestages, and Habitats

The adult, egg, and pre smolt lifestages are most limited by current conditions and future threats facing CC Chinook salmon in North-Central Coastal Diversity Stratum. The conditions most limiting include: Habitat Complexity: Percent Primary/Staging Pools and Pool/Riffle/Flatwater Ratios; Habitat Complexity: Large Wood and Shelter; Sediment: Gravel Quality and Distribution of Spawning Gravels; and Water Quality: Turbidity or Toxicity. The primary condition for adults, pre smolt and smolt lifestages is Viability: Density, Abundance and Spatial Structure. The greatest threats to recovery in this Diversity Stratum result from Logging and Roads.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating conditions and threats identified as having moderate or major effects, as discussed above, although strategies that address other factors may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. The general recovery strategies for the populations in this Stratum are discussed below with more detailed and site-specific recovery actions provided in North-Central Coastal Diversity Stratum Rapid Assessment.

Increase Survivorship at Every Lifestage

To achieve viability, particularly in the independent population of the Ten Mile River, increasing survival is critical. This goal will only be achieved with focused habitat restoration, sound management, and careful stewardship.

Habitat Complexity: Large Wood and Shelter

Many reaches of the Ten Mile and Albion watersheds would benefit from improved riparian composition and structure, which would increase future LWD recruitment. General practices to improve riparian condition include initiating a conifer release program to promote existing conifer growth, and working with landowners in the floodplain to increase riparian buffer widths. Fencing and planting in the floodplains could result in major improvement to the lower reaches of the South Fork and mainstem Ten Mile River, and in the upper Albion River. As stated above, Campbell Timberland Management has initiated a program of LWD supplementation program to enhance habitat complexity. Continuation of this program will likely be necessary due to the long period of time it may take for LWD to naturally recruit from existing riparian zones. In addition to directly contributing to habitat complexity, LWD and other habitat features such as boulders support development of complex pools, and improve pool/riffle ratios.

Address Upslope Sediment Sources to Improve Gravel Quality and Quantity

Active and abandoned logging roads and skid trails are located throughout the Diversity Stratum and likely contribute large volumes of sediment into the stream environment. Many logging roads have been upgraded to modern standards, but substantial work remains before this significant sediment source is thoroughly addressed. Ongoing road work should include a component that closes and decommissions unnecessary and abandoned roads and skid trails to reduce the overall road density in the watershed. Including road remediation within future timber harvest plans should be considered a top mitigation priority.

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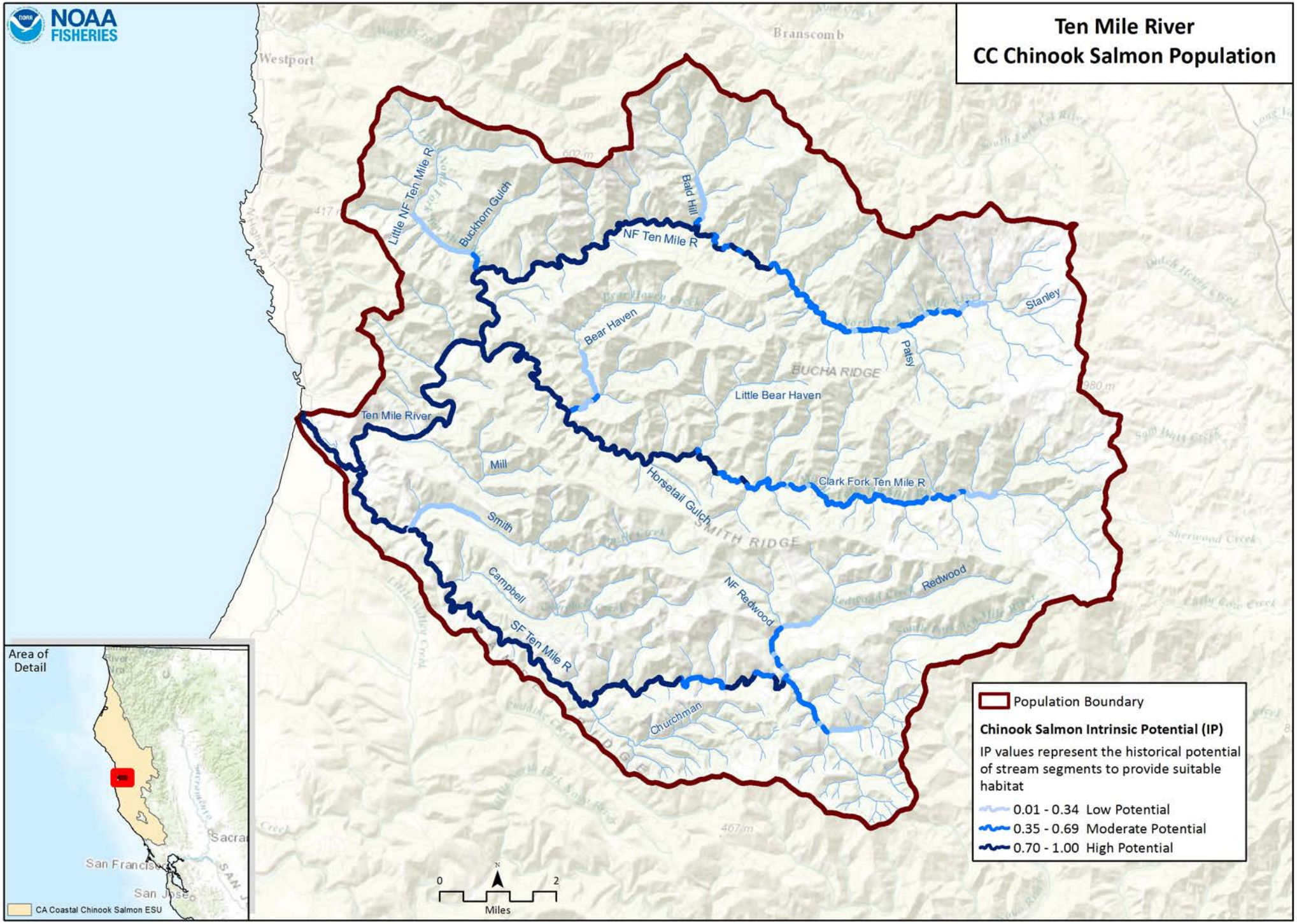
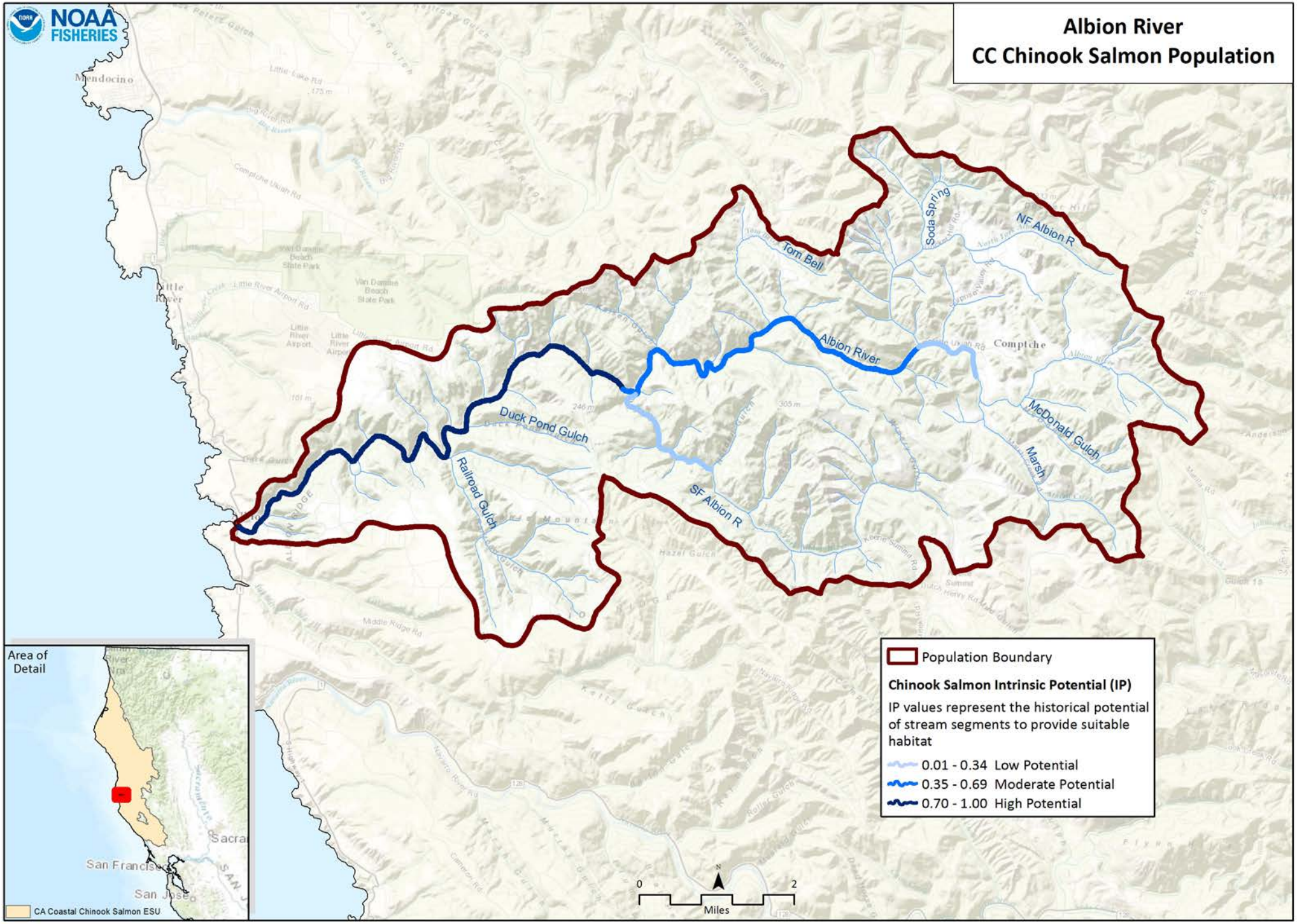

Ten Mile River
CC Chinook Salmon Population
NOAA FISHERIES
Westport
Branscomb
Little NF Ten Mile R
Buckhorn Gulch
Bald Hill
NF Ten Mile R
Bear Haven
Stanley
Paisy
BUCHA RIDGE
Little Bear Haven
Ten Mile River
Mill
Horsetail Gulch
Clark Fork Ten Mile R
Smith
SMITH RIDGE
Campbell
NF Redwood
Redwood
SF Ten Mile R
Churchman
Area of Detail
San Francisco
San Jose
CA Coastal Chinook Salmon ESU
0
2
Miles
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential


NOAA FISHERIES
Albion River
CC Chinook Salmon Population
Mendocino
Little River
Comptche
Albion River
Tom Bell
Soda Spring
NF Albion R
Duck Pond Gulch
Railroad Gulch
SF Albion R
McDonald Gulch
Marsh
Area of Detail
San Francisco
San Jose
CA Coastal Chinook Salmon ESU
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
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0
2
Miles

CC Chinook Salmon ESU: North Central Coastal Diversity Stratum (Albion/ Ten Mile)

Habitat & Population Condition Scores By Life Stage: VG = Very Good G = Good F = Fair P = Poor		Chinook Salmon Life History Stages			
		Adults	Eggs	Pre-Smolt	Smolts
Stresses: Key Attribute: Indicators	Estuary: Quality & Extent	G		G	G
	Velocity Refuge: Floodplain Connectivity	G		G	G
	Hydrology: Redd Scour		G		
	Hydrology: Baseflow & Passage Flows	G	G	G	G
	Passage/Migration: Mouth or Confluence & Physical Barriers	G		VG	VG
	Habitat Complexity: Percent Primary/Staging Pools & Pool/Riffle/Flatwater Ratios	G		F	G
	Habitat Complexity: Large Wood & Shelter	F		F	G
	Sediment: Gravel Quality & Distribution of Spawning Gravels	G	F	F	G
	Viability: Density, Abundance & Spatial Structure	P		P	P
	Water Quality: Turbidity & Toxicity	F		G	G

CC Chinook Salmon ESU: North Central Coastal Diversity Stratum (Albion/ Ten Mile)

Threat Scores
L: Low
M: Medium
H: High

Threats - Sources of Stress	Stresses: Estuary: Impaired Quality & Extent	Floodplain Connectivity: Impaired Quality & Extent	Hydrology: Gravel Scouring Events	Hydrology: Impaired Water Flow	Impaired Passage & Migration	Instream Habitat Complexity: Altered Pool Frequency and/or Pool/Riffle Ratios	Instream Habitat Complexity: Reduced Large Wood and/or Shelter	Instream Substrate/Food Productivity: Impaired Gravel Quality & Quantity	Reduced Density, Abundance & Diversity	Water Quality: Increased Turbidity or Toxicity
Agriculture	L	L	L		L	L	L	L		L
Channel Modification	L	L	L	L	L	L	L	L		L
Disease, Predation, and Competition	L	L			L	L	L		M	L
Fire, Fuel Management, and Fire Suppression	L	L	L		L	L	L	L		M
Livestock Farming and Ranching	L	L	L		L	L	L	L		L
Logging and Wood Harvesting	L	L	L		L	M	M	M		M
Mining	L	L	L		L	L	L	L		L
Recreational Areas and Activities	L	L	L		L	L	L	L		L
Residential and Commercial Development	L	L	L	L	L	L	L	L		L
Roads and Railroads	L	L	L	L	L	M	L	M		M
Severe Weather Patterns	L	L	L	L	L	L	L	L		L
Water Diversions and Impoundments	L	L	L	L	L	L	L	L	L	L
Fishing and Collecting									M	
Hatcheries and Aquaculture									L	L

Ten Mile River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
TMR-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
TMR-CCCh-1.1.1	Recovery Action	Estuary	Increase the quality and extent of estuarine habitat				
TMR-CCCh-1.1.1.1	Action Step	Estuary	Initiate estuary study to evaluate limiting factors in Ten Mile River estuary.	3	5	CDFW, NOAA RC, RWQCB, The Nature Conservancy, Trout Unlimited	Development of a multi-disciplinary Technical Advisory Committee (TAC) to develop the scientific foundation for this study is recommended. The TAC should be familiar with other estuaries and estuary reaches within the Lost Coast Diversity Stratum as well as past and ongoing studies within the CCC ESU.
TMR-CCCh-1.1.1.2	Action Step	Estuary	Where feasible, remove structures and modify practices that degrade or reduce the historical estuarine extent or functions to benefit Chinook salmon.	3	10	CDFW, NOAA RC, Private Landowners, The Nature Conservancy, Trout Unlimited	Ten Mile Estuary is relatively intact and likely has few structures that have significantly modified the historical tidal prism and feeding and transition habitat.
TMR-CCCh-1.1.1.3	Action Step	Estuary	Evaluate feasibility of enhancing the estuary with physical habitat improvement. Implement project if feasible and if determined to result in benefits to salmonid survival.	3	10	CDFW, Private Landowners, The Nature Conservancy	Targeting likely limiting factors such as over wintering and smolt transition habitats should be a high priority.
TMR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
TMR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
TMR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond and seasonal wetland habitats.	2	5	CalFire, CDFW, Lyme Timber, NOAA RC, Private Landowners	These actions should initially target habitat in the lower portions of the three mainstems (North Fork, Clark Fork, and South Fork).
TMR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
TMR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD and shelter.				
TMR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Identify historical habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover.	2	5	CDFW, Lyme Timber, Private Landowners, The Nature Conservancy	In addition to projects that increase large wood volumes in the three major subwatersheds and their tributaries attention should also be focused in the lower floodplain areas along the lower South Fork Ten Mile and areas below the Clark Fork/North Fork confluence. Projects designed to increase winter refuge habitat in these floodplain areas should be considered a high priority for salmonid habitat recovery.

Ten Mile River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
TMR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Install properly sized large woody debris to appropriate viability table targets.	2	10	CDFW, Lyme Timber, Private Landowners, The Nature Conservancy, Trout Unlimited	Campbell Timberlands (now Lyme Timber) has implemented numerous LWD projects at relatively low cost due their use of non-anchored material. This is significantly less expensive than engineered approaches. Data from CDFW habitat inventories indicate shelters throughout the Ten Mile River watershed are poor within all sampled reaches and this is a limiting factor for the summer rearing and smolt lifestages. LWD was likely removed during past land management activities and well intentioned stream clearing practices. However, since these surveys were completed in the mid-1990's, extensive efforts to improve instream habitat conditions have been conducted in the mainstem portions of the South Fork, Clark Fork and North Fork using the Accelerated Recruitment approach. 18 miles of the Ten Mile have been augmented with LWD and another 19 miles are targeted in the near future by Lyme Timber. While significant efforts have occurred, it is likely that instream habitat conditions overall (including some of the tributaries and properties not managed by CTM) are not at the viability targets for these attributes.
TMR-CCCh-6.1.1.3	Action Step	Habitat Complexity	Encourage coordination of LWD placement in streams as part of logging operations and road upgrades to maximize size, quality, and efficiency of effort (CDFG 2004).	2	100	CalFire, CDFW, Lyme Timber, Private Landowners, RCD, RWQCB	To implement this recommendation, additional streamlining of the THP process for LWD input by regulatory agencies is necessary. This recommendation should be adopted as a reoccurring recommendation for all restoration projects by individuals, agencies, and organizations that fund restoration projects. In Ten Mile stream reaches where there is little immediate downstream infrastructure, properly sized trees could be felled into stream channels to create these structures. Coordinating instream large wood placement with future timber harvest activities in the watershed could result in substantial cost savings and serve as an opportunity for effective timber harvest plan mitigation. Ten Mile has been habitat typed and thus the stream reaches lacking wood can be readily identified. Projects will occur as part of ongoing timber harvest actions and have lower overall costs, resulting in significant savings compared to restoration projects occurring without timber management equipment already nearby. Installing large woody material into a stream deficient in large wood should be considered a top restoration priority.
TMR-CCCh-6.1.1.4	Action Step	Habitat Complexity	Encourage retention and recruitment of large woody debris for all historical salmonid streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.	2	100	CalFire, CDFW, Private Landowners, RWQCB, USACE	This recommendation should be considered standard practice.
TMR-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
TMR-CCCh-7.1.1	Recovery Action	Riparian	Improve tree diameter				

Ten Mile River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
TMR-CCCh-7.1.1.1	Action Step	Riparian	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	2	20	CalFire, Lyme Timber, CDFW, Private Landowners	Many of the areas historically used for agricultural purposes have been extensively cleared of all riparian vegetation. Targeting restoration in these areas may result in some lands no-longer being farmed for hay production, etc. Landowner outreach will likely be required in these areas.
TMR-CCCh-7.1.1.2	Action Step	Riparian	Conduct conifer release to promote growth of larger diameter trees where appropriate.	2	10	CalFire, Lyme Timber, Private Landowners	Historical logging practices effectively removed all of the original conifer overstory (principally redwood and Douglas-fir) throughout the basin. As a result, no old-growth riparian stands remain within the watershed. Analysis of WHR size classes for Ten Mile watershed suggests that riparian stands are relatively well stock, albeit at a much younger age and generally in smaller size classes. Loss of the original forest changed the rate of recruitment and the quality of instream habitat forming features (e.g., old growth redwoods can persist instream for hundreds of years as LWD, and due to their large size create significant habitat forming features). Tree recruitment into the stream channel is likely at a slower rate than under historical conditions, due, in part, to the much younger age of the extant riparian stands.
TMR-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
TMR-CCCh-10.1.1	Recovery Action	Water Quality	Reduce turbidity and suspended sediment				
TMR-CCCh-10.1.1.1	Action Step	Water Quality	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions.	2	5	CalFire, Lyme Timber, Private Landowners, RWQCB	
TMR-CCCh-10.1.1.2	Action Step	Water Quality	Fully implement Ten Mile River TMDL.	2	20	CalFire, Lyme Timber, Private Landowners, RWQCB	High levels of instream fine sediment and turbidity likely impair the egg, smolt, and winter rearing lifestages within many basins in Ten Mile River Watershed (USEPA 2000). The source analysis in Ten Mile TMDL included an assessment of sediment sources historically and/or presently impacting water quality. Several management-related factors have contributed to the elevated sediment delivery rates throughout the watershed, primarily the high rate of timber harvest and associated road building. While overall rates have declined in the 67-year study period from 1933-1999, the USEPA (2000) determined that sediment generation from road surface erosion had increased. The TMDL targets high priority areas for implementation that are similar to NMFS prioritization for salmonid protection.
TMR-CCCh-10.1.1.3	Action Step	Water Quality	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	2	10	CalFire, California Geological Survey, Lyme Timber, Private Landowners, RWQCB	Identification of unstable areas will provide critical information for future THP planning and road construction and road decommissioning actions. Identification of high risk areas will provide important information for future road decommissioning grant funds by identifying areas for prioritization.

Ten Mile River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
TMR-CCCh-10.1.1.4	Action Step	Water Quality	Where restricting winter access to unpaved roads is not feasible, encourage measures such as rocking to prevent sediment from reaching salmonid streams.	2	100	CalFire, Lyme Timber, Private Landowners, RWQCB	Where restricting winter access to unpaved roads is not feasible, encourage measures such as rocking to prevent sediment from reaching salmonid streams (CDFG 2004).
TMR-CCCh-11.1	**Objective**	**Viability**	**Address other natural or manmade factors affecting the species' continued existence**				
TMR-CCCh-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure and diversity				
TMR-CCCh-11.1.1.1	Action Step	Viability	Re-establish a naturally reproducing run of Chinook salmon, with representation for each year class cohort.	1	5	CDFW, Lyme Timber, NOAA SWFSC, Private Landowners	
TMR-CCCh-11.1.1.2	Action Step	Viability	Develop and implement a program to regularly add salmon carcasses and/or salmon analogs to key locations within the watershed.	1	20	CDFW, Lyme Timber, NMFS, The Nature Conservancy, Trout Unlimited	
TMR-CCCh-11.2	**Objective**	**Viability**	**Address the inadequacy of existing regulatory mechanisms**				
TMR-CCCh-11.2.1	Recovery Action	Viability	Increase density, abundance, spatial structure and diversity				
TMR-CCCh-11.2.1.1	Action Step	Viability	Establish life cycle stations in the Ten Mile River watershed (Gallagher and Gallagher 2005). Consider placing a life cycle station on one key tributary (e.g., Little North Fork Ten Mile, Bear Haven, Campbell creeks) or, if possible, in each subwatershed (North Fork, Clark Fork, South Fork).	2	20	CDFW, Lyme Timber, NMFS	
TMR-CCCh-11.2.1.2	Action Step	Viability	Implement standardized assessment protocols (i.e., CDFW habitat assessment protocols) to ensure ESU-wide consistency.	3	60	CDFW, Lyme Timber, NMFS, RWQCB	
TMR-CCCh-15.1	**Objective**	**Fire/Fuel Management**	**Address the inadequacy of existing regulatory mechanisms**				
TMR-CCCh-15.1.1	Recovery Action	Fire/Fuel Management	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
TMR-CCCh-15.1.1.1	Action Step	Fire/Fuel Management	Implement sediment reduction techniques in concert with prescribed fire techniques to minimize sediment impacts to various salmonid life stages.	2	100	CalFire, Lyme Timber	
TMR-CCCh-15.1.1.2	Action Step	Fire/Fuel Management	Immediately implement appropriate sediment control measures following completion of fire suppression while firefighters and equipment are on site.	2	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-15.1.2	Recovery Action	Fire/Fuel Management	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
TMR-CCCh-15.1.2.1	Action Step	Fire/Fuel Management	Reduce erosion from fire prevention or suppression activities by maintaining existing natural topography to the extent possible.	3	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-15.1.2.2	Action Step	Fire/Fuel Management	Re-contour any new facility sites as soon as possible after site cleanup and fire.	3	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-15.1.3	Recovery Action	Fire/Fuel Management	Prevent or minimize impairment to stream hydrology (impaired water flow)				
TMR-CCCh-15.1.3.1	Action Step	Fire/Fuel Management	Draft water from lakes, ponds, storage tanks, and reservoirs not occupied by listed salmonids when possible. In fish-bearing streams, excavate active channel areas outside of wetted width to create off-stream pools for water source. Require all water trucks/tenders be fitted with CDFW and NMFS approved fish screens when water is acquired at fish bearing streams. Put up a silt fence or other erosion controls around the water extraction locations. Avoid significantly lower stream flows during water drafting.	3	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-15.1.4	Recovery Action	Fire/Fuel Management	Prevent or minimize increased landscape disturbance				
TMR-CCCh-15.1.4.1	Action Step	Fire/Fuel Management	In the event of a wildfire, CalFire Resource Advisors should contact the resource agencies for ESA consultation (or technical assistance) about the incident. The resource agencies can provide guidance regarding critical resources in the area that may be affected by fire fighting actions.	3	100	CalFire, Lyme Timber	
TMR-CCCh-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
TMR-CCCh-18.1.1	Recovery Action	Livestock	Prevent or minimize impairment to the estuary (impaired quality and extent)				
TMR-CCCh-18.1.1.1	Action Step	Livestock	Address water quality and nutrient loading issues by encouraging sustainable land management practices, controlling sediment sources, protecting riparian zones and employing BMPs that encourage permeability and infiltration (CDFG 2004).	2	100	Lyme Timber, Private Landowners	
TMR-CCCh-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				

Ten Mile River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
TMR-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)				
TMR-CCCh-19.1.1.1	Action Step	Logging	Timber harvest planning should evaluate and avoid or minimize adverse impacts to off-channel habitats, floodplains, ponds, and oxbows.	2	100	CalFire, Lyme Timber, Private Landowners	Timber harvest remains a threat to salmonid habitat in Ten Mile River, but at diminished levels compared to historical practices. There is a high rate of harvest in many of the planning watersheds. Even with application of new California Forest Practice Rules this threat is anticipated to continue.
TMR-CCCh-19.1.2	Recovery Action	Logging	Prevent or minimize impairment to stream hydrology (impaired water flow)				
TMR-CCCh-19.1.2.1	Action Step	Logging	Evaluate road surface treatment options to halt or minimize impacts from water drafting and diversion	3	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-19.1.3	Recovery Action	Logging	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
TMR-CCCh-19.1.3.1	Action Step	Logging	Protect headwater channels with larger buffers to minimize sediment delivery downstream.	2	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-19.1.3.2	Action Step	Logging	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	2	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-19.1.3.3	Action Step	Logging	For areas with high or very high erosion hazard, extend the monitoring period and upgrade road maintenance for timber operations.	2	100	CalFire, Lyme Timber, Private Landowners	This recommendation applies to all THPs located in the mixed lithology geomorphic units with steep slopes, and all sandstone geomorphic units (steep and gentle slopes).
TMR-CCCh-19.1.3.4	Action Step	Logging	Minimize timber harvest on unstable slopes adjacent to CFPRs Class 1 streams in the North Fork Ten Mile.	2	30	CalFire, CDFW, RPFs, RWQCB	
TMR-CCCh-19.1.4	Recovery Action	Logging	Prevent or minimize adverse alterations to riparian species composition and structure				
TMR-CCCh-19.1.4.1	Action Step	Logging	Manage riparian areas for their site potential composition and structure.	2	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-19.1.4.2	Action Step	Logging	Encourage wider riparian buffer zones in areas where stream temperatures or riparian canopy are found limiting.	2	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-19.1.4.3	Action Step	Logging	Reduce the amount and rate of even aged management.	3	100	CalFire, Lyme Timber	
TMR-CCCh-19.1.5	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
TMR-CCCh-19.1.5.1	Action Step	Logging	Encourage low impact timber harvest techniques such as full-suspension cable yarding (to improve canopy cover; reduce sediment input, etc.).	2	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-19.1.6	Recovery Action	Logging	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
TMR-CCCh-19.1.6.1	Action Step	Logging	All roads, landings, and skid trails associated with timber operations should, to the maximum extent practicable, be hydrologically disconnected to prevent sediment runoff and delivery to streams.	2	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-19.1.6.2	Action Step	Logging	Avoid new road construction in riparian zones	2	100	CalFire, Lyme Timber, Private Landowners	Old roads should not be reopened unless for proper decommissioning purposes. Particular care should be directed at new road construction or reconstruction adjacent to CFPRs Class 1 streams with high IP value habitat.
TMR-CCCh-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
TMR-CCCh-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
TMR-CCCh-19.2.1.1	Action Step	Logging	Establish greater oversight and post-harvest monitoring by the permitting agency for operations within areas supporting listed salmonids.	3	20	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-19.2.1.2	Action Step	Logging	Until California Forest Practice Rules are revised to include requirements that would ensure timber harvest plans avoid take of listed salmon and steelhead are developed or forest landowners have secured HCP or GCP, assign NMFS staff to conduct THP reviews by using revised "Guidelines for NMFS staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004) or "Short Term HCP Guidelines" (NMFS 1999).	3	15	NMFS	

Ten Mile River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
TMR-CCCh-19.2.1.3	Action Step	Logging	Encourage timber landowners to implement restoration projects as part of their ongoing timber management practices in stream reaches where large woody material is deficient.	2	100	CalFire, Lyme Timber, Private Landowners	Installing large woody material into stream deficient in large wood should be considered a top restoration priority. Restoration during harvest activities provides a unique opportunity to access key areas that are relatively undisturbed in comparison to areas of the watershed with a large rural residential footprint.
TMR-CCCh-19.2.1.4	Action Step	Logging	Discourage Mendocino County from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	2	100	CalFire, Mendocino County, Private Landowners	
TMR-CCCh-19.2.1.5	Action Step	Logging	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	2	100	CalFire, Mendocino County, Private Landowners	Illegal marijuana cultivation may occur in some areas and have the potential to severely degrade juvenile rearing conditions by diverting water and introducing toxic quantities of fertilizers and pesticides into the stream environment. Increased anthropogenic interface with forested lands will likely lead to increases in these activities.
TMR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
TMR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to watershed hydrology				
TMR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Size culverts to accommodate flashy, debris-laden flows and maintain trash racks to prevent culvert plugging and subsequent road failure.	2	5	CalFire, Lyme Timber, Private Landowners	All new and replacement culverts should be sized to accommodate a 100 year flow event.
TMR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	3	30	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
TMR-CCCh-23.1.2.1	Action Step	Roads/Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Weaver and Hagans, 2015).	2	50	CalFire, Lyme Timber, Private Landowners	Legacy roads from past logging activity continue to impact Ten Mile watershed. Legacy roads from past logging activity continue to adversely impact habitat quality for salmonids in Ten Mile watershed. Road densities are high throughout the watershed and are estimated at 2.5 miles of road per square mile of watershed area, and at 3.7 miles per square mile of riparian area. Many of these roads were poorly situated and constructed, improperly maintained, and many have been abandoned and not properly decommissioned.
TMR-CCCh-23.1.2.2	Action Step	Roads/Railroads	Conduct periodic training for road maintenance crews regarding modern sediment remediation techniques protective of salmonids.	2	100	CalFire, Lyme Timber, Private Landowners	Existing material can likely be used and tailored to private landowners and agencies with road maintenance staff. Roads are likely the largest contributor of sediment in the watershed, and sediment was rated as the most significant factor limiting salmonid production in the watershed. Outreach is critical to minimize the high rates of sediment input.
TMR-CCCh-23.1.2.3	Action Step	Roads/Railroads	Install sediment traps for pretreatment, and a modified culvert system that can act as an efficient detention system.	3	100	CalFire, Lyme Timber, Private Landowners	Sediment traps will require a significant maintenance commitment. Conduct inventory of culverts needing sediment traps.
TMR-CCCh-23.1.2.4	Action Step	Roads/Railroads	Install and maintain adequate energy dissipaters for culverts and other drainage pipe outlets where needed.	3	20	CalFire, Lyme Timber, Private Landowners	Particular care should be directed to ensuring water outfalls avoid unstable slopes. Conduct inventory of culverts needing energy dissipaters.

Ten Mile River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
TMR-CCCh-23.1.2.5	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	2	5	CalFire, Lyme Timber, Private Landowners	Assess the feasibility and extent of spoils storage site.
TMR-CCCh-23.1.2.6	Action Step	Roads/Railroads	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity. The assessments should prioritize sites and outline implementation timelines of necessary actions.	2	10	CalFire, Lyme Timber, Private Landowners	Active and abandoned logging roads and skid trials exist throughout the basin and likely contribute large volumes of sediment. Many logging roads have been upgraded to modern standards, but a lot of work remains before this sediment source is thoroughly minimized. An effective road program should include a component that closes and remediates unnecessary roads and skid trails in an effort to lower overall road density in the watershed. Road remediation for future timber harvest plans should be considered a top mitigation priority. The inventory should include all roads in the watershed, including abandoned roads. Many of these roads will likely not be addressed until timber harvest is resumed. The potential for sediment (both through chronic input and large episodic events) is likely to continue. Road rehabilitation from locations identified as high risk should not be based solely on timber harvesting schedules.
TMR-CCCh-23.1.2.7	Action Step	Roads/Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (CDFG 2004).	2	10	CalFire, Lyme Timber, Private Landowners, Trout Unlimited	Focus initial efforts (and/or continue ongoing efforts) in Little North Fork Ten Mile, Bear Haven (CDFG 2004), Mill, Campbell, and Smith Creeks. Indiscriminate road density reduction should be avoided so as not to preclude inhibiting future road realignments that could also effectively reduce sediment delivery. TU has partnered with CTM and Pacific Watershed Associates to upgrade 3.4 miles of inner gorge roads in Little North Fork which should be considered a major priority considering the importance of the salmonid populations in the Little North Fork.
TMR-CCCh-23.1.2.8	Action Step	Roads/Railroads	All harvest plans should identify problematic unused legacy roads or landings with WLPZ's and ensure these areas are hydrologically disconnected and revegetated with native species where practicable following completion of harvest activities.	2	100	CalFire, Lyme Timber, Private Landowners, RWQCB	
TMR-CCCh-23.1.2.9	Action Step	Roads/Railroads	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	3	100	CalFire, Lyme Timber, Private Landowners, RWQCB	Sediment basins must be maintained on a yearly basis. A limited number of areas may be suitable for sediment catchment basins, but where feasible, they should be used to retain or remove potentially chronic fine sediment sources that impact primary stream channels. Sties should be located on smaller tributaries or first order streams.
TMR-CCCh-23.1.2.10	Action Step	Roads/Railroads	Reduce road densities by 10 percent over the next 20 years, prioritizing high risk roads and salmonid habitat value.	3	10	CalFire, Lyme Timber, Private Landowners	This recommendation is more feasible within Ten Mile watershed because a large portion of it is owned by one landowner. Indiscriminate road density reduction should be avoided so as not to preclude inhibiting future road realignments that could also effectively reduce sediment delivery.
TMR-CCCh-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)				
TMR-CCCh-23.1.3.1	Action Step	Roads/Railroads	Design new roads to avoid unstable slopes, wetlands, floodplains and other areas of high habitat value.	2	100	CalFire, Lyme Timber, Private Landowners	

Ten Mile River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
TMR-CCCh-23.1.4	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
TMR-CCCh-23.1.4.1	Action Step	Roads/Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	3	100	CalFire, Lyme Timber, Private Landowners	Use NMFS (2001) Guidelines for Salmonid Passage at Stream Crossings.
TMR-CCCh-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
TMR-CCCh-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)				
TMR-CCCh-23.2.1.1	Action Step	Roads/Railroads	Avoid or minimize new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan, protective of salmonids and their habitat, is created and implemented.	2	10	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-23.2.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
TMR-CCCh-23.2.2.1	Action Step	Roads/Railroads	Conduct inspections of high risk or poorly maintained roads prior to winter. Correct conditions that are likely to deliver sediment to streams.	2	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-23.2.2.2	Action Step	Roads/Railroads	Limit winter use of unsurfaced roads and recreational trails to decrease fine sediment loads.	2	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-23.2.2.3	Action Step	Roads/Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	3	100	CalFire, Lyme Timber, Private Landowners	
TMR-CCCh-23.2.2.4	Action Step	Roads/Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	100	CalFire, Lyme Timber	Action is considered In-Kind
TMR-CCCh-23.2.2.5	Action Step	Roads/Railroads	Permitting and funding agencies (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	2	100	CalFire, CDFW, NRCS, RWQCB, USACE	This should be considered a standard business practice by regulatory agencies, however, due to staffing levels regulatory oversight is often inadequate.
TMR-CCCh-24.1	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species' continued existence**				
TMR-CCCh-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to passage and migration				
TMR-CCCh-24.1.1.1	Action Step	Severe Weather Patterns	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for salmonid recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of salmonids (CDFG 2004)(Water Code § 1707).	3	20	CDFW, NOAA RC, Private Landowners, The Nature Conservancy	The main benefit of this action is to improve flow conditions in the lower portion of the watershed where a few homes and limited agricultural use occurs.
TMR-CCCh-24.1.2	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)				
TMR-CCCh-24.1.2.1	Action Step	Severe Weather Patterns	Existing areas with floodplains or off channel habitats should be protected from future rural residential or urban development of any kind.	2	100	Lyme Timber, CDFW, Private Landowners	
TMR-CCCh-24.1.3	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
TMR-CCCh-24.1.3.1	Action Step	Severe Weather Patterns	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.	2	100	Lyme Timber, RWQCB	Extreme rainfall events could result in major input of sediment from upslope locations, particularly from legacy roads. The high road density in the watershed increases the likelihood of major sediment input during wet weather periods. Targeting high risk roads for closure and appropriate restoration actions will reduce the magnitude of this threat. Assess extent of high-risk shallow-seeded landslide areas and develop rehabilitation plan.

Albion River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
AlbR-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AlbR-CCCh-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat				
AlbR-CCCh-1.1.1.1	Action Step	Estuary	Remove riprap and gabion rock within the estuary and restore with a bioengineering solution.	2	5	California Coastal Conservancy, CDFW, Mendocino Redwood Company, NOAA RC, Private Landowners, Trout Unlimited	
AlbR-CCCh-1.1.1.2	Action Step	Estuary	Identify key locations to install LWD structures to improve shelter within the estuary.	2	10	CDFW, Mendocino Redwood Company, NOAA RC, Private Landowners	
AlbR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
AlbR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
AlbR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	2	CDFW, Mendocino Redwood Company, Private Landowners, Trout Unlimited	Use existing MRC watershed analysis, and channel typing information from habitat typing with field verification to determine floodplain restoration sites.
AlbR-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	10	CDFW, Mendocino Redwood Company, NOAA RC, Private Landowners	Use information from Action Step #1 to determine reaches for restoration.
AlbR-CCCh-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
AlbR-CCCh-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
AlbR-CCCh-3.1.1.1	Action Step	Hydrology	Require streamflow gaging devices to determine the level of impairment to natural flow. Determine sites appropriate for gaging below Comptche on the mainstem and the North Fork.	3	10	CDFW, Mendocino Redwood Company, NMFS, Private Landowners, USGS	
AlbR-CCCh-3.1.1.2	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (storage tanks for rural residential users). Focus efforts in the Comptche area to minimize effects to the North Fork Albion and mainstem Albion.	2	5	CDFW, NOAA RC, Private Landowners, SWRCB	
AlbR-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AlbR-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
AlbR-CCCh-5.1.1.1	Action Step	Passage	Investigate the feasibility of removing the earthen dam on Marsh Creek to increase habitat availability for salmonids.	2	2	CDFW, NOAA RC, Private Consultants, Private Landowners	
AlbR-CCCh-5.1.1.2	Action Step	Passage	Investigate a potential passage barrier for salmonids on the South Fork Albion River below Bull Team Gulch. A low flow concrete structure placed in the mid-1990s may be causing passage problems for adult salmonids	2	5	CDFW, Mendocino Redwood Company, NOAA RC	Small concrete structure was constructed in early 1990's. This structure needs to be evaluated and may need to be removed or modified.
AlbR-CCCh-5.1.1.3	Action Step	Passage	Continue to identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings.	2	20	CDFW, Mendocino Redwood Company, NMFS, Private Landowners	
AlbR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
AlbR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD, and shelters				
AlbR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.	2	2	CDFW, Mendocino Redwood Company, NOAA RC, Private Landowners, Trout Unlimited	Work with stakeholders to develop a Plan.
AlbR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Utilize information developed on LWD demand and recruitment potential in the MRC Albion Watershed Analysis.	2	2	CDFW, Mendocino Redwood Company, NOAA RC, Private Landowners, Trout Unlimited	This recommendation will direct other action steps.
AlbR-CCCh-6.1.1.3	Action Step	Habitat Complexity	Improve in-channel LWD densities by the addition of large key pieces, conifer trees and root wads. It is recommended that this be achieved by cutting large trees and dropping them into the channel, or preferably by pulling them partially into the channel complete with rootwad, at appropriate upstream locations. Downed logs may be transported to proper location to be placed in the stream.	2	10	CalFire, CDFW, Private Landowners	

Albion River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
AlbR-CCCh-6.1.1.4	Action Step	Habitat Complexity	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking. Consider falling existing riparian trees as a method to increase complexity and LWD frequencies.	3	50	CDFW, Mendocino Redwood Company, Private Landowners, Trout Unlimited	Conducting LWD placement when crews and equipment are available should be standard practice.
AlbR-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AlbR-CCCh-7.1.1	Recovery Action	Riparian	Improve tree diameter				
AlbR-CCCh-7.1.1.1	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004). Investigate additional conservation easements with MRC, or other willing landowners.	3	20	CDFW, Private Landowners	
AlbR-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
AlbR-CCCh-8.1.1	Recovery Action	Sediment	Improve instream gravel quality				
AlbR-CCCh-8.1.1.1	Action Step	Sediment	Treat high priority slides and landings that are identified in the MRC Albion River Watershed Analysis or other credible assessments.	2	10	CDFW, Mendocino County, NOAA RC, Private Landowners	
AlbR-CCCh-8.1.1.2	Action Step	Sediment	Provide technical assistance and incentives to landowners/managers in developing and implementing fine sediment reduction plans in high priority areas as determined by watershed analysis, CDFW, or CalFire.	2	20	CDFW, NOAA RC, NRCS	
AlbR-CCCh-11.1	**Objective**	**Viability**	**Address the inadequacy of existing regulatory mechanisms.**				
AlbR-CCCh-11.1.1	Recovery Action	Viability	Increase spatial structure and diversity				
AlbR-CCCh-11.1.1.1	Action Step	Viability	Monitor the response of population abundance and key habitat attributes to recovery efforts across the watershed.	3	24	CDFW, Mendocino Redwood Company, NMFS, Private Landowners	
AlbR-CCCh-11.1.1.2	Action Step	Viability	Conduct salmon carcass surveys in areas of the mainstem Albion, South Fork Albion, and the North Fork Albion, and selected tributaries.	2	20	CDFW, Mendocino Redwood Company, NMFS	
AlbR-CCCh-11.1.1.3	Action Step	Viability	Support a community based salmonid monitoring program in the Albion watershed.	3	10	CDFW, NOAA RC, Private Landowners, Public	
AlbR-CCCh-11.2	**Objective**	**Viability**	**Address other natural or manmade factors affecting the species' continued existence**				
AlbR-CCCh-11.2.1	Recovery Action	Viability	Increase density, abundance, spatial structure and diversity				
AlbR-CCCh-11.2.1.1	Action Step	Viability	Develop and implement a program to regularly add salmon carcasses and/or salmon analogs to key locations within the watershed.	1	20	CDFW, Mendocino Redwood Company, NMFS, Private Landowners	
AlbR-CCCh-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AlbR-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
AlbR-CCCh-19.1.1.1	Action Step	Logging	Discourage Mendocino County from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	3	60	CalFire, CDFW, Mendocino County, NMFS, NOAA RC, Private Landowners	
AlbR-CCCh-19.1.1.2	Action Step	Logging	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	2	60	CalFire, Mendocino County, Mendocino Redwood Company, NMFS	
AlbR-CCCh-19.1.1.3	Action Step	Logging	Reduce the amount and rate of even aged management.	3	100	CalFire, Mendocino Redwood Company, Private Landowners	
AlbR-CCCh-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms.**				
AlbR-CCCh-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
AlbR-CCCh-19.2.1.1	Action Step	Logging	Assign NMFS staff to conduct THP reviews of the highest priority areas.	2	20	CalFire, CDFW, NMFS, RWQCB	
AlbR-CCCh-19.2.1.2	Action Step	Logging	Work with private landowners to achieve reductions in area harvested.	2	20	CDFW, Mendocino Redwood Company, NMFS, Private Landowners, RWQCB	
AlbR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				

Albion River Chinook Salmon (North-Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
AlbR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
AlbR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Assess and implement road upgrades on Docker Hill Road along the North Fork Albion River.	2	10	CDFW, Mendocino County, NOAA RC, Private Landowners	
AlbR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Conduct road and sediment assessment on the Comptche Ukiah Road segment that drains to the Albion Watershed.	2	5	Mendocino County Department of Public Works, NOAA RC	May be possible to use some existing Mendocino County DOT road data.
AlbR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	3	10	CDFW, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners, RWQCB	
AlbR-CCCh-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
AlbR-CCCh-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
AlbR-CCCh-23.2.1.1	Action Step	Roads/Railroads	Minimize new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	20	CDFW, Mendocino Redwood Company, Private Landowners, RWQCB	
AlbR-CCCh-23.2.1.2	Action Step	Roads/Railroads	Limit winter use of unsurfaced roads and recreational trails to decrease fine sediment loads.	2	5	CDFW, NOAA RC, NRCS, Private Landowners, RCD	
AlbR-CCCh-23.2.1.3	Action Step	Roads/Railroads	For all rural (unpaved) and seasonal dirt roads apply best management practices for road construction, maintenance, management and decommissioning (e.g. Weaver and Hagans, 2015).	2	20	Mendocino County, NOAA RC, NRCS, Private Landowners, RCD	
AlbR-CCCh-23.2.1.4	Action Step	Roads/Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources.	2	15	CDFW, Mendocino Redwood Company, Private Landowners, RWQCB	
AlbR-CCCh-23.2.1.5	Action Step	Roads/Railroads	Reduce road densities by 10 percent over the next 20 years, prioritizing high risk roads and salmonid habitat value.	3	20	CalFire, Mendocino Redwood Company, Private Landowners	
AlbR-CCCh-24.1	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species continued existence**				
AlbR-CCCh-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
AlbR-CCCh-24.1.1.1	Action Step	Severe Weather Patterns	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for salmonids recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of salmonids (CDFG 2004)(Water Code § 1707).	2	20	CDFW, Private Landowners, SWRCB	The main benefit of this action is to improve flow conditions in the lower portion of the watershed where the majority of home owners and agricultural use occurs.

Central Coastal Diversity Stratum

This stratum includes populations that spawn in watersheds that tend to be warmer and drier than those to the north. The Navarro and Garcia basins are included in this stratum on the basis of environmental conditions throughout much of the interior basin, save for a narrow band along the coast.

The populations that have been selected for the recovery scenario are listed in the table below and their profiles, maps, results, and recovery actions are in the pages following. Essential populations are listed by alphabetical order within the diversity stratum, followed by the Rapid Assessment of the Supporting populations:

- Garcia River
- Russian River
- Central Coastal Diversity Stratum Rapid Assessment
    - Gualala River
    - Navarro River

CC Chinook Salmon Central Coastal Diversity Stratum, Populations, Historical Status, Population's Role in Recovery, Current IP-km, and Spawner Density and Abundance Targets for Delisting. The Diversity Stratum recovery targets are only comprised of the essential populations because these are the populations that are expected to be viable (See Vol. 1 Chapter 5).

Diversity Stratum	CC Chinook salmon Populations	Historical Population Status	Population's Role In Recovery	Current Weighted IP-km	Spawner Density	Spawner Abundance
Central Coastal	Garcia River	I	Essential	56.2	36.0	2,000
	Gualala River	I	Supporting	175.6	6-12	1,052-2,105
	Navarro River	I	Supporting	131.5	6-12	787-1,576
	Russian River	I	Essential	465.2	20.0	9,300
Diversity Stratum Recovery Target						**11,300**

CC Chinook salmon Central Coastal Diversity Stratum Populations selected for the recovery scenario.

Garcia River Population

CC Chinook Salmon Fall-Run

- Role within ESU: Potentially Independent Population
- Diversity Stratum: Central Coastal
- Spawner Abundance Target: 2,000 adults
- Current Intrinsic Potential: 56.2 IP-km

For information regarding NC steelhead and CCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the CCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

Quantitative abundance and distribution estimates of fall-run Chinook salmon within the Garcia River watershed are sparse or non-existent. Chinook salmon abundance is severely depleted from historical accounts, and in most years very few individuals are observed or reported (TCF 2006). Anecdotal accounts of Chinook salmon from the early 1920s suggest abundant and sustainable runs within the Garcia River (Warmerdam 2010).

Although degraded from pristine conditions, a substantial amount of high value habitat still exists within the Garcia watershed. The extent of suitable Chinook salmon habitat is primarily limited to the mainstem Garcia River below the confluence with Inman Creek. The North Fork Garcia River may also support Chinook salmon in some years.

History of Land Use

The early period of logging and timber harvest in the Garcia River watershed began in the late 1860s and ended in 1915. In the 1950s, logging resumed in response to the post-World War II housing boom, with intense harvest rate and loggers utilizing more advanced technologies and heavy machinery. This period of intense logging ended in 1961 and left the watershed in a much degraded state. Large amounts of land were again harvested for timber more recently as 52-percent of the basin was harvested between 1987 and 1997 (NCRWQCB 2005). Logging and wood harvest still occur within the watershed; however, timber harvest practices have improved as compared to previous logging areas, and, therefore, logging-related impacts to salmonid habitat may be less likely. Logging the forest in the watershed triggered increased sediment production, and floodplain development in the lower watershed disconnected the river from deposition zones. The consequence of these two land uses was deposition in the estuary, diminishing the habitat in that important area.

Current Resources and Land Management

A large tract (24,000 acres) of the Garcia River was purchased in 2004 by the Conservation Fund, a group that has been in partnership with The Nature Conservancy, State Coastal Conservancy, Wildlife Conservation Board, and the California Department of Fish and Wildlife in developing and implementing an Integrated Resource Management Plan (2006) for the basin. The Conservation Fund is implementing sustainable management practices that include decreasing the intensity of timber harvests, decreasing timber harvest frequency, improving roads, and widening riparian buffers to improve water quality instreams degraded by past land uses. Other land uses occurring within the Garcia watershed include: agriculture, other timber companies, dairies, and cattle grazing and ranching. Conversion of hillside forest stands to vineyards is also occurring. The majority of the watershed is privately owned. Many government, public interest, and tribal groups and agencies are active or have jurisdiction within the watershed as well. The following pertinent documents are available for the Garcia River watershed:

- Garcia River Forest: Integrated Resource Management Plan (TCF 2006);
- Evaluation of the Garcia River Restoration with Recommendations for Future Projects (CDFG 2003);
- Action Plan for the Garcia River Watershed Sediment TMDL (NCRWQCB 2001);
- Garcia River Sediment Total Maximum Daily Load (USEPA 1998);
- Garcia River Estuary Cross Sections (Jackson 1999);
- A Salmon Spawning Survey for Portions of Ten Mile River, Casper, and the Garcia River 1995-96 (Maahs 1996);
- Fisheries Elements of the Garcia River Estuary Enhancement Feasibility Study (Higgins 1995);
- Garcia River Drilling Mud Spill: Damage Assessment and Suggestions for Mitigation, Restoration, and Monitoring (Higgins 1992); and
- The Garcia River Watershed Enhancement Plan (Monschke and Caldon 1992).

Salmonid Viability and Watershed Conditions

The following indicators were rated Poor through the CAP process for Chinook salmon: LWD frequency, shelter rating, streamside road density, staging pools. Other indicators that are identified as impaired to the extent that rehabilitation work is needed include the following: physical barriers, spawner density, and water temperature. Recovery strategies will focus on ameliorating these habitat indicators, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed.

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP Viability analysis. The Garcia River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Floodplain Connectivity: Velocity Refuge

The historic floodplains in the lower Garcia River watershed have been disconnected due to a century of channel management including straightening, embankment, and willow revetment. Floodplains when inundated during winter and spring are the most productive habitats for salmonids because of the vast space and high food production, resulting in high growth rates and subsequently increased viability of the juvenile life stage.

Sediment Transport: Road Density

High road densities within the Garcia River watershed are primarily associated with past timber harvest. While road building standards have improved greatly in recent years, old road networks and landing still pose a high erosion risk (Higgins 1992). Common problems with existing roads within the Garcia River include perched or raveling fills on the outside road edge; fill gullying at watercourse crossings; shot-gunned culverts, or short culverts; inadequate or missing downspouts; and plugged ditches (TCF 2006). A major challenge for the future will be identifying and remediating these problem roads (TCF 2006). High sediment yields from failing roads have greatly affected watershed sediment transport processes and gravel quality in the past, and if continued, will impair habitat conditions for salmonids.

Sediment: Gravel Quality and Distribution of Spawning Gravels

The Garcia River watershed is comprised of very unstable soil types and has a history of intensive logging and associated logging road networks (Higgins 1992). The Garcia Watershed Enhancement Plan (Monschke and Caldon 1992) found that excessive fine sediment exists in the coarse spawning gravels within the lower river and tributaries. Other habitat inventories suggest that quality gravel exists within many watershed tributaries and can provided suitable spawning gravels for salmonids (CDFG 2002; 2003a; 2003c; 2004; 2005). Undoubtedly, suitable spawning gravel exists in some areas within the watershed and other areas still are impaired from past land use. If Chinook salmon are to be recovered, clean and stable spawning gravel must be available in the mainstem for egg incubation and survival.

Passage/Migration: Mouth or Confluence and Physical Barriers

A high percentage of the historic Chinook salmon habitat within the Garcia River watershed is currently accessible, although some fish passage impairments do exist within the watershed (see CalFish Passage Assessment Database online). Most identified passage impairments are partial barriers at stream crossings that may preclude Chinook salmon from reaching spawning destinations in the upper mainstem and adjacent tributaries under certain flow conditions. Some logjams from past logging have also been identified (Bell 2003).

Habitat Complexity: Large Wood and Shelter and Altered Pool Complexity and/or Pool/Riffle Ratios

Extensive CDFW stream surveys (CDFG 2002; 2003a; 2003c; 2004; 2005) indicate that many streams lack pool shelter complexity and desirable riffle/pool ratios. These habitat complexity features have been impaired primarily due to a large wood deficit within the stream channel. Past logging and degraded riparian zones have severely limited the natural recruitment of large wood in many historically productive streams within the watershed. The Conservation Fund and their partners have embarked on many instream large wood placement projects that have improved habitat complexity in some areas (TCF 2006). However, many other stream reaches will require similar supplementation of LWD, boulders, and other channel forming features to encourage more desirable pool/riffle ratios (including primary pools) and increase mean shelter ratings.

Habitat Complexity: Large Wood and Shelter and Staging Pools

The lower seven miles of the mainstem Garcia River flows through an alluvial valley where large amounts of sediment would naturally deposit. Following intensive timber harvest and poor land management, sediment deposition increased substantially during the previous several decades. Additionally, large wood recruitment was lost as riparian habitat was destroyed, limiting the amount of channel forming features (LWD) that encourage sediment sorting and scouring of large pools. Currently, few large, deep pools suitable for early migrating and staging adult Chinook salmon exist within the lower mainstem.

Viability: Density, Abundance & Spatial Structure

The severely limited remnant or stray population of Chinook salmon entering the Garcia River watershed is most likely not abundant enough to recover a viable run. However, habitat conditions have greatly improved and are currently adequate for Chinook salmon to successfully complete their freshwater life history. Population enhancement (supplementation and /or broodstock program) could play an important role in restoring Chinook salmon to the Garcia River. Whether the few returning adult Chinook salmon are of Garcia River origin and are suitable for population enhancement is currently unknown. Scientific investigations need to be

conducted regarding population genetics and the potential importation of out-of-basin stock. To ensure success of population enhancement efforts, long-term habitat protection and continuing rehabilitation efforts need to occur.

Threats

The following discussion focuses on those threats that rate as High or Very High (See Garcia River CAP Results). Recovery strategies will likely focus on ameliorating High rating threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in the Garcia River CAP Results.

Logging and Wood Harvesting

Logging and wood harvesting remains a threat to salmonid habitat quantity and quality within the Garcia River watershed. Timber harvest practices have improved greatly within the bounds of the Conservation Fund property and subsequent implementation of the Integrated Resource Management Plan (TCF 2006). However, other portions of the watershed still face accelerated timber harvest rates and high impact harvest techniques. Additionally, habitat degradation (gravel quality, water temperature, instream wood recruitment) associated with past timber harvest persists throughout the watershed, although some processes are currently in a state of recovery. Future management and recovery actions need to protect all salmonid high value habitat from degraded water quality conditions (turbidity and increased temperature) associated with timber harvest, and ensure the continuation of watershed rehabilitation efforts.

Roads and Railroads

Even with current logging road improvements and standards (rolling dips, rock surfaces, and road widths), legacy logging roads remain a threat to salmonid habitat quantity and quality throughout the Garcia River watershed. Impaired passage and migration at road crossings will continue to limit access to suitable habitat, and fine sediment inputs from poorly built, improperly maintained, and abandoned roads will continue. More efficient road networks, removal and replacement of impassable and undersized culverts, and radical decommissioning efforts on problem roads will prevent further salmonid habitat degradation within the watershed.

Water Diversions and Impoundments

Currently, there are no large long standing dams within the Garcia River watershed. Watershed hydrology is relatively unimpaired and free from major water diversions when compared to most watersheds within the NCCC Recovery Domain. However, concerns regarding future land uses, increasing agriculture, and increasing illegal marijuana cultivation pressure could increase water

demand and further reduce spring and summer streamflows. Additionally, future streamflow alterations could alter the hydrodynamics of the estuary during the summer months. Provisions need to be made that ensure future residential and agricultural development do not adversely impact summer and spring baseflows or groundwater recharge.

Livestock Farming and Ranching

Livestock farming and ranching have been reduced around the lower Garcia River/estuary, which has rehabilitated some stream riparian areas and significantly reduced erosion of adjoining properties (see KRIS Garcia[1]). However, the historic quality and extent of the Garcia River estuary is still impaired, as some tidal sloughs continue to be disturbed by cattle activities.

Fishing and Collecting

Poaching within the Garcia River continues to be a major concern within the Garcia River for fisheries managers and restoration practitioners (Joshua Fuller, NMFS, personal communication, 2016). In March 2012, law enforcement from CDFW and the Mendocino County Sheriff's Department seized 18 (17 females, 1 male) wild steelhead from a local non-tribal resident. In response, Congressman Jared Huffman, state, federal, and tribal entities and conservation groups worked together in developing an agreement that made combating poaching a shared responsibility, and outlined a common strategy to protect critically low populations of steelhead, coho and Chinook salmon of the Garcia River. The Manchester-Point Arena Band of Pomo Indians developed *A Resolution of the Business Committee of the Manchester-Point Arena Band of Pomo Indians for the Protection of Garcia River Endangered Species* (Resolution No. #327-11-07-2014). Implementation of this Resolution has made significant progress; however, reports of illegal poaching activities still occur during periods of low-flow. This threat to ESA-listed salmonids of the Garcia River will continue until all poaching has seized.

Limiting Stresses, Lifestages, and Habitats

With few adult Chinook salmon returning to the Garcia River watershed, it is unlikely a self-sustaining population will re-establish independently, and implementing a population enhancement plan will be needed.

General Recovery Strategy

Improve Habitat Complexity and LWD Recruitment

Pool shelter ratings and primary pool frequencies are limited in most tributaries in the Garcia River watershed. Strategically placing channel forming features in high priority reaches of the

[1] http://krisweb.com/krisgarcia/krisdb/html/krisweb/index.htm

Blue Waterhole, North Fork, Inman Creek, Signal Creek, and Graphite Creek sub-basins will increase surface water hydrologic connectivity in highly aggraded reaches and increase summer rearing production. Additionally, establishing appropriate size riparian buffer zones throughout the watershed will increase stream shading and promote natural LWD recruitment.

Protect Natural Hydrologic Conditions

With physical habitat features improving and slowly recovering in many portions of the watershed, protecting spring and summer hydrologic conditions will be essential toward recovering all salmonids within the Garcia River watershed. Any alternatives to the natural watershed hydrology will present a future threat to the recovery of Chinook salmon due to potential reductions in groundwater and subsequently surface flows.

Protect, Enhance, and Rehabilitate the Quality and Extent of the Garcia River Estuary

Efforts should be implemented to reclaim tidal sloughs from cattle grazing and agriculture within some areas of the Garcia River estuary. Integrating Hathaway Creek into future estuary rehabilitation efforts should be investigated.

Investigate Potential Population Augmentation for Chinook Salmon

Scientific investigations need to be conducted regarding population genetics, dynamics, and the potential importation of out-of-basin stock if a viable Chinook salmon run is to be restored to the Garcia River watershed.

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NOAA FISHERIES
Garcia River
CC Chinook Salmon Population
Hathaway
NF Garcia R
Garcia River
Lee
Rolling Brook
EUREKA HILL
Larmour
East End
Redwood
Mill
Cabin
North Mill
Sled
Pardaloe
Monahan
Inman
Signal
SF Garcia R
Fleming
Pacific Ocean
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
0
2
Miles
Area of Detail
CA Coastal Chinook Salmon ESU

CC Chinook Salmon Garcia River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-km (>6 Key Pieces/100 meters)	Good
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Fair
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	50% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	67% streams/ 98% IP-km (>49% average primary pool frequency)	Very Good
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	67% streams 98% IP-km (>30% Pools; >20% Riffles)	Very Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	39% Class 5 & 6 across IP-km	Fair

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-km maintains severity score of 3 or lower	Good
		Size	Viability	Density	<1 spawners per IP-Km	1-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		<1 spawners per IP-km	Poor
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	<50% of Historical Range	Poor
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	Fair
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	100% of streams/ IP-km (>50% stream average scores of 1 & 2)	Very Good

3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Properly Functioning Condition	Good
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	50% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	67% streams/ 98% IP-km (>49% average primary pool frequency)	Very Good
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	67% streams 98% IP-km (>30% Pools; >20% Riffles)	Very Good
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.18 Diversions/10 IP-km	Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	39% Class 5 & 6 across IP-km	Fair

			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	100% of streams/ IP-km (>50% stream average scores of 1 & 2)	Very Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Good
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-km maintains severity score of 3 or lower	Good
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	<50% of Historical Range	Poor
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.18 Diversions/10 IP-km	Good

			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	100% of IP-km	Very Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	100% of streams/ IP-km (>50% stream average scores of 1 & 2)	Very Good
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	No Acute or Chronic	Good
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-km maintains severity score of 3 or lower	Good
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces high risk spawner density per Spence (2008)	Poor
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	0.147% of Watershed in Impervious Surfaces	Very Good

			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	1.134% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	15% of Watershed in Timber Harvest	Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	1% of watershed >1 unit/20 acres	Very Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	51-74% Intact Historical Species Composition	Good
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	2.2 Miles/Square Mile	Good
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	2.8 Miles/Square Mile	Poor

CC Chinook Salmon Garcia River CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	Medium	Low	Medium	Medium	Medium	Medium
2	Channel Modification	Medium	Low	Medium	Medium	Low	Medium
3	Disease, Predation and Competition	Medium		Medium	Medium	Low	Medium
4	Fire, Fuel Management and Fire Suppression	Low	Low	Low	Low	Low	Low
5	Fishing and Collecting	High			Medium		High
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium
8	Logging and Wood Harvesting	Medium	High	Medium	Medium	High	High
9	Mining	Low	Low	Low	Medium	Low	Low
10	Recreational Areas and Activities	Low	Low	Low	Low	Low	Low
11	Residential and Commercial Development	Medium	Low	Low	Medium	Low	Medium
12	Roads and Railroads	Medium	Medium	Medium	Medium	High	Medium
13	Severe Weather Patterns	Medium	Medium	Medium	Medium	Low	Medium
14	Water Diversion and Impoundments	Medium	Medium	Medium	Medium	Low	Medium

Garcia River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GarR-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-1.1.1	Recovery Action	Estuary	Rehabilitate natural river mouth dynamics				
GarR-CCCh-1.1.1.1	Action Step	Estuary	Investigate and determine if the river/estuary mouth dynamics have changed from historical conditions (i.e. opening/closing patterns). Evaluate passage conditions relative to adult salmonid run timing.	2	10	BLM, CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB	
GarR-CCCh-1.1.1.2	Action Step	Estuary	If determined necessary, develop and implement strategies that address adverse passage conditions for adult salmonids caused by altered river mouth dynamics.	3	20	CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, RCD, RWQCB, The Nature Conservancy	The alternatives to address adverse passage conditions will be determined from the above action steps, if necessary.
GarR-CCCh-1.1.2	Recovery Action	Estuary	Rehabilitate inner estuarine hydrodynamics				
GarR-CCCh-1.1.2.1	Action Step	Estuary	Investigate the value of re-aligning the lower estuary channel from Minor Hole to the mouth in efforts to increase estuary depth and improve tidal wetlands.	2	10	CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-1.1.2.2	Action Step	Estuary	If determined beneficial to estuary health and function, develop and implement a lower estuary channel re-alignment project.	2	10	CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-1.1.3	Recovery Action	Estuary	Increase the physical extent of estuarine habitat				
GarR-CCCh-1.1.3.1	Action Step	Estuary	Investigate the extent of sedimentation within the estuary associated watershed legacy impacts (e.g. logging). Evaluate sediment transport within the estuary and determine if the estuary is "filling" with sediment or "flushing" sediment (i.e., recovering).	2	10	CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-1.1.3.2	Action Step	Estuary	Investigate and determine the current vs. historical extent of the Garcia estuary. Include tracts of salt and freshwater marshes, sloughs, tidal channels, etc.	1	10	BLM, CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-1.1.3.3	Action Step	Estuary	Evaluate, design, and implement strategies to enhance habitat conditions within Hathaway Creek and near its confluence with the Garcia River main stem. Consider thinning vegetation within lower Hathaway to increase hydrologic circulation. Optimize winter rearing habitat/refuge while considering upstream migration to upper Hathaway Creek if determined beneficial.	1	10	BLM, CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-1.1.3.4	Action Step	Estuary	Evaluate, design, and implement rehabilitation projects targeting tidal sloughs and off-channel habitats impaired by cattle located within the historical extent of the Garcia River estuary.	1	5	BLM, CDFW, NMFS, NOAA RC, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-1.1.3.5	Action Step	Estuary	Continue estuary rehabilitation efforts (public acquisition and easements, Bell 2003).	1	10	BLM, CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-1.1.4	Recovery Action	Estuary	Increase and enhance estuarine habitat complexity features				
GarR-CCCh-1.1.4.1	Action Step	Estuary	Increase the percentage of area containing high value habitat complexity elements and features (SAV, LWD, boulders, marshes, vegetation, pools > 2 meters).	1	10	BLM, CDFW, Friends of the Garcia River, NMFS, NOAA RC, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-1.1.4.2	Action Step	Estuary	Identify key locations to install LWD structures targeting increased pool depth and habitat conditions within the Garcia estuary.	1	10	BLM, CDFW, Friends of the Garcia River, NMFS, NOAA RC	
GarR-CCCh-1.1.4.3	Action Step	Estuary	Continue working with landowners and rehabilitating riparian conditions within the Garcia estuary.	1	50	BLM, CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-1.1.5	Recovery Action	Estuary	Improve estuarine freshwater inflow				
GarR-CCCh-1.1.5.1	Action Step	Estuary	Install a stream gauge immediately upstream of the estuary to monitor inflow conditions during the dry season.	1		CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, RCD, RWQCB, SWRCB, The Nature Conservancy	
GarR-CCCh-1.1.5.2	Action Step	Estuary	Investigate the hydrodynamics of freshwater inflow and estuary water quality conditions relative to juvenile salmonid estuarine summer rearing (acclimated and non-acclimated saltwater tolerant juveniles).	2	10	CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, RCD, RWQCB, The Nature Conservancy	

Garcia River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GarR-CCCh-1.1.5.3	Action Step	Estuary	Identify and implement a minimum freshwater inflow threshold to ensure optimal estuary health and function for rearing salmonids.	1	10	CDFW, Friends of the Garcia River, NMFS, NRCS, RCD, RWQCB, SWRCB, The Nature Conservancy	
GarR-CCCh-1.1.6	Recovery Action	Estuary	Improve estuarine water quality				
GarR-CCCh-1.1.6.1	Action Step	Estuary	Install continuous water quality monitoring stations throughout the Garcia estuary.	2	5	CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-1.1.6.2	Action Step	Estuary	Identify and implement strategies to address point pollutant sources causing impairment to estuarine water quality conditions.	1	20	BLM, CDFW, Friends of the Garcia River, NMFS, NRCS, Private Landowners, RCD, The Nature Conservancy	
GarR-CCCh-1.1.7	Recovery Action	Estuary	Enhance macro-invertebrate abundance and taxa richness				
GarR-CCCh-1.1.7.1	Action Step	Estuary	Investigate and identify prey items/availability for rearing salmonids and the associated water quality conditions in which they reside.	2	15	CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, Private Consultants, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
GarR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Conduct a Lower Garcia River off-channel low gradient habitat assessment targeting juvenile salmonid rearing requirements (biological performance criteria, i.e. reduced velocity targets relative to juvenile salmonids). Identify potential off-channel rehabilitation sites.	2	5	BLM, CDFW, NMFS, NOAA RC, NRCS, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Work with landowners and encourage rehabilitation activities within the lower Hathaway Creek area in efforts to enhance backwater/off-channel and floodplain habitat for winter rearing salmonids.	2	100	BLM, CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-2.1.1.3	Action Step	Floodplain Connectivity	Identify, design, and implement rehabilitation projects that target winter rearing floodplain habitat within the lower reaches of the Garcia River.	2	5	CDFW, Mendocino Redwood Company, The Nature Conservancy	
GarR-CCCh-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
GarR-CCCh-3.1.1.1	Action Step	Hydrology	Map all water diversions (including illegal and legal) and upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	2	10	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	
GarR-CCCh-3.1.1.2	Action Step	Hydrology	Install and maintain stream gauges within the following tributaries that provide cold water to the Garcia River main stem: Hathaway, North Fork, Rolling Brook, Mill Creek (lower Garcia River), South Fork, Signal, Mill Creek (upper Garcia River).	2	10	CDFW, NMFS, Private Landowners, SWRCB, The Nature Conservancy	
GarR-CCCh-3.1.1.3	Action Step	Hydrology	Identify strategic locations to install off-channel storage facilities to reduce impacts associated with water diversions (e.g. storage tanks for rural residential users).	2	30	CDFW, NMFS, NRCS, Private Landowners, RCD, SWRCB	
GarR-CCCh-3.1.1.4	Action Step	Hydrology	CDFW, SWRCB, RWQCB, CalFire, Caltrans, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact salmonids. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (CDFG 2004).	2	60	CalFire, CalTrans, CDFW, Mendocino County Department of Public Works, Private Landowners, RWQCB	Most diversions in the Garcia for dust control are for timber management actions. Most of these diversion have a streambed alteration agreement with the Department of Fish and Wildlife and are likely incorporated into existing operations.
GarR-CCCh-4.1	**Objective**	**Landscape Patterns**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-4.1.1	Recovery Action	Landscape Patterns	Prevent or minimize increased landscape disturbance				

Garcia River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GarR-CCCh-4.1.1.1	Action Step	Landscape Patterns	Consider developing and/or identifying Salmonid Preserves. Consider the Garcia River watershed as a Salmonid Preserve.	2	100	CDFW, Conservation Fund, NMFS, NOAA RC, Private Landowners, State Parks, The Nature Conservancy, Trout Unlimited	
GarR-CCCh-4.1.1.2	Action Step	Landscape Patterns	Should large tracts of forestlands within the Garcia River watershed become available for purchase, the State of California and/or the Federal Government should consider purchasing the area as a Demonstration Forest, State Park, or Salmonid Preserve.	2	100	CDFW, Conservation Fund, NMFS, NOAA RC, Private Landowners, State Parks, The Nature Conservancy, Trout Unlimited	
GarR-CCCh-4.1.1.3	Action Step	Landscape Patterns	Discourage counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	2	100	CDFW, Mendocino County, NMFS, Sonoma County	
GarR-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
GarR-CCCh-5.1.1.1	Action Step	Passage	Evaluate, design, and implement strategies to address potential impairment to passage due to vegetation encroachment or "choking" in Hathaway Creek. Ensure that winter rearing refuge for juvenile salmonids is optimize. Investigate habitat quality in upper Hathaway Creek.	2	5	BLM, CDFW, Friends of the Garcia River, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-5.1.1.2	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Bridge at Highway 1 on Hathaway Creek (Gasker Slough) (See CALFISH: PAD_ID 716762; Passage ID 26883).	3	5	CalTrans, CDFW, NMFS, USACE	
GarR-CCCh-5.1.1.3	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Fish Rock Road on Mill Creek (See CALFISH: PAD_ID 705892; Passage ID 7210)	3	5	CDFW, Mendocino County, NMFS, NOAA RC, Private Landowners, USACE	
GarR-CCCh-5.1.1.4	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Fish Rock Road on Mill Creek (See CALFISH: PAD_ID 705893; Passage ID 7211).	3	5	CDFW, Mendocino County, NMFS, USACE	
GarR-CCCh-5.1.1.5	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at private road crossing on Mill Creek (See CALFISH: PAD_ID 713212; Passage ID 16600).	3	5	CDFW, Mendocino County, NMFS, Private Landowners, USACE	
GarR-CCCh-5.1.1.6	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at private road crossing on Mill Creek (See CALFISH: PAD_ID 713213; Passage ID 16601).	3	5	CDFW, Mendocino County, NMFS, Private Landowners, USACE	
GarR-CCCh-5.1.1.7	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Fish Rock Road on Sled Creek (See CALFISH: PAD_ID 713211; Passage ID 16599)	3	5	CDFW, Mendocino County, USACE	
GarR-CCCh-5.1.1.8	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at private road crossing on Hathaway Creek (See CALFISH: PAD_ID 716763; Passage ID 26884).	2	5	CDFW, Mendocino County, NMFS, Private Landowners, USACE	
GarR-CCCh-5.1.1.9	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at culvert at mouth on SF Garcia River (See CALFISH: PAD_ID 712859; Passage ID 16063).	3	5	CalTrans, CDFW, Mendocino County, NMFS, NOAA RC, USACE	
GarR-CCCh-5.1.1.10	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at culvert on Flemming Creek (See CALFISH: PAD_ID 723443; Passage ID 9525)	3	5	CDFW, Mendocino County, NMFS, Private Landowners, USACE	
GarR-CCCh-5.1.1.11	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at unnamed tributary to SF Garcia River (See CALFISH: PAD_ID 723441; Passage ID 9523).	3	5	CDFW, Mendocino County, NMFS, Private Landowners, USACE	
GarR-CCCh-5.1.1.12	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at culvert on unnamed tributary to main stem Garcia River (See CALFISH: PAD_ID 723440; Passage ID 9522).	3	5	CDFW, Mendocino County, Private Landowners, USACE	
GarR-CCCh-5.1.1.13	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at identified logjams throughout the Garcia watershed (only if necessary).	3	20	CDFW, Mendocino County, Mendocino County Fish and Wildlife Advisory Board, Mendocino Redwood Company, NMFS, Private Landowners, USACE	
GarR-CCCh-5.1.1.14	Action Step	Passage	Identify and prioritize all logjams that are complete or partial barriers and indicate passage impairment to specific life stage (Bell 2006, as cited by KrisWeb 2011).	3	20		
GarR-CCCh-5.1.1.15	Action Step	Passage	Ensure that all logjams are carefully modified and that all LWD remains in the active stream channel (Monschke and Caldon 1992).	3	30		
GarR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency (BFW 0-10 meters)				

Garcia River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GarR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Increase wood frequency in spawning and rearing areas to the extent that a minimum of six key LWD pieces exists every 100 meters in 0-10 meters BFW streams.	2	10	CDFW, Conservation Fund, Friends of the Garcia River, Mendocino Redwood Company, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Identify and install key LWD pieces in Rolling Brook to the extent that LWD frequency is optimized.	3	10	CDFW, NMFS, NRCS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-6.1.2	Recovery Action	Habitat Complexity	Increase large wood frequency (BFW 10-100 meters)				
GarR-CCCh-6.1.2.1	Action Step	Habitat Complexity	Increase wood frequency in seasonal habitat and migratory reaches to the extent that a minimum of 1.3 to 4 key LWD pieces exists every 100 meters in 10-100 meter BFW streams.	2	10	Board of Forestry, CalFire, CDFW, Conservation Fund, Friends of the Gualala River Watershed, Mendocino Redwood Company, NMFS, NOAA RC, Private Landowners, Public, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-6.1.2.2	Action Step	Habitat Complexity	Target Signal Creek, North Fork Garcia, Rolling Brook, lower Mill Creek, Pardaloe, Blue Waterhole, Lanmour, and upper Mill Creek sub-basins as high priorities for LWD placement and rehabilitation work.	2	20	CDFW, Conservation Fund, Friends of the Garcia River, Mendocino Redwood Company, NMFS, NOAA RC, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-6.1.2.3	Action Step	Habitat Complexity	Evaluate and implement strategies to rehabilitate LWD frequency and natural recruitment within the Garcia River main stem.	2	20	CDFW, Conservation Fund, Friends of the Garcia River, NMFS, NOAA RC, Private Landowners, Public, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-6.1.2.4	Action Step	Habitat Complexity	Identify strategic locations to install key LWD features in the SF Garcia main stem to the extent that habitat complexity is optimized.	2	20	CDFW, Conservation Fund, Friends of the Garcia River, Mendocino Redwood Company, NMFS, NOAA RC, NRCS, Private Landowners, Public, Railroad, RWQCB, The Nature Conservancy	
GarR-CCCh-6.1.2.5	Action Step	Habitat Complexity	Encourage coordination of LWD placement in streams as part of logging operations and road upgrades to maximize size, quality, and efficiency of effort (CDFG 2004).	2	100	CalFire, CDFW, Private Landowners	
GarR-CCCh-6.1.3	Recovery Action	Habitat Complexity	Increase primary pools frequency				
GarR-CCCh-6.1.3.1	Action Step	Habitat Complexity	Increase the number of primary pools to the extent that more than 40% of summer rearing pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order streams; >3 feet in third order or larger streams.)	2	10	CDFW, Conservation Fund, Mendocino Redwood Company, NMFS, NOAA RC, NRCS, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-6.1.3.2	Action Step	Habitat Complexity	Evaluate, develop, and implement strategies to increase primary pool frequency in high priority reaches within the following tributaries: Fleming Creek, Little SF Garcia, Signal Creek (and tribs).	2	20	CDFW, Mendocino Redwood Company, NMFS, NOAA RC, NRCS, Private Landowners, Public, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-6.1.4	Recovery Action	Habitat Complexity	Improve shelter				
GarR-CCCh-6.1.4.1	Action Step	Habitat Complexity	Increase the number of pools that have a minimum shelter of 80 (See NMFS/CDFG criteria).	2	10	CDFW, Conservation Fund, Friends of the Garcia River, Mendocino Redwood Company, NMFS, NOAA RC, NRCS, Private Landowners, Public, RCD, The Nature Conservancy	
GarR-CCCh-6.1.4.2	Action Step	Habitat Complexity	Evaluate, identify, and improve shelters in pools within the main stem Garcia River and the following tributaries: Blue Waterhole, Fleming Creek, Graphite Creek, Inman Creek, Little SF Garcia, NF Garcia, and Signal Creek (and tribs).	2	10	CDFW, Conservation Fund, Friends of the Garcia River, Mendocino Redwood Company, NMFS, NOAA RC, NRCS, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-6.1.5	Recovery Action	Habitat Complexity	Increase frequency of staging pools				

Garcia River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GarR-CCCh-6.1.5.1	Action Step	Habitat Complexity	Increase the number of staging pools (primary pool as segregate) to the extent that more than 40% of summer residual pool depth meets criteria in third or higher order streams (>3 feet depth).	2	5	NOAA RC, NOAA/NMFS, Pomo Tribe, The Nature Conservancy	
GarR-CCCh-6.1.5.2	Action Step	Habitat Complexity	Evaluate, develop, and implement strategies to increase staging pool frequency in high priority Chinook reaches (Garcia & SF Garcia main stem).	2	5	NOAA RC, NOAA/NMFS, Pomo Tribe, The Nature Conservancy	
GarR-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-7.1.1	Recovery Action	Riparian	Improve canopy cover				
GarR-CCCh-7.1.1.1	Action Step	Riparian	Increase the average stream canopy cover within all current and potential salmonid spawning and rearing reaches to a minimum of 80%.	2	20	Board of Forestry, CalFire, Conservation Fund, Mendocino Redwood Company, NMFS, RWQCB, The Nature Conservancy	
GarR-CCCh-7.1.1.2	Action Step	Riparian	Plant and protect riparian vegetation, including redwood, on the lower 7 mile reach (Eureka Hill Road Bridge and Windy Hollow Road) or where necessary to provide the following: shade and lower water temperatures, cover, protection for fish, bank protection from erosion, and large organic debris in the future for habitat (Bell 2003).	2	10	Board of Forestry, CalFire, CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-7.1.1.3	Action Step	Riparian	Identify and implement riparian enhancement projects where current canopy density and diversity are inadequate and site conditions are appropriate to: initiate tree planting, thinning, and other vegetation management to encourage the development of a denser more extensive riparian canopy within the Blue Waterhole sub-basin.	2	20	Board of Forestry, CalFire, Conservation Fund, Mendocino Redwood Company, NMFS, RWQCB, The Nature Conservancy	
GarR-CCCh-7.1.1.4	Action Step	Riparian	Retain all existing native riparian vegetation where stream cover is provided.	2	20	Board of Forestry, CalFire, CDFW, Conservation Fund, NMFS, RWQCB, The Nature Conservancy	
GarR-CCCh-7.1.2	Recovery Action	Riparian	Improve tree diameter				
GarR-CCCh-7.1.2.1	Action Step	Riparian	Increase tree diameter to a minimum of 80% CWHR density rating "D" across all current and potential spawning and juvenile rearing areas.	2	20	Board of Forestry, CalFire, Conservation Fund, NMFS, RWQCB, The Nature Conservancy	
GarR-CCCh-7.1.2.2	Action Step	Riparian	Conduct conifer release to promote growth of larger diameter trees where appropriate.	2	10	Board of Forestry, CDFW, Conservation Fund, NMFS, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-7.1.2.3	Action Step	Riparian	Develop a Large Wood Recruitment Plan that assesses in stream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.	3	2	AC Alliance, Board of Forestry, Napa CFCWCD, NOAA RC, NOAA/NMFS, NRCS, The Nature Conservancy	
GarR-CCCh-7.1.2.4	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004). Focus on partnerships with railroad and timber industry, as well as large private landowners.	3	20	CA Coastal Commission, California Coastal Conservancy, CDFW, Mendocino County, NMFS, NRCS, Private Landowners, RCD, Redwood Forest Foundation	
GarR-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-8.1.1	Recovery Action	Sediment	Improve and expand instream gravel quantity				
GarR-CCCh-8.1.1.1	Action Step	Sediment	Increase the percentage of gravel quality embeddedness to values of 1s and 2s (See NMFS Conservation Action Planning Attribute Table Report) in all current and potential juvenile salmonid summer and seasonal (fall/winter/spring) rearing areas.	2	20	CDFW, Conservation Fund, Friends of the Garcia River, NMFS, NOAA RC, RWQCB, The Nature Conservancy	A habitat survey assessment needs to be conducted to determine extent of embeddedness.
GarR-CCCh-8.1.1.2	Action Step	Sediment	Identify and implement strategies to treat landslides and old features such as stream side landings (Bell 2003).	3	10	CDFW, Conservation Fund, Friends of the Garcia River, NMFS, NOAA RC, Private Landowners, RWQCB, The Nature Conservancy	
GarR-CCCh-8.1.1.3	Action Step	Sediment	Complete the remaining 25% of erosion control sites identified in the South Fork Garcia River by the Trout Unlimited North Coast Coho Project.	2	5	Mendocino Redwood Company, Trout Unlimited	
GarR-CCCh-8.1.1.4	Action Step	Sediment	Treat high and medium priority sites that are identified in the MRC Garcia River Watershed Analysis, Garcia River Forest Integrated Resource Management Plan and other credible landowner assessments.	1	10	CDFW, NOAA RC, Private Consultants, Private Landowners, SWRCB	

Garcia River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GarR-CCCh-8.1.1.5	Action Step	Sediment	Acquire funding for assessment and implementation of sediment reduction measures associated with the 2008 Jacks Fire which occurred in the North Fork Garcia River subbasin.	2	2	CalFire, NRCS, Private Landowners, RCD	
GarR-CCCh-8.1.1.6	Action Step	Sediment	Continue the implementation of the Garcia River TMDL and associated sediment reduction efforts.	1	20	Board of Forestry, CalFire, CDFW, NMFS, NOAA RC, RWQCB, The Nature Conservancy	
GarR-CCCh-8.1.1.7	Action Step	Sediment	Develop and implement bank erosion prevention and riparian planting in Pardaloe Creek (Monschke and Caldon 1992).	2	10	CDFW, Conservation Fund, NMFS, NOAA RC, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions				
GarR-CCCh-10.1.1.1	Action Step	Water Quality	Work with TNC and Stillwater Sciences to develop a Basin Temperature model to aid in efforts to reduce stream temperatures between Signal and the Pardaloe/Mill creeks confluence.	2	10	CDFW, Conservation Fund, NMFS, NOAA RC, Private Landowners, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-10.1.1.2	Action Step	Water Quality	Work with landowners to plant riparian zones of Blue Waterhole, Inman Creek, and Pardaloe Creek with the goal of reducing instream water temperatures of the Garcia River main stem during the dry season.	2	10	CDFW, NOAA RC, Private Landowners	
GarR-CCCh-10.1.1.3	Action Step	Water Quality	Identify and Implement actions to maintain and restore water temperatures to meet habitat requirements for salmonids in specific streams (CDFG 2004).	2	10	CDFW, CDFW Law Enforcement, NMFS OLE, NOAA RC, NOAA/NMFS, Private Landowners, RCD	
GarR-CCCh-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure and diversity				
GarR-CCCh-11.1.1.1	Action Step	Viability	Identify if the population is at short-term or immediate risk of extinction.	2	10	NOAA RC, NOAA SWFSC, NOAA/NMFS, Pomo Tribe	
GarR-CCCh-11.1.1.2	Action Step	Viability	Identify the biological or DPS significance of the subject population.	2	10	NOAA RC, NOAA SWFSC, NOAA/NMFS	
GarR-CCCh-11.1.1.3	Action Step	Viability	Investigate the current population dynamics and viability status..	1	20	NOAA RC, NOAA SWFSC, NOAA/NMFS	
GarR-CCCh-11.1.1.4	Action Step	Viability	Investigate the current status of the population genetic diversity.	1	20	NOAA RC, NOAA SWFSC, NOAA/NMFS	
GarR-CCCh-11.1.1.5	Action Step	Viability	Identify population viability goals and the expectations of a conservation hatchery/supplementation/augmentation program.	2	20	NOAA RC, NOAA SWFSC, NOAA/NMFS	
GarR-CCCh-11.1.1.6	Action Step	Viability	Identify where a conservation hatchery/supplementation/ augmentation program will complement the overall recovery effort.	2	20	NOAA RC, NOAA SWFSC, NOAA/NMFS	
GarR-CCCh-11.1.1.7	Action Step	Viability	If determined necessary, identify an out-of-basin source population that could be used to start a population augmentation/supplementation/broodstock program.	2	30	NOAA RC, NOAA SWFSC, NOAA/NMFS	
GarR-CCCh-16.1	**Objective**	**Fishing/Collecting**	**Address the inadequacy of existing regulatory mechanisms**				
GarR-CCCh-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
GarR-CCCh-16.1.1.1	Action Step	Fishing/Collecting	Reduce poaching of adult salmonids by increasing law enforcement.	1	100	CDFW, NOAA/NMFS	
GarR-CCCh-16.1.1.2	Action Step	Fishing/Collecting	Promote CalTip to discourage poaching (CDFG 2004).	2	100	CDFW, NOAA/NMFS	
GarR-CCCh-16.2	**Objective**	**Fishing/Collecting**	**Address other natural or manmade factors affecting the species' continued existence**				
GarR-CCCh-16.2.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
GarR-CCCh-16.2.1.1	Action Step	Fishing/Collecting	Investigate and consult with local tribal officials in efforts to stop gill-netting in the Garcia River watershed.	1	30	CDFW, CDFW Law Enforcement, NMFS OLE, NOAA/NMFS, Pomo Tribe	
GarR-CCCh-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-18.1.1	Recovery Action	Livestock	Prevent or minimize impairment to estuary quality and extent				

Garcia River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GarR-CCCh-18.1.1.1	Action Step	Livestock	Work with BLM to ensure that future cattle leasing agreements do not reduce potential rehabilitation of high value summer and winter juvenile salmonid rearing habitat within the lower Garcia River and estuary.	2	20	BLM, CDFW, NOAA RC, NOAA/NMFS	
GarR-CCCh-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to water quality (instream water temperature)				
GarR-CCCh-19.1.1.1	Action Step	Logging	Protect current riparian zones in all summer salmonid rearing areas to the extent that they are able to mature, provide, and maintain a minimum of 80% canopy cover.	2	50	Board of Forestry, CalFire, CDFW, Conservation Fund, Mendocino Redwood Company, NMFS, NOAA RC, Private Landowners, RWQCB, The Nature Conservancy	
GarR-CCCh-19.1.2	Recovery Action	Logging	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
GarR-CCCh-19.1.2.1	Action Step	Logging	Ensure future forest management allows for optimal levels of natural LWD recruitment of larger older trees into stream channels	2	100	CDFW, Conservation Fund, Mendocino Redwood Company, NMFS, RWQCB, The Nature Conservancy	
GarR-CCCh-19.1.3	Recovery Action	Logging	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
GarR-CCCh-19.1.3.1	Action Step	Logging	Develop and implement low impact timber and wood harvest techniques (e.g., full-suspension cable yarding) in efforts to reduce turbidity impacts in streams. Example: Parker Ranch in the Ten Mile River Basin (Bell 2003).	2	100	Board of Forestry, CDFW, Conservation Fund, Mendocino Redwood Company, Private Landowners, RWQCB, The Nature Conservancy	
GarR-CCCh-19.1.3.2	Action Step	Logging	Extend the monitoring period and upgrade THP road maintenance after harvest.	2	60	CalFire	
GarR-CCCh-19.1.3.3	Action Step	Logging	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	2	20	CalFire, Mendocino Redwood Company, NOAA RC, Private Landowners	
GarR-CCCh-19.1.4	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
GarR-CCCh-19.1.4.1	Action Step	Logging	Areas adjacent to currently owned State parks or forestlands supporting high priority areas should be considered for purchase (if feasible within the next 5 years).	2	50	CDFW, NMFS, Private Landowners, Redwood Forest Foundation, The Nature Conservancy, Trout Unlimited	
GarR-CCCh-19.1.4.2	Action Step	Logging	Should large tracts of forestlands within the Garcia River watershed become available for purchase, the State of California and/or the Federal Government should consider purchasing the area as a Demonstration Forest, State Park, or Salmonid Preserve.	2	50	CDFW, NMFS, Redwood Forest Foundation, RWQCB, The Nature Conservancy	
GarR-CCCh-19.1.4.3	Action Step	Logging	Continue the activities of the North Coast Watershed Assessment /Coastal Watershed Program.	2	20	CDFW, NMFS, Private Landowners	
GarR-CCCh-19.1.4.4	Action Step	Logging	Maintain and expand working forestlands and forestlands held by the State.	2	20	Board of Forestry, CalFire, CDFW, NMFS, RWQCB	
GarR-CCCh-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
GarR-CCCh-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
GarR-CCCh-19.2.1.1	Action Step	Logging	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	2	20	Board of Forestry, CA Coastal Commission, CDFW, NMFS	
GarR-CCCh-19.2.1.2	Action Step	Logging	Work with the California Board of Forestry to design and implement a program of BMPs for logging areas that meets the approval of NMFS and CDFW.	3	20	Board of Forestry, CDFW, NMFS, RWQCB	
GarR-CCCh-19.2.1.3	Action Step	Logging	Conduct an assessment of the mechanisms driving forestland conversion and develop strategies to protect forestlands.	3	10	Board of Forestry, Mendocino County, NMFS	
GarR-CCCh-19.2.1.4	Action Step	Logging	Consider the development of a Watershed Database (similar to the CDFW Northern Spotted Owl database) for salmonids that provides watershed data and information in a consistent fashion to all foresters for consideration in their harvest plans.	2	20	Board of Forestry, CDFW, NMFS	
GarR-CCCh-19.2.1.5	Action Step	Logging	Develop a framework similar to Washington State that establishes a scientific framework for monitoring the effectiveness of practices in meeting watershed process goals and a decision-making process that is adaptive to the new information.	2	30	Board of Forestry, CalFire, CDFW, Conservation Fund, Mendocino Redwood Company, NMFS, Private Landowners	

Garcia River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GarR-CCCh-19.2.1.6	Action Step	Logging	Provide information to BOF regarding salmonid priorities and recommend upgrading relevant forest practices.	2	2	CDFW, NMFS	
GarR-CCCh-19.2.1.7	Action Step	Logging	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	2	100	CA Coastal Commission, CDFW, Mendocino County, NMFS	
GarR-CCCh-19.2.1.8	Action Step	Logging	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	3	5	Board of Forestry, CalFire, CDFW, NMFS	
GarR-CCCh-19.2.1.9	Action Step	Logging	Develop a California Forest Practice monitoring protocol to determine whether specific practices are effectively meeting intended objectives and are providing for the protection of salmonids.	3	20	Board of Forestry, CalFire, NMFS, NRCS, RCD, RWQCB, The Nature Conservancy	
GarR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
GarR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats.	2	10	Board of Forestry, CalFire, Mendocino County, NMFS, NOAA RC, RWQCB	
GarR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Map and identify stream crossings with the intention of replacement or removal if they cannot pass the 100 year flow. Designs should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	2	10	CDFW, Mendocino County Department of Public Works, NOAA RC, NRCS, Private Landowners, RCD	
GarR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Weaver and Hagans, 1994; Sommarstrom et al., 2002; Oregon Department of Transportation, 1999).	3	10	CalFire, CDFW, Mendocino County Department of Public Works, NRCS, Private Landowners	Ten year duration to accommodate changes in BMPs.
GarR-CCCh-23.1.1.4	Action Step	Roads/Railroads	Restoration projects that upgrade or decommission high risk roads should be considered an extremely high priority for funding (e.g., PCSRF).	2	20	CDFW, NOAA RC, NRCS	
GarR-CCCh-23.1.1.5	Action Step	Roads/Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (CDFG 2004).	2	20	CalFire, CDFW, NOAA RC, NRCS, Private Landowners, RCD	
GarR-CCCh-23.1.1.6	Action Step	Roads/Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	2	20	CalFire, CDFW, NOAA RC, NRCS, Private Landowners, RCD	
GarR-CCCh-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
GarR-CCCh-23.1.2.1	Action Step	Roads/Railroads	Develop a private road database using standardized methods. The methods should document all road features, apply erosion rates, and compile information into a GIS database.	3	5	CalFire, Mendocino County Department of Public Works, NMFS, Private Consultants, Private Landowners	
GarR-CCCh-23.1.2.2	Action Step	Roads/Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	10	CDFW, Mendocino County, NOAA RC, NRCS, Private Landowners	
GarR-CCCh-23.1.2.3	Action Step	Roads/Railroads	All new crossings and upgrades to existing crossings (bridges, culverts, fills, and other crossings) should accommodate 100-year flood flows and associated bedload and debris.	3	20	Mendocino County, NMFS, NRCS, Private Landowners, RCD	
GarR-CCCh-23.1.2.4	Action Step	Roads/Railroads	Evaluate existing and future stream crossings that impair natural geomorphic processes. Replace or retrofit crossings to achieve more natural conditions that meet sediment transport goals.	3	10	Board of Forestry, CalFire, CDFW, Friends of the Garcia River, Mendocino Redwood Company, NMFS, NOAA RC, NRCS, RCD, RWQCB	
GarR-CCCh-23.1.2.5	Action Step	Roads/Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	2	5	CalFire, CalTrans, CDFW, NMFS, NRCS, Private Landowners	
GarR-CCCh-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
GarR-CCCh-23.1.3.1	Action Step	Roads/Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	2	100	CalTrans, Mendocino County Department of Public Works	
GarR-CCCh-23.1.3.2	Action Step	Roads/Railroads	Ensure that all future road or bridge repairs at stream crossing provide unimpaired fish passage for all salmonid life stages.	2	20	Mendocino County	

Garcia River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GarR-CCCh-24.1	**Objective**	**Severe Weather Patterns**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (stream flow)				
GarR-CCCh-24.1.1.1	Action Step	Severe Weather Patterns	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.	2	20	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, RWQCB, SWRCB	
GarR-CCCh-25.1	**Objective**	**Water Diversion/ Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GarR-CCCh-25.1.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (stream flow)				
GarR-CCCh-25.1.1.1	Action Step	Water Diversion/ Impoundment	Work with landowners, the tribe, CDFW, RWQCB, DWR, and SWRCB to ensure that water supply demands can be met without impacting flow either directly or indirectly through groundwater withdrawals and aquifer depletion.	2	20	DWR, CDFW, NMFS, RWQCB, SWRCB, Tribes	
GarR-CCCh-25.1.1.2	Action Step	Water Diversion/ Impoundment	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and California Water Code §1707 (CDFG 2004).	2	20	CDFW, NOAA RC, Private Landowners, SWRCB	
GarR-CCCh-25.1.2	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to passage and migration				
GarR-CCCh-25.1.2.1	Action Step	Water Diversion/ Impoundment	Establish flow related adult and smolt migration thresholds prior to authorizing future water diversions.	1	20	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	
GarR-CCCh-25.1.3	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to the estuary (quality and extent)				
GarR-CCCh-25.1.3.1	Action Step	Water Diversion/ Impoundment	Discourage the development of any surface water diversions in the watershed that independently or cumulatively have significant impact on reducing inflow to the estuary during spring/summer/fall months (ECORP and Kamman Hydrology & Engineering 2005).	1	20	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	
GarR-CCCh-25.1.4	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to water quality (instream temperature)				
GarR-CCCh-25.1.4.1	Action Step	Water Diversion/ Impoundment	Work with partners to ensure future water diversions do not impair instream water temperatures during the dry season.	1	50	CA Coastal Commission, CWQCB, NMFS OLE, NOAA/NMFS, Pomo Tribe, Private Landowners, RCD, WCB	
GarR-CCCh-25.2	**Objective**	**Water Diversion/ Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
GarR-CCCh-25.2.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (stream flow)				
GarR-CCCh-25.2.1.1	Action Step	Water Diversion/ Impoundment	Work with the SWRCB to eliminate depletion of summer base flows from unauthorized water uses. Coordinated efforts by Federal and State, and County law enforcement agencies to remove illegal diversions from streams.	1	10	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	
GarR-CCCh-25.2.1.2	Action Step	Water Diversion/ Impoundment	Encourage compliance with the most recent update of NMFS' Water Diversion Guidelines.	2	100	CDFW, NMFS, NRCS, SWRCB	
GarR-CCCh-25.2.1.3	Action Step	Water Diversion/ Impoundment	Ensure all water diversions and impoundments are complaint with AB2121 or other appropriate protective measures.	2	50	CDFW, NMFS, SWRCB	
GarR-CCCh-25.2.1.4	Action Step	Water Diversion/ Impoundment	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	3	30	SWRCB	

Garcia River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GarR-CCCh-25.2.1.5	Action Step	Water Diversion/ Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	2	20	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	
GarR-CCCh-25.2.1.6	Action Step	Water Diversion/ Impoundment	Support the SWRCB in regulating groundwater.	3	20	CDFW, NMFS, RWQCB	
GarR-CCCh-25.2.1.7	Action Step	Water Diversion/ Impoundment	Request that SWRCB review and/or modify water use based on the needs of salmonids and authorized diverters (CDFG 2004).	2	20	CDFW, NMFS, SWRCB	

Russian River Population

CC Chinook Salmon Fall-Run

- Role within ESU: Functionally Independent Population
- Diversity Stratum: Central Coastal
- Spawner Abundance Target: 9,300 adults
- Current Intrinsic Potential: 465.2 IP-km

For information regarding CCC steelhead and CCC coho salmon for this watershed, please see the CCC steelhead volume of this recovery plan and the CCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

The historical abundance and distribution of Chinook salmon within the Russian River are poorly understood. Prior to the first recorded stocking of Chinook salmon within the basin in 1881, there were no records of the fish's presence or absence within the Russian River (Chase *et al.* 2007). Spawning was likely focused in the mainstem, and larger lower tributaries, and access to spawning habitat was likely dependent on fall rains to restore adequate flow for migration and spawning (See map, following the profile). Though early reports of a modest Chinook salmon fishery in the Russian River estuary prior to the turn of the century suggests a pre-existing population within the watershed prior to the 1881 stocking, since the likelihood of a single stocking event establishing a harvestable population is low (Chase *et al.* 2007). Documentation of detailed catches in the estuary ended in 1922, and few comprehensive surveys were conducted during the following decades; most literature detailing fish presence and abundance within the Russian River during most of the twentieth century were generally qualitative in nature, and typically suggested either the absence of a Chinook salmon run, or at most the presence of a small, ephemeral population (Chase *et al.* 2007). CDFW accelerated the efforts to establish a spawning population of Chinook salmon within the basin by stocking 2.25 million fry between 1956 and 1960. During the early stocking years, broodstock fish were mainly transfers from the Klamath, Sacramento, and Eel river systems; Russian River broodstock were not used until the 1980s and 1990s (Chase *et al.* 2007).

In 1981, the Department of the Army, Corps of Engineers constructed the Don Clausen Fish Hatchery (DCFH) on Dry Creek to compensate for spawning and nursery areas blocked by the Warm Springs Dam—Lake Sonoma Project. The established mitigation goals included 1,000,000 released smolts and 1,750 returning adults. Juvenile Chinook salmon production peaked in winter 1985-86 with the release of 884,520 juveniles from the DCFH (CDFG 2011a). Between 1982

and 1999 adult Chinook salmon returns ranged from 0 to 304, peaking in 1988 (CDFG 2011b) (Figure 1). Though no mitigation goals for Chinook salmon were established for the Coyote Valley Fish Facility (CVFF) on the upper river, adult Chinook salmon returns to

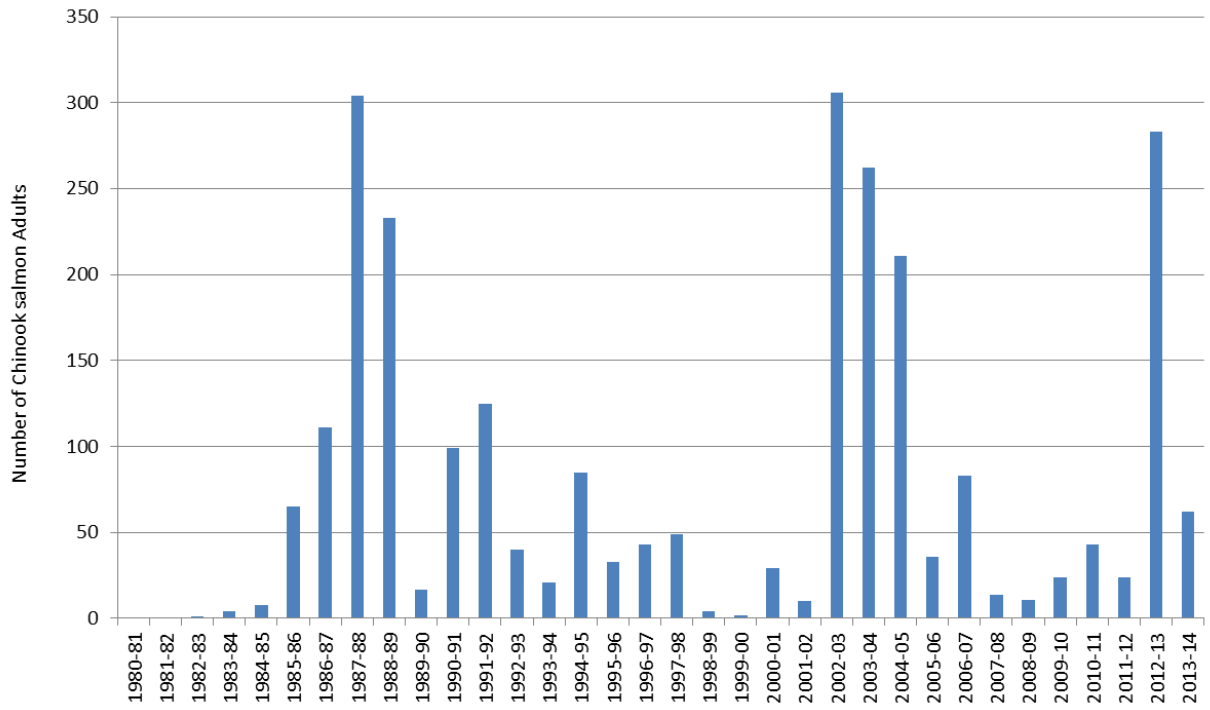

Figure 1: Adult chinook returns counted at the Warm Spring Fish Hatchery on Dry Creek, 1980-81 through 2013-2014.

CVFF have ranged from 1 to 23, with a peak year in 2003 (Figure 2). Stocking continued at both Russian River facilities until 1999 when stocking was discontinued due to concerns regarding the small broodstock population size and inbreeding depression. No Chinook salmon have been spawned or released at DCFH since 1999, though wild adult Chinook salmon still return to the facility. All adult Chinook salmon that enter the DCFH are returned to Dry Creek tributaries per NMFS direction.

Prior to the completion of Warm Springs Dam, Dry Creek likely provided spawning habitat only during years with sufficient early rains allowed for suitable migration and spawning conditions (Winzler & Kelly Consulting Engineers 1978). Current water supply operations provide a stable release of cold water down Dry Creek. Spawner surveys and downstream migrant trapping conducted by Sonoma County Water Agency (SCWA) has documented large numbers of Chinook salmon successfully spawning and rearing in Dry Creek, and the upper mainstem.

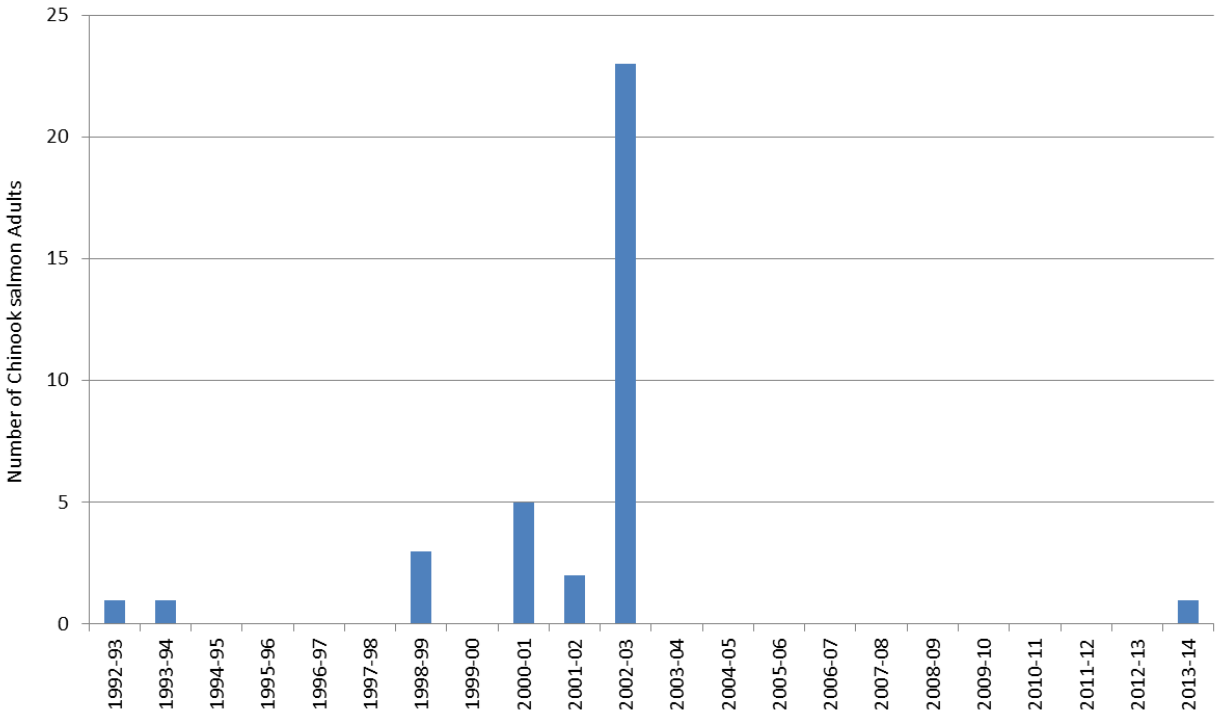

Figure 2: Adult chinook returns counted at the Coyote Valley Fish Facility on the East Branch Russian River, 1992-93 through 2013-14.

SCWA conducts video monitoring at a fish ladder associated with their Mirabel Diversion Dam, and recent minimum counts of adult Chinook salmon ranged from 1,138 to 6,969 between 2000 and 2013 (Figure 3).

SCWA redd surveys have documented Chinook salmon spawning over an extensive area of the Russian River mainstem, although most spawning occurred between the town of Cloverdale (river kilometer 101) and the confluence of the East and West branches of the Russian River (river kilometer 150). Chinook salmon spawning has also been documented within five Russian River sub-basins and their tributaries (Dry, Santa Rosa, Austin, Green Valley and Forsythe creeks), although most Russian River tributaries are only accessible to Chinook salmon during years with substantial and sustained early fall rains (See map, following profile). While the larger tributaries are utilized opportunistically, their contribution to spawning and rearing habitat in the basin is relatively low compared to the mainstem and Dry Creek (*e.g.*, SCWA counted 342 redds in 2004).

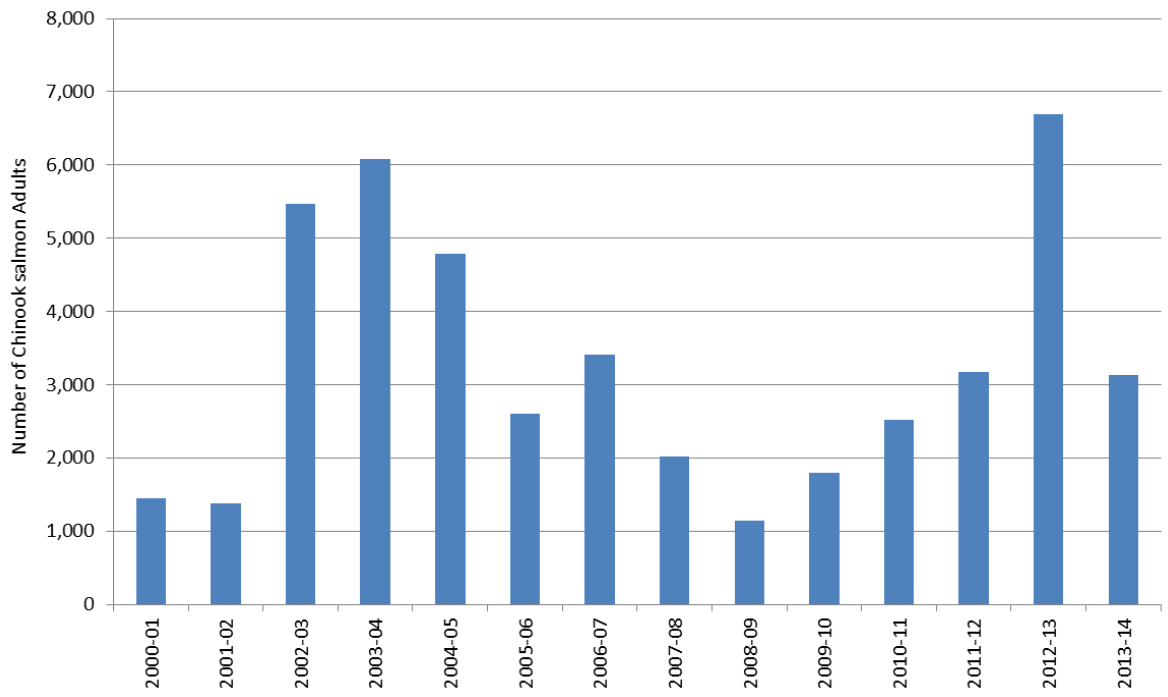

Figure 3. Minimum counts of Chinook salmon (2000-01 to 2013-14) which pass video counting station at the SCWA Mirabel water diversion facility (source, SCWA).

History of Land Use

The Russian River Watershed is centrally located in California, with a drainage area of approximately 1,485 square miles (approximating 1 million acres). The basin's fog-influenced coastal region, which extends 10 miles inland, typically has cool summers and abundant summer fog moisture. The drier interior region, on the other hand, experiences hot, dry summers with temperatures increasing to upwards of 100º F in the northeastern valleys most isolated from coastal influence (Coey *et al.* 2002). Winter temperatures can reach the low 20ºs F, though snowfall is uncommon, and rainfall in the basin ranges from 22-80 inches, with a basin-wide average of 41 inches (SEC 1996). The Franciscan lithology is very unstable and landslides are common throughout most mountain regions within the basin.

The history of resource use in the Russian River area began with the Pomo Indians, who occupied the river basin for as long as 5,000 years prior to European settlement, living in numerous settlements of up to 1,000 people (Wilson 1990). These tribes altered their environment with the regular burning of oak woodlands and grasslands as a means of promoting new growth of their food sources and increasing wildlife habitat. In the late 1700's, the Spanish landed at Bodega Bay to find the river basin a virtual paradise, followed by the Russians who established colonies at Fort Ross and Bodega Bay in the 1800's (Ferguson 1931).

The arrival of many land-hungry "American" settlers soon decimated the Native Americans living in villages throughout the river valley (Wilson 1990), and at that time, the sheer size and density of the old growth redwood forests were almost unfathomable. In 1865 intensive logging in the lower watershed began with the outside markets, dramatically boosting the production of the timber industry (Stindt 1974). Salmon (chinook, coho and pink) and steelhead were once so prevalent in the Russian River that they supported a commercial fishery (USBFF 1888). Cannery records give no mention of species, but fish weighed between eight and 20 pounds, suggesting salmonids were a large part of the catch. In 1888, 183,597 pounds of fish were caught near Duncan Mills for cannery and personal use (USBFF 1888). Assuming a range of fish weight from 12 to 20 pounds, between 9,200 and 15,300 fish were taken (Coey et al 2002).

Although logging and fishing continued through the early 20th Century, three of the more significant anthropogenic changes to the watershed during this period were the construction of the two dams as discussed previously, which were constructed without fish ladders, and the advent of gravel mining in the 1940's to supply a burgeoning population and hunger for aggregate in the SF Bay Area.

Most of the land along the Russian River was already under cultivation by 1900 (SEC 1996) and this early agriculture focused mainly on the production of grapes, apples, hops and prunes. Farmers removed riparian vegetation and filled in sloughs and side channels in order to maximize their usable agricultural lands. These practices continued until the late 1940's when very few wetlands remained (SEC 1996). At that time, the river valley was leveled, creeks were channelized and, in an attempt at flood control, agricultural operations began removing small in-channel islands and gravel bars. In the 1940's in-channel gravel extraction began and, in the years to follow, the production of sand and gravel was the principal industry from Healdsburg through Ukiah. The removal of Russian River gravels from in-channel was used for concrete construction and roads from Santa Rosa to Ukiah and throughout the entire Bay Area. In the 1950s, bank stabilization measures began in response to headcutting, with the river bottom dropping as much as 22' in the middle reach (Martin Griffin, personal communication). Ultimately, these practices resulted in mass channelization of the mainstem.

In the 1970's, in-channel gravel mining slowed and operations moved to the adjacent terraces where floodplain pits are constructed amidst agricultural operations. Agriculture is still the dominant land use within the basin, with the recent trend being conversion of historic crop lands, livestock, dairy lands, and forest lands to vineyards. Today, the upper reaches of the Russian River flow south through southern Mendocino County and the towns of Redwood Valley, Calpella, Ukiah, and Hopland south to Sonoma County, and the towns of Healdsburg, Windsor

and Santa Rosa, which support a highly productive and successful wine growing region which is supported by a healthy and economically valuable tourism industry.

Throughout the 20th Century, both coho and Chinook salmon and steelhead were propagated and released into the Russian River. In 2001 NMFS recommended ceasing chinook spawning at WSH and CVFF due to concerns over genetic bottlenecking from too few returning adult fish (NMFS 2008). Today, both steelhead and coho salmon are reared and released at the facilities according to a Hatchery and Genetic Management Plan.

For more information, please refer to the Russian River Overview chapter and individual CCC steelhead population profiles for detailed discussions concerning the history of land use.

Current Resources and Land Management

Approximately 92% of the Russian River Watershed is privately owned, with the remaining managed as federal, state and county lands. A majority of the federally managed lands are within the jurisdiction of BLM and USCOE dam recreation areas.

Nearly 38% of the watershed is forested with montane hardwoods, annual grasslands (18%), shrub (95) and Douglass fir (7%) being the most common forest communities. Urban areas represent less than 7% of the watershed area with the largest developments located inland in developed floodplain areas of the Santa Rosa plain. Agriculture, which comprises 13 percent of the land acreage within the Russian River watershed, is predominantly located in low-lying, flat landscapes adjacent to and within the historic floodplain of the Russian River mainstem.

For more information please refer to the Russian River Overview chapter and individual Russian River CCC steelhead population profiles for detailed discussions concerning the current resource and land management.

Salmonid Viability and Watershed Conditions

The following indicators were rated Poor through the CAP process for Chinook salmon: habitat complexity, riparian vegetation, passage/migration, estuary/lagoon, velocity refugia, sediment transport, and water quality (turbidity). Other indicators that are identified as impaired include sediment, temperature, and viability. Recovery strategies will focus on improving these poor conditions as well as those needed to ensure population viability and functioning watershed processes.

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Russian River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Sediment Transport: Road Density

Sediment Transport, road density conditions have a rating of Poor. Altered sediment transport limits spawning gravel recruitment and impacts spawning gravel quality to properly functioning watershed processes. Sediment transport is especially compromised within the upper tributary watersheds where road densities are high; in many streams, flows are inadequate to flush accumulated fine sediment. With the high potential for increased urban development and forest conversion (*i.e.,* tree removal to allow agriculture) within the basin, altered sediment transport is a stress that will likely impair adult habitat into the future.

Estuary: Quality and Extent

Estuary rearing is considered a critical life-history pattern for Chinook salmon within coastal watersheds of the central coast of California. Russian River Chinook salmon rear for a short time in the mainstem or tributaries where they are spawned, prior to migrating downstream, spending a short time in fresh and brackish waters where they undergo smolt transformation. Migration through the Russian River estuary to the Pacific Ocean peaks in May and June. Historic data indicate the Russian River estuary often existed in a perched or closed lagoon state through the summer. Following dam construction, for several decades the estuary was managed during the summer as an open, tidally-influenced estuary in order to alleviate flooding risks (NMFS 2008). A NMFS 2008 Biological Opinion has improved estuary management, which attempts to balance risks of flooding with an increase in habitat volume to improve rearing habit for juvenile salmonids prior to ocean entry. The quantity and quality of rearing conditions vary by lifestage, depending upon the frequency and timing of barrier bar development, which highly influences tidal, perched or closed conditions (NMFS 2008).

Velocity Refuge: Floodplain Connectivity

Floodplain habitat, which provides velocity refugia and foraging opportunity for juvenile salmonids, is lacking in sections of the upper Russian River. Significant lengths of mainstem and tributary streambanks have been levied and diked, or had floodplain vegetation removed for agricultural and residential/commercial development. The floodplain connectivity condition has a Poor rating for adult and pre-smolt lifestages.

Passage/Migration: Mouth or Confluence and Physical Barriers

Although few physical barriers exist, the mouths of many tributaries, particularly in the Alexander Valley reach, can become perched in the late fall or early spring due to aggraded sediment at the mainstem/tributary confluence in drier years. This condition can impede both adult migration and smolt emigration into tributaries and can limit spawner abundance and subsequent juvenile recruitment to the mainstem reaches. Passage to the upper sections of Dry Creek and the East Branch Russian River are blocked by Lake Sonoma and Lake Mendocino respectively.

Habitat Complexity: Large Wood and Shelter and Habitat Complexity: Percent Primary/Staging Pools and Pool/Riffle/Flatwater Ratios

Habitat Complexity: Large Wood and Shelter conditions rates Poor for most life stages of Chinook salmon throughout much of the watershed. Deep pools with submerged LWD where adults migrating Chinook salmon could hold and spawn, and where juveniles could rear prior to estuary residency are lacking in the Russian River mainstem and lower portions of tributaries where they migrate and spawn. Staging pools that adult Chinook salmon historically utilized during migration have been filled in with sediment by historic flood control and gravel mining practices.

Water Quality: Turbidity or Toxicity

Turbidity is an issue within the mainstem Russian River where turbid discharges from Coyote Valley Dam can extend well past Hopland during summer months (McKeon 2010). Turbidity likely impairs juvenile and smolt feeding in the mainstem during their migration to the estuary, which is an important period when juvenile fish must feed to grow and undergo smolt transformation. NMFS has identified the need for the USACE to fund and begin a feasibility study to re-design the dam outlet or otherwise solve/address this issue, which affects all Chinook salmon emigrating from the upper and middle basin (NMFS 2008). Additionally, research into the potential level of impacts from and solutions to environmental estrogens associated with wastewater discharge and domestic septic leakage are needed.

Other Current Conditions

Additionally, riparian habitat has been impacted in many sections of the watershed, often by streambank armoring and flood control, clearing for agriculture, invasive species establishment, or riparian grazing (CDFW stream habitat reports). The conditions of excessive gravel scouring and impaired watershed hydrology also rated as Fair.

Threats

The following discussion focuses on those threats that rate as High or Very High (see Russian River CAP results). Recovery strategies will likely focus on ameliorating High rating threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Russian River CAP results.

Agriculture

Agriculture, which comprises 13 percent of the land acreage within the Russian River watershed, is predominantly located in low-lying, flat landscapes adjacent to and within the historic floodplain of the Russian River mainstem. Historic agriculture practices have removed trees and vegetation along the channel, reducing the potential for LWD input, and contributing sediment into stream channels that can smother spawning gravels.

Channel Modification

Streams flowing through agricultural and urban areas have often been channelized, straightened, or simplified to prevent flooding and erosion of adjacent land. This has led to channel bed scouring in degrading portions (Middle Reach and Ukiah reaches) and deposition in the aggrading portions (Alexander Valley reaches) of the river. This effect, combined with agricultural water diversion and groundwater pumping, can contribute to hydrologic disconnection of tributaries from the mainstem during the fall and late spring.

Fishing and Collecting

Although no official fishing season for adult Chinook salmon exists due to their protected status, currently the summer trout and winter steelhead recreational sports fishing seasons overlap with the adult Chinook salmon migration seasons respectively; thus, incidental bycatch of Chinook salmon occurs. Poaching incidents have been documented in the past, and as a result, enforcement and education efforts have been increased.

Hatcheries and Aquaculture

Though modern stocking efforts of Chinook salmon have occurred since the 1950's, a substantial run of Chinook salmon was not established. The Healdsburg fish ladder installed in 2001 improved passage over the dam foundation during periods of low flow, and likely expanded the window of spawning opportunity on the upper river. Hatcheries were rated as a Low threat, as hatchery supplementation of Chinook salmon from the DCFH was discontinued in 1999, when NMFS determined that the genetic concerns of inter-breeding associated with the small broodstock population outweighed the risks of impaired demographics in the small wild

population. Mitigation release goals are currently zero until adult returns reach 500 at either hatchery facility.

Mining

Historic gravel mining practices had a major effect on Chinook salmon habitat in the Russian River mainstem and tributaries by removing stable riffle and LWD habitat, and widening and simplifying channel morphology. These practices resulted in long stretches of flattened channel characterized by shallow, wide pools with little resting cover. Through recent improvements to gravel mining practices (*e.g.,* involvement by NMFS in implementing BMPs that maintain bar height, promote deeper pools, and encourage channel alcove development), have mitigated these adverse effects to a large degree, and have resulted in more sustainably managed aggregate resources.

Residential and Commercial Development

Although much of the Upper Russian watershed is rural and sparsely populated, the most heavily populated areas along the mainstem (*i.e.,* Santa Rosa, Healdsburg, Geyserville, Cloverdale and Ukiah) and tributaries (*e.g.,* Mark West Creek, Santa Rosa Creek, Dry Creek, and the Geyserville and Ukiah sub-basins) are co-located adjacent to Chinook salmon spawning habitat. Early urban development in the Russian River transformed river and lower tributary spawning and rearing habitat in the valley floors that were likely dominated by oak-savannah ecotypes, with high quality habitat and flow.

Roads and Railroads

Stream side road density is Very High in the Russian River watershed, and is a significant threat to the egg lifestage and impacts watershed processes. Impervious surfaces increase run-off and channel velocities, road culverts decrease gravel transport and cause channel incision, while unpaved surfaces and ditches can increase surface erosion and instream sediment deposition that can diminish spawning gravel quality. Numerous unpaved roads exist in the Mendocino County portion of the watershed, and though the roads have been programmatically assessed with CDFW grant funding, to date much of the recommendations have not been implemented. With increasing development pressures in the rural portions of Sonoma and Mendocino counties, and associated road building to support future agricultural and urban development, this high threat is likely to continue in the future.

Severe Weather Patterns

The Upper Russian watershed is characterized by a Mediterranean-type climate, with dry, hot summers and moderate rainfall occurring primarily between November and March (Coey *et al.* 2002). Though this hydrologic regime favors Chinook salmon, simplified tributary stream

channels and river confluences no longer support connectivity under dry or drought conditions. Since much of the river is artificially disconnected from floodplain habitat by man-made dikes and levees, high river flows no longer inundate floodplain habitat along much of the Russian River mainstem. Aggradation has occurred in some mainstem and lower tributary reaches, diminishing the amount and spatial extent of staging pools for holding during low flow periods.

Water Diversion and Impoundments

Two large impoundments block Chinook salmon migration within the middle and upper portions of the Russian River population; Warm Springs Dam and Coyote Valley Dam. Ramping rates from the two dams, had been identified as a potential source of stranding emerging or juvenile Chinook salmon (NMFS 2008). The elevated and regulated flow structure in the mainstem and Dry Creek also affects the estuary's ability to function naturally. Finally, water diversions associated with agricultural summer pumping or spring frost protection, from the mainstem and tributaries can impact rearing Chinook salmon by lowering baseflows, de-watering redds, or stranding fish in isolated pool habitats.

Limiting Stresses, Life Stages, and Habitats

Pre-smolt and smolt lifestages are impact by several stresses, most notably the limited amount and poor quality of habitat encountered while emigrating downstream. Restoration efforts should focus on ameliorating these impacts, which is reflected in the recovery strategy below.

General Recovery Strategy

Improve Habitat Complexity: Pool Depth, Shelter value and LWD Volume

Restoration efforts that place wood in streams are needed to improve shelter ratings and pool volumes. Where appropriate, wood/boulder structures have been and should continue to be constructed or set within simplified stream reaches of the mainstem and larger tributaries to scour pool habitat, sort spawning gravel, and create complex habitat for adult and smolt migration. To improve long-term LWD loading rates, riparian restoration plans should be developed that focus on restoring both native riparian habitat and the hydrologic/fluvial processes that regulate natural wood loading dynamics.

Improve Lower Tributary Flows

NOAA's coordination efforts have fostered restoration actions between landowners during low flow conditions to minimize acute dewatering episodes, and encouraged the use of alternative frost protection strategies (*e.g.,* wind fans, off-channel reservoirs, *etc.*), many of which have already been successfully employed throughout the basin. USACE and NMFS jointly evaluated

the effects of ramping on juvenile salmonids, and modified ramping schedule criteria in 2016 to diminish and avoid stranding.

Improve Flow Connectivity and Passage

As noted, sediment aggradation at mainstem/tributary confluences can delay or inhibit adult and smolt migration. Aggraded sections can also force streamflow subsurface, dewatering stream habitat that would otherwise have consistent flow. Gravel extraction strategies in these areas could improve passage over the short term. Improving sediment transport in low gradient reaches, and eliminating sediment sources in higher gradient and headwater reaches, would improve fish passage over the longer term. Improving connectivity to floodplain habitat, enhancements to flood control channels and upgrading upslope road networks will be necessary to accomplish this. Habitat potential, and a conceptual plan for passage above Lake Mendocino should be evaluated.

Evaluate and Improve the Regulated Flow Structure

Current efforts between NMFS, and the NWS California / Nevada River Forecasting Center (CNRFC), Monterey Weather Forecasting Office (WFO – Monterey (MTR) and Eureka (EKA)), and the Office of Hydrologic Development (OHD), seek to balance and sustain fisheries flows while maximizing reservoir capture of watershed runoff. These efforts involving forecast-based reservoir operations for flood control and conservation, modeling watershed runoff, and improvement of atmospheric rainfall and river forecasts to identify opportunistic periods for diversion and bypass should be supported. Further work is needed to evaluate storage and flow releases from Coyote Dam to improve flows to the needs of listed salmonids. Changes to mainstem river flows are expected to occur via the 2008 Biological Opinion which should improve rearing habitat on the upper mainstem and improve estuary flow and flooding management. Dedicated "blockwater" flows are recommended to be incorporate into future flow structures for the two dams to improve migration cues or temperatures for fall/winter adult migration, or spring smolt emigration. Meanwhile, large scale habitat restoration efforts required by the 2008 Biological Opinion for coho salmon and steelhead continue and are expected to improve rearing and spawning habitat for Chinook salmon as well.

Increase Abundance and Distribution

DCFH enhancement goals for Chinook salmon smolt releases on Dry Creek were revised to zero in 1999, until such time that adult returns to DCFH reach 500 adults. A Hatchery and Genetic Management Plan (HGMP) would be required by NMFS to re-initiate artificial propagation. Few Chinook salmon still return to the hatchery; to date adult escapement goals at the facility have not beens reached. Hatchery supplementation could be a tool to expand population size, although improvements to genetic management and rearing practices would need to be

implemented through the HGMP that would evaluate the need for stocking and protect the wild spawning population in the context of both recovery and enhancement goals. If Chinook salmon rearing and stocking was re-initiated, smolt releases from CVFF should be increased to expand the number of upper river spawners, given that the bulk of spawning habitat occurs on the mainstem upstream of Dry Creek. Recent addition of a low flow closure in the state fishing regulations should decrease the seasonal overlap of the steelhead sport fishing run with the Chinook salmon run, which should significantly reduce incidental bycatch and mortality of Chinook salmon.

Improve Water Quality: Turbidity or Toxicity

A feasibility study to address turbidity issues in the upper Russian River from Coyote Dam should be completed and solutions implemented by the USACE. One alternative could include installation of a multi-level outlet structure to minimize the discharge of suspended sediment during critical periods of the Chinook salmon lifecycle.

Address Upslope Sediment Sources

Problem roads and active erosion sites already identified from existing road sediment surveys should be prioritized and restoration actions implemented by Mendocino County Department of Transportation. Additionally, remaining roads (city and private) within Sonoma and Mendocino counties should be addressed as part of a comprehensive sediment reduction and transportation plan for the entire basin. Future road construction should utilize BMPs to prevent altering watershed hydrologic processes, sediment transport and fish passage, and avoid construction of roads within riparian zones.

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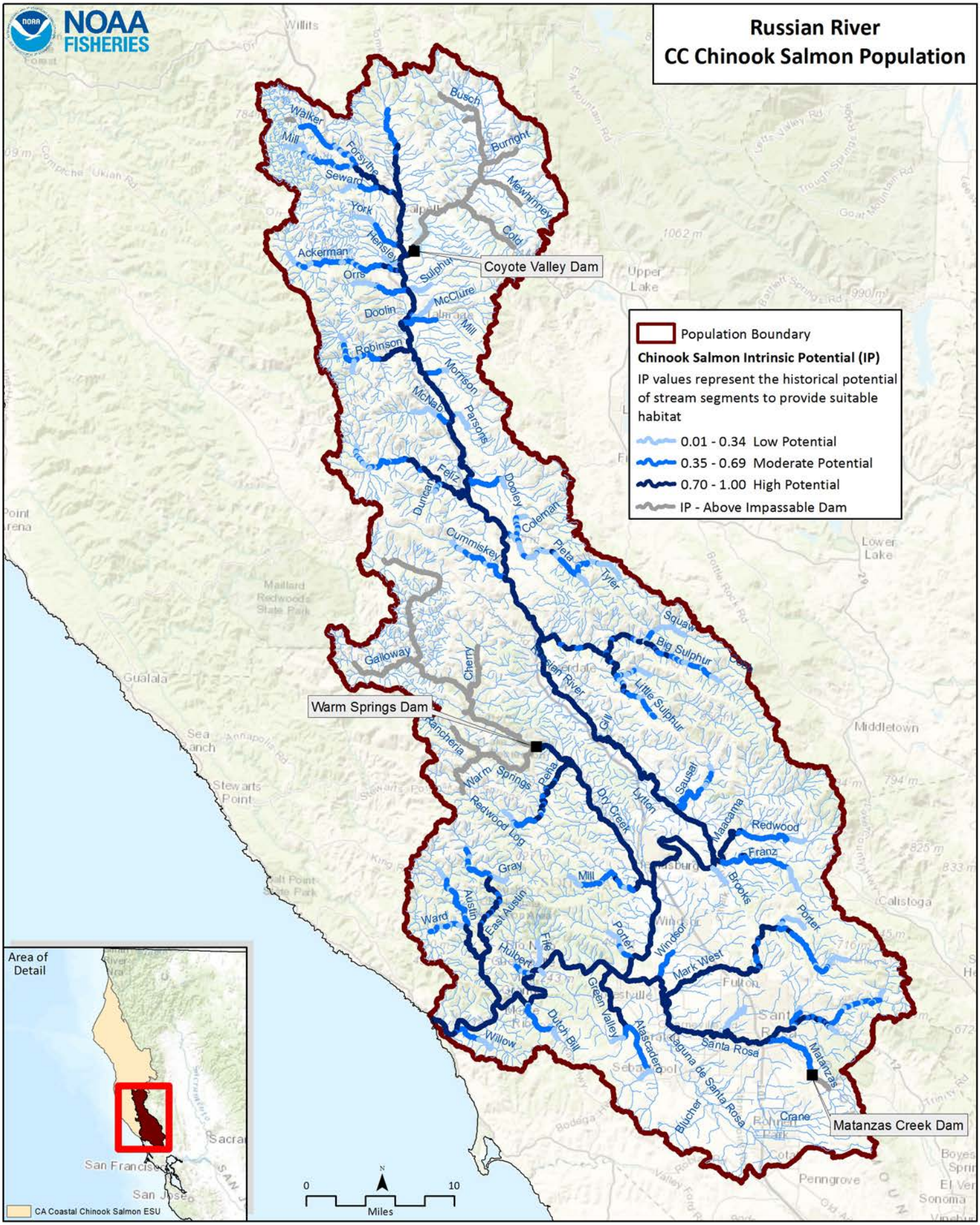
NOAA FISHERIES
Russian River
CC Chinook Salmon Population
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
IP - Above Impassable Dam
Coyote Valley Dam
Warm Springs Dam
Matanzas Creek Dam
Walker
Mill
Forsythe
Seward
York
Hensley
Ackerman
Orris
Sulphur
Busch
Burright
Mewhinney
Cold
McClure
Doolin
Mill
Robinson
Morrison
McNab
Parsons
Feliz
Duncan
Dooley
Coleman
Cummiskey
Peta
Tyler
Squaw
Big Sulphur
Little Sulphur
Galloway
Cherry
Russian River
Gill
Rancheria
Warm Springs
Pena
Dry Creek
Lytton
Sausal
Maacama
Redwood
Franz
Redwood
Log
Gray
Mill
Brooks
Porter
Ward
Austin
East Austin
Porter
Windsor
Mark West
Fife
Hulbert
Green Valley
Dutch Bill
Willow
Alascadero
Laguna de Santa Rosa
Santa Rosa
Matanzas
Blucher
Crane
Area of Detail
San Francisco
San Jose
CA Coastal Chinook Salmon ESU
0
10
Miles
N

CC Chinook Salmon Russian River CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Staging Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	50% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	29% streams/ 51% IP-km (>49% average primary pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-Km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	99.28 of IP-km	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	7% Class 5 & 6 across IP-km	Poor

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50 to 75% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<7 spawners per IP-Km	7-20 Spawners per IP-Km	20-40 Spawners per IP-Km (e.g., Low Risk Extinction Criteria)		7-20 spawners per IP-km: low risk spawner density per Spence (2008)	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	50-74% of Historical Range	Fair
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	Good
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	52% streams/ 35% IP-km (>50% stream average scores of 1 & 2)	Fair

3	Pre Smolt	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% average primary pool frequency)	50% to 74% of streams/ IP-Km (>49% average primary pool frequency)	75% to 89% of streams/ IP-Km (>49% average primary pool frequency)	>90% of streams/ IP-Km (>49% average primary pool frequency)	29% streams/ 51% IP-km (>49% average primary pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	33% streams/ 40% IP-km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	6% streams/ 7% IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	4.94 Diversions/10 IP-km	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km	Poor
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	7% Class 5 & 6 across IP-km	Poor

			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	52% streams/ 35% IP-km (>50% stream average scores of 1 & 2)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
		Size	Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	50-74% of Historical Range	Fair
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	6% streams/ 7% IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	4.94 Diversions/10 IP-km	Fair

			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-Km to 90% of IP-km	Good
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	52% streams/ 35% IP-km (>50% stream average scores of 1 & 2)	Fair
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	2.271% of Watershed in Impervious Surfaces	Good

			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	8.653% of Watershed in Agriculture	Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	Very Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	19% of Watershed >1 unit/20 acres	Fair
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	3 Miles/Square Mile	Fair
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	3 Miles/Square Mile	Poor

CC Chinook Salmon Russian River CAP Threat Results

Threats Across Targets		Adults	Eggs	Pre Smolt	Smolts	Watershed Processes	Overall Threat Rank
Project-specific-threats		1	2	3	5	6	
1	Agriculture	High	Low	Medium	Medium	Medium	Medium
2	Channel Modification	High	Medium	High	High	Medium	High
3	Disease, Predation and Competition	Low		Medium	Medium	Low	Medium
4	Fire, Fuel Management and Fire Suppression					Low	Low
5	Fishing and Collecting	Medium			Low		Medium
6	Hatcheries and Aquaculture						
7	Livestock Farming and Ranching	Low	Low	Medium	Low	Low	Low
8	Logging and Wood Harvesting	Low	Low	Medium	Low	Low	Low
9	Mining	Medium	Low	Medium	Medium	Medium	Medium
10	Recreational Areas and Activities					Low	Low
11	Residential and Commercial Development	High	Low	High	High	Medium	High
12	Roads and Railroads	Medium	Medium	High	High	Medium	High
13	Severe Weather Patterns	Medium	Low	Medium	Medium	Low	Medium
14	Water Diversion and Impoundments	Medium	Medium	Very High	Medium	Medium	High

Russian River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RR-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-1.1.1	Recovery Action	Estuary	Increase extent of estuarine habitat				
RR-CCCh-1.1.1.1	Action Step	Estuary	Develop and implement Estuary Protection and Enhancement projects to improve estuary function and habitat for juveniles and smolts.	2	5	California Coastal Conservancy, CDFW, MCRRFCD, Mendocino County, NMFS, NOAA NOS, NOAA RC, Private Landowners, Public Works, RWQCB, Sonoma County, Sonoma County Water Agency, State Parks, USACE	
RR-CCCh-1.1.1.2	Action Step	Estuary	Continue implementation of the Russian River estuary management program, as described within NMFS' Russian River Biological Opinion (NMFS 2008).	2	12	CDFW, MCRRFCD, Mendocino County, NMFS, Sonoma County Water Agency, USACE	
RR-CCCh-1.1.2	Recovery Action	Estuary	Improve estuarine water inflow				
RR-CCCh-1.1.2.1	Action Step	Estuary	Manage dam releases to minimize the influence on lagoon formation as described in the Russian River Biological Opinion (NMFS 2008).	2	12	CDFW, MCRRFCD, Mendocino County, NMFS, Sonoma County Water Agency, USACE	
RR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
RR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Reestablish the hydrologic connection between the stream channel and adjacent floodplain habitat.	2	25	CDFW, FEMA, Mendocino County, NMFS, Private Landowners, USACE	
RR-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Create flood refuge habitat, such as by: 1) hydrologically connecting floodplains with riparian forest; 2) removing or setting back levees; or 3) using the streamway concept where appropriate. Installing shelter components (LWD, boulders, etc.) appropriate to the channel type.	2	10	County Planning, FEMA, Private Landowners, USACE	
RR-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
RR-CCCh-5.1.1.1	Action Step	Passage	Barriers on mainstem Russian River (memorial beach and Willow Water District Dam) should be assessed by a fish passage specialist and modified if needed.	1	10	CDFW, Mendocino County, NMFS, Sonoma County	
RR-CCCh-5.1.1.2	Action Step	Passage	Barriers on Big Sulphur, Little Sulphur, Mill, Pena, Dry, and Santa Rosa Creeks should be assessed by a fish passage specialist and modified if needed.	1	10	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD	
RR-CCCh-5.1.1.3	Action Step	Passage	Evaluate railroad stream crossing on McNabb Creek.	1	2	CDFW, NMFS, NOAA RC	
RR-CCCh-5.1.1.4	Action Step	Passage	Modify railroad crossing as prescribed by evaluation to allow for fish passage at all lifestages	1	2	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD	
RR-CCCh-5.1.1.5	Action Step	Passage	Habitat potential, and a conceptual plan for passage above Lake Mendocino should be evaluated.	1	20	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, USACE	
RR-CCCh-5.1.2	Recovery Action	Passage	Rehabilitate and enhance passage into tributaries (aggradation/degradation)				
RR-CCCh-5.1.2.1	Action Step	Passage	Investigate the need for fish ladders and resting pools/cover for migrating fish within tributaries near and within the City of Ukiah (CDFG 2002).	1	2	CDFW, NMFS, NOAA RC	
RR-CCCh-5.1.2.2	Action Step	Passage	Pending investigation of the need for fish ladders and resting pools/cover for migrating fish within tributaries near and within the City of Ukiah, fund projects to add these structures where needed.	1	2	CDFW, Mendocino County, NMFS, Sonoma County, Water Agencies	
RR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD, and shelters				
RR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Complete habitat surveys within the West Fork Russian River watershed (CDFG 2002).	2	5	CDFW	
RR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Develop tributary pool and shelter projects with cooperative landowners to enhance presmolt and smolt survival	2	100	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD	
RR-CCCh-6.1.1.3	Action Step	Habitat Complexity	Encourage bio-engineering projects to address erosion issues on private lands.	2	3	CDFW, NOAA RC, NRCS, RCD	

Russian River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RR-CCCh-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary or staging pools				
RR-CCCh-6.1.2.1	Action Step	Habitat Complexity	Enhance east branch and mainstem migration and resting habitats with LWD, boulders, and other instream features to increase habitat complexity and improve staging pool frequency and depth.	2	10	CDFW, NMFS, NOAA RC, NRCS, RCD	
RR-CCCh-6.1.2.2	Action Step	Habitat Complexity	Improve instream habitat complexity such that target criteria for primary and staging pool depths and shelter value is achieved within mainstem and tributary habitats utilized by chinook. Priority streams would include Austin, Maacmama, Mark West, Santa Rosa, Ackerman, Feliz, Robinson, and Pieta Creeks, and the East and West Branches and upper Mainstem Russian River.	2	2	California Conservations Corps, CDFW, Private Landowners, Russian River Wild Steelhead Society, Trout Unlimited	
RR-CCCh-6.1.2.3	Action Step	Habitat Complexity	Maintain current LWD, boulders, and other structure-providing features which provide stream complexity, pool frequency, and depth when evaluating permits for stream or bank modification.	3	100	CDFW, NOAA RC, Private Consultants, Private Landowners	
RR-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-10.1.1	Recovery Action	Water Quality	Reduce turbidity and suspended sediment				
RR-CCCh-10.1.1.1	Action Step	Water Quality	Develop and fund a feasibility study to address the significant turbidity issues from Lake Mendocino outlet	1	10	USACE	
RR-CCCh-10.1.1.2	Action Step	Water Quality	Fund and implement recommendations from proposed feasibility study to address significant turbidity issues from the Lake Mendocino outlet	1	20	Mendocino County, USACE, Water Agencies	
RR-CCCh-10.1.1.3	Action Step	Water Quality	Research into the potential level of impacts from and solutions to environmental estrogens associated with wastewater discharge and domestic septic leakage are needed.	2	10	RWQCB, Cities, Water Agencies	
RR-CCCh-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity				
RR-CCCh-11.1.1.1	Action Step	Viability	Develop standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas.	3	20	CDFW, NMFS, NRCS, Private Consultants, Private Landowners, RCD	
RR-CCCh-11.1.1.2	Action Step	Viability	Measure or estimate the condition of key habitat attributes across the watershed.	2	20	CDFW, NMFS, NRCS, Private Consultants, Private Landowners, RCD	
RR-CCCh-11.1.1.3	Action Step	Viability	Utilize CDFW approved implementation, effectiveness, and validation monitoring protocols when assessing efficacy of restoration efforts.	2	100	CDFW, NOAA RC, NRCS, Private Consultants, Private Landowners, RCD	
RR-CCCh-11.1.1.4	Action Step	Viability	Continue funding Life Cycle Monitoring Station	1	10	CDFW, NMFS, Sonoma County Water Agency	
RR-CCCh-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-12.1.1	Recovery Action	Agriculture	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
RR-CCCh-12.1.1.1	Action Step	Agriculture	Solicit cooperation from NRCS, RCDs, Farm Bureau, and others to devise incentive programs and incentive-based approaches to encourage increased involvement and support existing landowners who conduct operations in a manner compatible with CCC steelhead and CC Chinook salmon recovery priorities.	3	10	CDFW, Farm Bureau, NMFS, NRCS, Private Landowners, RCD	
RR-CCCh-12.1.1.2	Action Step	Agriculture	Streamline permit processing where landowners are conducting actions aligned with recovery priorities.	3	5	CDFW, NMFS, NRCS, RCD, SWRCB, USACE	
RR-CCCh-12.1.2	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
RR-CCCh-12.1.2.1	Action Step	Agriculture	Support and implement Best Management Practices such as those in the Fish Friendly Farming program (California Land Stewardship Institute), or other cooperative conservation programs.	3	10	CDFW, Farm Bureau, NMFS, Private Landowners, RCD	
RR-CCCh-12.1.2.2	Action Step	Agriculture	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.	3	25	CalFire, CDFW, NMFS	
RR-CCCh-12.1.3	Recovery Action	Agriculture	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				

Russian River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RR-CCCh-12.1.3.1	Action Step	Agriculture	Encourage the NRCS, RCDs, and other appropriate organizations to increase the number of landowners participating in sediment reduction planning and implementation.	3	10	CDFW, NMFS, NRCS, Private Landowners, RCD	
RR-CCCh-12.1.3.2	Action Step	Agriculture	Complete Farm Conservation Plans (through the RCD, NRCS, Fish Friendly Farming program or other cooperative conservation programs) to address sediment source reduction, riparian habitat, forest health, and restoration.	3	10	CDFW, Farm Bureau, NMFS, NRCS, Private Landowners, RCD	
RR-CCCh-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to watershed hydrology				
RR-CCCh-13.1.1.1	Action Step	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.	2	100	CDFW, Mendocino County, NMFS, Private Consultants, Private Landowners, Sonoma County, Sonoma County Water Agency	
RR-CCCh-13.1.1.2	Action Step	Channel Modification	Discourage stabilization projects which will lead to additional instability either up- or downstream.	2	100	CDFW, Mendocino County, NMFS, Sonoma County, USACE	
RR-CCCh-13.1.1.3	Action Step	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel and use bioengineering techniques.	3	100	CDFW, Mendocino County, NMFS, NRCS, Private Landowners, RCD, Sonoma County, USACE	
RR-CCCh-13.2	**Objective**	**Channel Modification**	**Address the inadequacy of existing regulatory mechanisms**				
RR-CCCh-13.2.1	Recovery Action	Channel Modification	Prevent or minimize impairment to watershed hydrology				
RR-CCCh-13.2.1.1	Action Step	Channel Modification	Where new levees or similar flood control projects are planned, develop setbacks to allow the river to respond to natural hydrologic process and remain in equilibrium. At a minimum, setbacks should accommodate a 100 year event.	3	100	CDFW, Farm Bureau, Mendocino County, NMFS, Private Landowners, Sonoma County	
RR-CCCh-13.2.1.2	Action Step	Channel Modification	Flood control projects or other modifications facilitating new development (as opposed to protecting existing infrastructure) should be avoided.	3	100	CDFW, FEMA, Mendocino County, NMFS, Private Landowners, Sonoma County	
RR-CCCh-13.2.1.3	Action Step	Channel Modification	Modify Federal, State, city and county regulatory and planning processes to minimize to the extent feasible provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historic CCC steelhead and CC Chinook salmon watersheds.	3	10	CDFW, County of Mendocino, NMFS, Public, Sonoma County	
RR-CCCh-13.2.1.4	Action Step	Channel Modification	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	3	2	CDFW, NMFS	
RR-CCCh-13.2.2	Recovery Action	Channel Modification	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
RR-CCCh-13.2.2.1	Action Step	Channel Modification	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	1	100	CDFW, Land Trusts, Mendocino County, NMFS, NRCS, Private Landowners, RCD, Sonoma County, USACE	
RR-CCCh-13.2.2.2	Action Step	Channel Modification	Develop a mitigation policy that requires In-Kind replacement of removed large woody debris at a 3:1 ratio.	3	100	CDFW, NMFS, USACE	
RR-CCCh-13.2.3	Recovery Action	Channel Modification	Prevent or minimize adverse alterations to riparian species composition and structure				
RR-CCCh-13.2.3.1	Action Step	Channel Modification	All proposed levees should be designed to account for minimal maintenance associated with an intact and functioning riparian zone.	2	100	FEMA, Mendocino County, NMFS, Private Landowners, Sonoma County, USACE	
RR-CCCh-13.2.3.2	Action Step	Channel Modification	Counties and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	100	Mendocino County, Sonoma County	
RR-CCCh-16.1	**Objective**	**Fishing/Collecting**	**Address the inadequacy of existing regulatory mechanisms**				
RR-CCCh-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
RR-CCCh-16.1.1.1	Action Step	Fishing/Collecting	Work with CDFW to modify existing sport fishing regulations. Develop adequate low flow closures and angling season to minimize impacts to chinook salmon.	2	5	CDFW, NMFS, Public	

Russian River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RR-CCCh-16.1.1.2	Action Step	Fishing/Collecting	Increase enforcement and patrol during the steelhead and general fishing seasons in the upper and middle river area to reduce poaching and unintentional catch of Chinook salmon.	2	5	CDFW, NMFS, Public	
RR-CCCh-17.1	**Objective**	**Hatcheries**	**Address other natural or manmade factors affecting the species' continued existence**				
RR-CCCh-17.1.1	Recovery Action	Hatcheries	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
RR-CCCh-17.1.1.1	Action Step	Hatcheries	Evaluate hatchery utilization in the context of reaching recovery targets both within the Russian River and elsewhere within the Central Coast ESU, in terms of increasing abundance and spatial distribution of Russian River and CC Chinook salmon.	1	5	CDFW, NMFS, USACE	
RR-CCCh-17.1.1.2	Action Step	Hatcheries	If stocking is re-initiated, implement changes identified in Hatchery and Genetic Management Plans to improve genetic and rearing management	1	5	CDFW, NMFS, USACE	
RR-CCCh-17.1.1.3	Action Step	Hatcheries	If stocking is reinitiated, conduct or increase the proportion of releases from Coyote Valley Fish Facility to expand and increase the numbers of upper river spawners	1	20	CDFW, NMFS, USACE	
RR-CCCh-17.1.1.4	Action Step	Hatcheries	Evaluate the need for revising release numbers, release sizes, release locations and strategies in the context of meeting recovery goals and mitigation requirements of both Russian River Hatcheries (DCFH and CVFF). Update and revise the HGMP according to proposed changes and recommendations	1	5	CDFW, NMFS, USACE	
RR-CCCh-17.1.1.5	Action Step	Hatcheries	Manage Russian River Hatcheries following a Hatchery and Genetic Management Plan (HGMP) which is regularly updated to include adaptive management strategies and recommendations.	1	5	CDFW, NMFS, USACE	
RR-CCCh-20.1	**Objective**	**Mining**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-20.1.1	Recovery Action	Mining	Prevent or minimize impairment to instream habitat complexity (altered pool complexity and/or pool riffle ratio)				
RR-CCCh-20.1.1.1	Action Step	Mining	Continue to implement and support BMP's which improve, maintain or prevent impacts to habitat complexity when reviewing new mining plans.	2	5	CDFW, Counties, NMFS, Private Landowners, USACE	
RR-CCCh-20.1.1.2	Action Step	Mining	Develop and enhance staging pool habitats and thalweg depth where geomorphic conditions dictate and allow	2	10	CDFW, Counties, NMFS, Private Landowners, USACE	
RR-CCCh-20.1.1.3	Action Step	Mining	Remove dikes/levees separating river channel from available areas of off-channel habitat restoration in former terrace gravel mining pit locations.	2	10	CDFW, Counties, NMFS, Private Landowners, USACE	
RR-CCCh-20.1.2	Recovery Action	Mining	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
RR-CCCh-20.1.2.1	Action Step	Mining	Retain LWD, boulders and vegetation on riffles where structure is beneficial to migration and resting cover	2	20	CDFW, Counties, NMFS, Private Landowners, USACE	
RR-CCCh-20.1.2.2	Action Step	Mining	Develop and enhance offchannel habitats such as alcoves, seasonal wetlands, ponds and secondary channels to promote presmolt rearing habitat	2	20	CDFW, Counties, NMFS, Private Landowners, USACE	
RR-CCCh-22.1	**Objective**	**Residential/ Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-22.1.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
RR-CCCh-22.1.1.1	Action Step	Residential/ Commercial Development	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.	3	10	CDFW, Cities, Counties, NMFS, Private Landowners, Water Agencies	
RR-CCCh-22.1.1.2	Action Step	Residential/ Commercial Development	Educate county and city public works departments, flood control districts, and planning departments, etc., on the critical importance of maintaining riparian vegetation, instream LWD, and LWD recruitment.	3	20	CDFW, Cities, Counties, NMFS	
RR-CCCh-22.1.1.3	Action Step	Residential/ Commercial Development	Design and implement education programs to promote public awareness of salmon and steelhead habitat within urban creek settings.	3	5	CDFW, Cities, Counties, NMFS, Public	
RR-CCCh-22.1.1.4	Action Step	Residential/ Commercial Development	Assess efficacy and necessity of ongoing stream maintenance practices and evaluate, avoid, minimize and/or mitigate their impacts to rearing and migrating steelhead and Chinook salmon.	2	5	CDFW, Cities, Counties, NMFS, NOAA RC, Water Agencies	
RR-CCCh-22.1.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize increased landscape disturbance				

Russian River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RR-CCCh-22.1.2.1	Action Step	Residential/ Commercial Development	As mitigation for hydrograph consequences, municipalities and counties should investigate funding of larger detention devices in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.	3	5	CDFW, Cities, Counties, NMFS	
RR-CCCh-22.1.2.2	Action Step	Residential/ Commercial Development	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, and use streamway concept where appropriate.	2	25	CDFW, Cities, Counties, NMFS, Private Landowners	
RR-CCCh-22.1.2.3	Action Step	Residential/ Commercial Development	Where existing infrastructure exists within historical floodplains or offchannel habitats in any historical steelhead or chinook watersheds, and restoration is found feasible, encourage willing landowners to restore these areas through conservation easements, etc.	3	25	CDFW, Counties, Land Trusts, NMFS, Private Landowners	
RR-CCCh-22.1.2.4	Action Step	Residential/ Commercial Development	Purchase conservation easements from landowners that currently have grazing or agricultural operations along the estuary.	2	10	California Coastal Conservancy, CDFW, Counties, NMFS, Private Landowners, RCD	
RR-CCCh-22.1.2.5	Action Step	Residential/ Commercial Development	Identify areas at high risk of conversion, and develop incentives and alternatives for landowners that discourage conversion.	3	25	CDFW, Counties, NMFS, Private Landowners, RCD	
RR-CCCh-22.1.2.6	Action Step	Residential/ Commercial Development	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC steelhead or CC Chinook salmon watercourse.	3	100	CDFW, Cities, Counties, NMFS	
RR-CCCh-22.1.2.7	Action Step	Residential/ Commercial Development	Counties and municipalities should adopt a policy of “managed retreat” (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	50	CDFW, Cities, Counties, NMFS	
RR-CCCh-22.1.2.8	Action Step	Residential/ Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential in undeveloped areas.	3	100	CDFW, Cities, Counties, NMFS	
RR-CCCh-22.1.3	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
RR-CCCh-22.1.3.1	Action Step	Residential/ Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges, which can result in locally severe erosion and disruption of riparian vegetation and instream habitat.	2	100	Cities, Counties	
RR-CCCh-22.2	**Objective**	**Residential/ Commercial Development**	**Address the inadequacy of existing regulatory mechanisms**				
RR-CCCh-22.2.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
RR-CCCh-22.2.1.1	Action Step	Residential/ Commercial Development	Implement performance standards in Stormwater Management Plans.	3	100	Mendocino County, Private Landowners, Sonoma County	
RR-CCCh-22.2.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
RR-CCCh-22.2.2.1	Action Step	Residential/ Commercial Development	Avoid, or minimize the use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.	2	100	Cities, Mendocino County, Sonoma County	
RR-CCCh-22.2.2.2	Action Step	Residential/ Commercial Development	Toxic waste products from urban activities should receive the appropriate treatment before being discharged into any body of water that may enter any steelhead or Chinook salmon waters.	2	100	Cities, Counties, Public	
RR-CCCh-22.2.3	Recovery Action	Residential/ Commercial Development	Prevent or minimize increased landscape disturbance				
RR-CCCh-22.2.3.1	Action Step	Residential/ Commercial Development	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	25	CDFW, Farm Bureau, Land Trusts, NMFS, NRCS, RCD, Sonoma County	
RR-CCCh-22.2.3.2	Action Step	Residential/ Commercial Development	Discourage Sonoma County from rezoning forestlands to rural residential or other land uses.	3	20	CDFW, NMFS, Sonoma County	

Russian River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RR-CCCh-22.2.3.3	Action Step	Residential/ Commercial Development	Enforce existing building permit programs to minimize unpermitted construction.	3	100	CDFW, Cities, Counties	
RR-CCCh-22.2.3.4	Action Step	Residential/ Commercial Development	Develop legislation that will fund county planning for environmentally sound growth and water supply and work in coordination with California Dept. of Housing, Association of Bay Area Governments and other government associations (CDFG 2004).	3	10	CDFW, Cities, Counties, NMFS, Private Landowners, Public	
RR-CCCh-22.2.3.5	Action Step	Residential/ Commercial Development	Modify County General Plan to eliminate provisions allowing new construction in undeveloped areas within the 100-year flood prone zones in all historic CCC steelhead and CC Chinook salmon watersheds.	3	5	CDFW, NMFS, Sonoma County	
RR-CCCh-22.2.3.6	Action Step	Residential/ Commercial Development	Work with Mendocino County to develop more protective regulations in regard to exurban development (vineyard and rural residential).	3	10	CDFW, NMFS, RWQCB, SWRCB	
RR-CCCh-22.2.3.7	Action Step	Residential/ Commercial Development	Encourage Sonoma and Mendocino County to develop and implement ordinances (e.g., Santa Cruz) to restrict subdivisions by requiring a minimum acreage limit for parcelization and in concert with limits on water supply and groundwater recharge areas.	3	5	CDFW, Mendocino County, NMFS, Sonoma County	
RR-CCCh-24.1	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species continued existence**				
RR-CCCh-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
RR-CCCh-24.1.1.1	Action Step	Severe Weather Patterns	Establish an emergency drought operations center (EDOC), (e.g., Washington Department of Fish and Wildlife, 2001), comprised of the SWRCB, CDFW, NMFS, and others to develop emergency rules for augmenting water supplies and mitigating the effects of drought on fish.	2	100	CDFW, NMFS, Sonoma County Water Agency, SWRCB	
RR-CCCh-24.1.1.2	Action Step	Severe Weather Patterns	Work with water managers on regulated streams to assure adequate and proper consideration is given to fish needs. Develop agreements that will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.	2	20	CDFW, NMFS, Private Landowners, SWRCB	
RR-CCCh-24.1.1.3	Action Step	Severe Weather Patterns	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.	2	100	CDFW, NMFS, Private Landowners, SWRCB, Water Agencies	
RR-CCCh-24.1.1.4	Action Step	Severe Weather Patterns	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.	2	100	CDFW, NMFS, Private Landowners, SWRCB, USACE, Water Agencies	
RR-CCCh-24.1.1.5	Action Step	Severe Weather Patterns	Manage reservoirs and dam releases to maintain suitable rearing temperatures and migratory flows in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration).	2	100	CDFW, NMFS, Private Landowners, SWRCB, Water Agencies	
RR-CCCh-24.1.1.6	Action Step	Severe Weather Patterns	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	2	10	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	
RR-CCCh-25.1	**Objective**	**Water Diversion/Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RR-CCCh-25.1.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
RR-CCCh-25.1.1.1	Action Step	Water Diversion/ Impoundment	Implement changes to minimum flow requirements permitted by SWRCB Decision 1610 as specified within the Russian River Biological Opinion (NMFS 2008).	1	15	CDFW, MCRRFCD, Mendocino County, NMFS, Sonoma County Water Agency	
RR-CCCh-25.1.1.2	Action Step	Water Diversion/ Impoundment	Support current efforts to balance and sustain fisheries flows while maximizing reservoir capture of watershed runoff. These efforts involving forecast-based reservoir operations for flood control and conservation, modeling watershed runoff, and improvement of atmospheric rainfall and river forecasts to identify opportunistic periods for diversion and bypass should be supported.	1	5	CDFW, MCRRFCD, NMFS, NOAA NWS, Private Landowners, Sonoma County Water Agency, SWRCB, USACE	
RR-CCCh-25.1.1.3	Action Step	Water Diversion/ Impoundment	Promote the use of reclaimed water for agricultural or other uses.	2	5	CDFW, Farm Bureau, Mendocino County, NMFS, RWQCB	

Russian River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RR-CCCh-25.1.1.4	Action Step	Water Diversion/ Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	2	5	CDFW, Farm Bureau, Mendocino County, NMFS, Private Landowners	
RR-CCCh-25.1.2	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to estuary (impaired quality and extent)				
RR-CCCh-25.1.2.1	Action Step	Water Diversion/ Impoundment	Manage dam releases to minimize the influence on lagoon formation as described in the Russian River Biological Opinion (NMFS 2008).	2	5	CDFW, NMFS, USACE, Water Agencies	
RR-CCCh-25.1.2.2	Action Step	Water Diversion/ Impoundment	Landowners along Upper mainstem and East Fork Russian River should coordinate water withdrawals with SCWA and the MCRRFC & WCID, in the interest of providing reliable releases from Lake Mendocino, and managing spring flow releases in support of efforts to maintain a freshwater lagoon in the estuary.	1	5	CDFW, MCRRFCD, NMFS, Sonoma County Water Agency, SWRCB	
RR-CCCh-25.1.2.3	Action Step	Water Diversion/ Impoundment	Landowners along Dry Creek should coordinate water withdrawals with SCWA, in the interest of providing reliable releases from Lake Sonoma, and managing spring flow releases in support of efforts to maintain a freshwater lagoon in the estuary.	1	10	CDFW, NMFS, Sonoma County Water Agency, SWRCB	
RR-CCCh-25.1.3	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to passage and migration				
RR-CCCh-25.1.3.1	Action Step	Water Diversion/ Impoundment	Implement instream habitat restoration along six miles of mainstem Dry Creek as specified within the Russian River Biological Opinion (NMFS 2008).	2	10	CDFW, NMFS, Sonoma County Water Agency, USACE	
RR-CCCh-25.1.3.2	Action Step	Water Diversion/ Impoundment	Work with project proponents and landowners to implement instream habitat enhancement work along Dry Creek in addition to the 6 miles required by the NMFS 2008 Biological opinion, utilizing the Current Conditions Inventory and Conceptual Design work by Interfluve.	2	25	CDFW, MCRRFCD, NMFS, NRCS, Private Landowners, RCD, Sonoma County	
RR-CCCh-25.1.3.3	Action Step	Water Diversion/ Impoundment	Continue to support the Safe Harbor Agreements for Dry Creek landowners participating in habitat enhancement along Dry Creek.	3	5	NMFS, Private Landowners, Sonoma County Water Agency	
RR-CCCh-25.1.4	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
RR-CCCh-25.1.4.1	Action Step	Water Diversion/ Impoundment	Ramp all reservoir releases (flood maintenance releases, fisheries passage releases, summer baseflow, and other planned releases) as necessary to minimize deleterious effects of flow increases/decreases.	1	5	CDFW, NMFS, USACE, Water Agencies	
RR-CCCh-25.2	**Objective**	**Water Diversion/ Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
RR-CCCh-25.2.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
RR-CCCh-25.2.1.1	Action Step	Water Diversion/ Impoundment	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and California Water Code §1707 (CDFG 2004).	2	25	CDFW, NMFS, SWRCB	
RR-CCCh-25.2.1.2	Action Step	Water Diversion/ Impoundment	Support efforts to provide improved localized weather prediction capabilities in support of finer scale frost protection capabilities for the benefit of grape growers and fisheries flows.	2	5	CDFW, County Planning, Farm Bureau, NMFS, NOAA NWS, NOAA RC, NRCS, Private Landowners, RCD, Water Agencies	
RR-CCCh-25.2.1.3	Action Step	Water Diversion/ Impoundment	To resolve frost protection/fisheries conflicts over spring baseflows evaluate alternatives such as: develop information about prioritizing tributaries and locations for offstream storage; develop criteria for sizing offstream storage; develop criteria making compensatory releases from large dams; provide policy and funding for the above actions to maximize benefits for fisheries and agriculture.	2	5	CDFW, County Planning, Farm Bureau, NMFS, NOAA NWS, NOAA RC, NRCS, Private Landowners, RCD, Water Agencies	

Russian River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RR-CCCh-25.2.1.4	Action Step	Water Diversion/ Impoundment	Develop and apply a distributed hydrologic water budget model to characterize surface stream flows within Russian River tributaries, to allow for comparisons between impaired and unimpaired conditions, with an emphasis on summer base flow conditions relative to rearing juvenile salmonids. These data will reduce uncertainty, provide greater temporal and spatial focus on impaired reaches and greater certainty for reaches that have water available for consumptive uses and be useful as a decision-support tool for other programs.	2	5	CDFW, County Planning, Farm Bureau, MCRRFCD, NMFS, NOAA NWS, NOAA RC, NRCS, Private Landowners, RCD	
RR-CCCh-25.2.1.5	Action Step	Water Diversion/ Impoundment	Request that SWRCB review and/or modify water use based on the needs of Chinook salmon/steelhead and authorized diverters (CDFG 2004).	3	5	CDFW, NMFS, SWRCB	
RR-CCCh-25.2.1.6	Action Step	Water Diversion/ Impoundment	Avoid and/or minimize the adverse effects of water diversion on salmonid habitat by establishing a more natural hydrograph, by-passing adequate downstream flows, regulating season of diversion, and promoting and implementing off-stream storage solutions (CDFG 2004).	3	25	CDFW, Mendocino County, NMFS, Sonoma County	
RR-CCCh-25.2.1.7	Action Step	Water Diversion/ Impoundment	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	3	5	CDFW, NMFS, SWRCB	
RR-CCCh-25.2.1.8	Action Step	Water Diversion/ Impoundment	Evaluate requests for on-stream dams above migratory reaches for effects on the natural hydrograph and spawning gravel recruitment downstream (CDFG 2004).	3	100	CDFW, NMFS, SWRCB	
RR-CCCh-25.2.1.9	Action Step	Water Diversion/ Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	100	CDFW, CDFW Law Enforcement, Mendocino County, NMFS, NMFS OLE, Sonoma County	
RR-CCCh-25.2.1.10	Action Step	Water Diversion/ Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of salmon and their habitats, and avoidance of adverse impacts caused by water diversion (CDFG 2004).	3	5	CDFW, MCRRFCD, NMFS, Private Landowners, Public, Sonoma County Water Agency, SWRCB	
RR-CCCh-25.2.1.11	Action Step	Water Diversion/ Impoundment	Support the Development and implementation of groundwater use regulations.	3	25	CDFW, Mendocino County, NMFS, Sonoma County, SWRCB	

CC Chinook Salmon ESU Rapid Assessment Profile: Central Coastal Diversity Stratum Populations

Navarro River

- Role within ESU: Functionally Independent Population
- Spawner Abundance Target: 787-1,576 adults
- Current Intrinsic Potential: 131.5 IP-km

Gualala River

- Role within DPS: Independent Population
- Spawner Abundance Target: 1,052-2,105 adults
- Current Intrinsic Potential: 175.6 IP-km

For information regarding NC steelhead and CCC coho salmon for this watershed, please see the NC steelhead volume of this recovery plan and the CCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

The status of Chinook salmon in the Navarro and Gualala Rivers and populations that make up the Central Coastal diversity stratum are highly uncertain (Spence *et al.* 2008). The only known observation of Chinook salmon in the Navarro was made by a CDFW biologist during carcass surveys on the North Fork Navarro where one adult fish was found (S. Harris, CDFW personal communication, as cited in Spence *et al.* 2008). There are no recent accounts of Chinook salmon in the Gualala River (Spence *et al*. 2008).

History of Land Use, Land Management and Current Resources

<u>Navarro River</u>

The present-day Navarro River watershed is in multiple land use with timber harvest, agriculture (largely vineyards), and grazing as the principal uses. Historically, timber harvest was the primary land use, with harvest activities beginning in the mid-1800s and a second logging boom occurring from the 1930s to the early 1950s. Industrial and private timberlands have been harvested consistently since the 1950s, with a spike from the late 1980s to about 1998. Agricultural and grazing development began as early as the 1850s in Anderson Valley, with apple production and sheep grazing in the watershed. Italian immigrants built the first commercial winery in the valley during the early 1910s, but viticulture did not expand until the late 1970s. Current wine grape production in the Anderson Valley has increased to approximately 3,000 acres, or about 2

percent of the watershed area (NMFS GIS, CDFF FRAP GIS). The current population is approximately 3,500 people, which is largely centered around the town of Boonville in Anderson Valley. Highway 128 spans the length of the watershed, eventually meeting Highway 1 at the Navarro River estuary.

Past timber harvest, agricultural, and grazing impacts have resulted in the establishment of a TMDL for impaired temperature and sediment conditions by the EPA in 2000. Water diversion is an issue in this basin due to agricultural diversions; the CSWRCB (1998) concluded the Navarro be listed as fully appropriated between April 1 and December 14. The SWRCB DWR subsequently formally recognized the Navarro as fully allocated during the summer.

The Navarro River watershed is predominately in private ownership, with forestland as the major land use (70 percent of watershed area). Rangeland makes up 25 percent of the current land use, agriculture about 2 percent, and a small percentage in rural residential development. There are also state parks, which include Hendy Woods, Paul M. Demmick, and Navarro River Redwoods State Park. The Navarro River Redwoods State Park stretches along an 11-mile corridor of the mainstem Navarro River from the North Fork to the estuary.

The Anderson Valley Land Trust, Mendocino County Water Agency, and the California State Coastal Conservancy jointly sponsored a Navarro Watershed Restoration Plan, focusing on restoration opportunities related to sediment and temperature, and their impacts on salmonid species in the watershed.

Gualala River

The first documented accounts of logging of old growth redwoods date back to 1862 in lower portions of the watershed (Klamt *et al.* 2003). By 1965, aerial photos of the watershed show large areas denuded of trees and scarred by roads and skid trails. Logging and clearing of dense conifer and woodland areas was frequently followed by prolonged cattle grazing. Following slowed periods of logging in the 1970 and 1980, timber harvest activity again increased in the 1990s. During the 1990s, smaller but numerous clear-cut blocks appeared in the redwood lowland areas under Gualala Redwoods, Inc. ownership (Klamt *et al.* 2003). There is also a history of instream gravel mining that has been conducted in the South and Wheatfield Forks of the Gualala River.

Currently, greater than 99 percent of the Gualala River watershed is privately owned. Of that, approximately 34 percent is owned by four timber companies: The Conservation Fund, Gualala Redwoods, Soper Wheeler Company, and Mendocino Redwood Company. Over the past 20 years, 54 percent of the watershed has been under a Timber Harvest Plan. As such timber production remains the primary land use in the Gualala River watershed today, along with

grazing and rural residential development (USEPA 2001). Vineyards are also present within the watershed, and more recently, large forestland-to-vineyard land conversions have been proposed. Instream gravel mining is also conducted in the watershed.

A TMDL aimed at addressing sediment impairments, water temperatures, and water quality was developed by the USEPA in 2001 and adopted by the North Coast Regional Water Quality Control Board in 2004. Other stakeholders within the watershed include the Gualala River Watershed Council and Friends of the Gualala River, who are both very active in grassroots watershed protection. These grass-root groups are successful in working with landowners in reducing excessive fine sediment into adjacent waterways, placing LWD instreams, and conducting natural resource-type research in many areas of the Gualala River watershed. In 2003, the North Coast Watershed Assessment Program completed the Gualala River Watershed Assessment. The following pertinent documents are available for the Gualala River watershed:

- Draft North Fork Gualala River Reconnaissance Assessment and Study Plan (Stillwater Sciences 2012);
- Gualala Estuary and Lower River Enhancement Plan: Results of 2002 and 2003 Physical and Biological Surveys (ECORP and Kamman Hydrology & Engineering 2005);
- North Coast Watershed Assessment Program (Bleier *et al.* 2003);
- Gualala River Watershed Technical Support Document For Sediment (CRWQCB 2001) ;
- Gualala River Total Maximum Daily Load (USEPA, 2001); and
- Preservation Ranch Limiting Factors Analysis. Final Report (Stillwater Sciences 2008).

Diversity Stratum Population and Habitat Conditions

Poor Conditions are current impairments resulting directly or indirectly from human activities, and are expected to continue until restored and/or the threat acting on the condition is abated. The majority of conditions evaluated for the two watersheds rated as Good or Fair for most lifestages. Overall, the Navarro and Gualala watersheds are subject to fewer stresses than many other watersheds.

The following discussion focuses on those conditions that rate as Poor or Fair for the Chinook salmon life history stages (see "Central Coastal Diversity Stratum" Rapid Assessment). These were: Estuary: Quality & Extent; Hydrology: Redd Scour; Habitat Complexity: Percent Primary Pools and Pool/Riffle Ratios; Habitat Complexity: Large Wood and Shelter; Sediment: Gravel Quality and Distribution of Spawning Gravels and Viability: Density, Abundance & Spatial Structure. Recovery strategies will focus on improving these conditions as well as those needed to ensure population viability and functioning watershed processes.

Estuary: Quality and Extent

Estuary conditions are rated as Fair for adults, due in large part to the altered conditions of the estuary and generally unsuitable summer rearing conditions due to poor water quality.

Navarro

The Navarro river estuary is impaired due to poor water quality. The reduction in poor water quality is likely caused from reduced freshwater inflow to the estuary/lagoon in the summer and fall months. Cannata (1998) reports that maintaining adequate freshwater inflow to the lagoon is a critical component in maintaining water quality within the Navarro River estuary. The USEPA (1999) reports data records from the Division of Water Rights (DWR) that show permitted summer diversions from the Navarro mainstem are approximately 9.0 cubic feet per second. Given the analysis of Jackson (1991) illustrating a trend of lower summer flows on the mainstem just above the estuary, it appears that water diversions occurring in throughout the basin are reducing the quality of habitat in the estuary. During drier water years this impact is much more evident than in water years with higher runoff.

Gualala

How much of the historic extent of the estuary has been lost or filled due to excessive sediments loads resulting from past and current logging and agricultural activities is unclear. Designing and implementing habitat complexity features (*e.g.*, LWD, boulder, *etc.*) that encourage deeper pools and provide shelter may significantly improve the estuary.

Hydrology: Redd Scour

Redd scour was rated as Fair and has moderate effects to all lifestages, primarily due to impaired instream sediment conditions from ongoing timber and agricultural activities in these watersheds.

Habitat Complexity: Percent Primary/Staging Pools & Pool/Riffle/Flatwater Ratios

This condition was rated as Fair for adults, pre-smolts and smolts primarily due to impaired sediment conditions from ongoing timber and agricultural activities in these watersheds.

Habitat Complexity: Large Wood and Shelter

Lack of habitat complexity in the form of wood and high levels of instream sediment resulted in a Fair rating and is having a moderate adverse effect on the adult, pre-smolt and smolt lifestages. Lack of instream complexity is likely the result of long term land uses related to timber harvest, agriculture and vineyard development in the two watersheds, particularly impacts associated with mechanized logging practices prior to the California Forest Practice Rules and removal of wood during the 1960s-1980s.

Navarro

Data from CDFW habitat inventories indicate shelter ratings throughout the Navarro River watershed are poor within 90 percent of all sampled reaches. Poor to Fair LWD ratings were also documented during habitat surveys, which are due largely to a lack of functional riparian corridors and poor recruitment of large conifer species from adjacent upslope areas. The general lack of wood within the Navarro River watershed is from timber harvesting, and stream cleaning efforts that occurred in the 1970s through the 1980s. The multiple timber harvesting regimes since the 1850s have shifted forest size, and to some extent the composition, of riparian forest from historical conifer/redwood stands characteristic of late seral forests to smaller conifer and hardwood dominated stands that have been maintained due to the Forest Practices Act of 1973. This shift in forest-type has resulted in lower wood volumes available for recruitment into the streams. Reduced shelter ratings across the basin reduce habitat suitability for juvenile rearing during critical low-flow summer periods and high-flow conditions in the winter.

Gualala

CDFW habitat surveys conducted in 2002 and 2004 indicated lacking pool shelter, habitat complexity, and less than desirable riffle/pool/flatwater ratios in many tributaries. Habitat complexity has been lost in many streams due to poor abundance of channel forming features (*e.g.,* LWD, boulders, *etc*.), channel simplification, and sediment aggradation, which are all associated with past logging and wood harvest activities. In addition, riparian zones degraded by past logging have severely limited the natural recruitment of LWD in many historically productive streams within watershed, limiting the quality of juvenile rearing habitat in many areas of the watershed. Gualala Redwoods, Inc. and their partners have embarked on many instream large wood placement projects, which have improved habitat complexity in some areas. However, many other stream reaches will require similar supplementation of LWD, boulders and other channel forming features to encourage more desirable pool/riffle ratios (including primary pools) and increase pool shelter ratings. Rehabilitating these streams will greatly improve the quality of available spawning and seasonal rearing habitat potential for Chinook.

Sediment: Gravel Quality and Distribution of Spawning Gravels

Gravel quality was rated as Fair for the egg lifestage due to lack of wood and impaired gravel quality.

Viability: Density, Abundance and Spatial Structure

Viability: Density, Abundance and Spatial Structure is rated as Poor. Chinook populations are believed to be extirpated in both watersheds.

Threats

The following discussion focuses on those threats that rate as Fair (see "Central Coastal Diversity Stratum" Rapid Assessment). Recovery strategies focus on ameliorating primary threats; however, some strategies may address other threat categories when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in "Central Coastal Diversity Stratum" Rapid Assessment.

Logging and Wood Harvesting

Logging and Wood Harvesting was rated as a low future threat. However, early logging activities left a legacy of impacts, some of which persist today (Klamt *et al.* 2003). Splash dams and log drives tended to flatten and simplify stream channels. Watercourses were frequently used as skid paths to move logs downslope including the use of splash dams (Klamt *et al.* 2003). More recent data (CRWQCB 2001) showed that timber harvest rates between 1991 and 2001 were Very High (>30-percent of a watershed area in less than 10-years) in some areas of the Gualala River watershed. Other reports indicate that 50 percent of the combined area of Annapolis, Little and Grasshopper creeks was disturbed by timber harvest between 1991 and 2008 (Higgins 2009). Past and present impacts associated with logging include: reduced canopy cover resulting in increased stream water temperatures, increased sediment load into adjacent waterways impairing gravel quality in downstream reaches, and significant loss of LWD recruitment, which is an essential component of habitat complexity, form and function. Although logging has improved compared to historical practices, habitat degradation from past logging and potential impacts associated with future logging will continue to threaten the recovery of Chinook and their habitat.

Severe Weather Patterns

This threat is rated as Good or Fair to ten conditions. Because of the potential for severe weather to affect flows, it is rated as Poor and considered a major threat to Hydrology: Baseflow and Passage Flows. The impacts of a severe drought (in conjunction with ongoing diversions in the Albion River of surface flows) could adversely affect the summer rearing lifestage of Chinook in the watershed, particularly during the summer months.

Water Diversion and Impoundments

<u>Navarro River</u>

The vast majority of water diversions and impoundments in this basin are associated with the relatively (1980s) recent increase in viticulture in the Anderson Valley and other non-timber areas of the basin. Agriculture is focused mainly within the southern portion of the basin, affecting the mainstem Navarro River and smaller mainstem tributaries, as well as Indian, Anderson, and Rancheria creeks. Water diversions supporting viticulture and rural residential homes in these

areas reduce summer baseflows, disconnecting aquatic habitat and elevating instream temperatures (USEPA 2000). Many stream reaches in the Anderson Valley have reportedly gone dry with increasing frequency. As stated earlier, the Navarro River watershed has been listed as fully appropriated during the summer months. Therefore, any future diversions will likely be illegal if conducted in the summer months, and, as a result, any additional water diversions are expected to be sought during the winter and spring months. However, uncoordinated diversion practices designed to limit frost damage may increase stranding potential in some tributaries. In addition, rearing habitat in the estuary/lagoon will likely be further impaired, as rural residential and illegal summer diversions withdraw in excess of the estimated 9 cfs currently diverted.

Gualala River

Currently, there are no large long standing dams within the Gualala River watershed. Based on existing water rights, land use data, and observations reported by CDFW during instream field surveys conducted in 2001, water diversions within the watershed do not appear to significantly affect streamflows. However, most active diversions within the watershed are not monitored and the resulting impacts on streamflow have not been evaluated or recorded (Klamt *et al.* 2003). DeHaven (2008; 2010) reported severe dewatering in some years within the Wheatfield Fork sub-basin and near its confluence with the SF Gualala River. It is likely that current low-flow constraints in the Gualala River will prohibit future California State Water Resources Control Board appropriative water allocations; however, higher use of current water rights allocated to Sea Ranch and the North Gualala Water Company are expected in the future (NCWAP 2003). The North Fork Gualala River has been identified as an important source of baseflow to the lower Gualala River and estuary during late season periods (ECORP and Kamman Hydrology & Engineering 2005).

The current quality and extent of the estuary for seasonal (March 15 to November 15) juvenile Chinook rearing is controlled by hydrologic and water quality characteristics. Increases in water diversions have the potential to not only adversely affect the timing, but also reduce the magnitude of freshwater flow entering the estuary and thus having a significant impact on the health and ecology in the estuary. Therefore, further reductions in flow during the spring and summer, caused by water diversions and impoundments, pose a significant threat for not only salmonids rearing in sub-basins within the watershed (Klamt 2003), but also for juvenile rearing within the estuary (ECORP and Kamman Hydrology & Engineering 2005).

Fishing and Collecting

Current low flow regulations are based on the Russian River Hacienda stream gage. Unlike the Gualala and Navarro Rivers, the Russian River has two large reservoirs that regulate streamflows, and is operated for flood control during the wet months. These regulated operations often slow

descending hydrologic conditions, resulting in higher prolonged and sustained streamflows. These conditions do not accurately reflect unregulated hydrologic conditions of the Gualala and Navarro River. Adopting a more appropriate low flow fishing closure that protects all salmonids and better reflects hydrologic conditions in theses watersheds is needed.

Limiting Conditions, Lifestages, and Habitats

Each lifestage for Chinook is being limited by current conditions and future threats. The greatest threats appear to be future residential and commercial development, roads, severe weather and water diversions associated with agricultural, development and vineyard activities.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating conditions and threats identified rate as Poor or Fair, as discussed above, although strategies that address other factors may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. The general recovery strategies for the populations in these watersheds are discussed below.

Improve Canopy Cover and LWD Volume

These watersheds would benefit from improved riparian composition and structure, which would increase stream shading, improve LWD recruitment, and increase instream shelter for juvenile fish. General practices to improve riparian condition include increasing the number of riparian conservation easements, reducing timber harvest in riparian areas, increased riparian planting, and installing livestock exclusion fencing where appropriate.

Address Upslope Sediment Sources

Roads supporting timber harvest, ranching, and to a lesser extent agriculture, exist throughout the basin. Many of these roads need to be upgraded to reduce fine sediment delivery into streams. Problem roads and active erosion sites should be prioritized and addressed as part of comprehensive sediment reduction plans at the subbasin level. Agricultural operations need to practice BMPs that minimize soil disturbance and sediment delivery to stream channels.

Increase Instream Shelter Ratings and Pool Volume

Shelter ratings are Low for many stream reaches in these watersheds. Where applicable, restoration efforts should incorporate instream wood/boulder structures, and/or implement large conifer recruitment (fall trees) into degraded reaches to improve shelter and overall habitat complexity.

Address Water Diversion and Groundwater Extraction

Low summer streamflow has been observed. Reduced flow conditions, and resulting disconnected flow conditions (dry stream channels), appear to be the result of water diversions and groundwater pumping. Federal, state and local government representatives should work with landowners to implement creative solutions that minimize these effects; these solutions should examine conservation methods, water management planning, and water storage and recharge solutions.

Establish a Population of Chinook Salmon

Since there is no Chinook salmon population that exists in the Navarro or Gualala Rivers, biologists should investigate developing a plan to develop a population. A Chinook salmon population restoration plan is needed to determine the steps that would be required to establish a population in these watersheds. This may include the selection of other Central Coast populations that are available and appropriate for use in rebuilding an in population. Several subwatersheds have the potential to provide high quality for Chinook salmon reestablishment. For the Navarro the areas for consideration could include the mainstem Navarro River, North Fork Navarro River, and Rancheria Creek. For the Gualala, the areas for consideration could include mainsteam Gualala, North and South Forks and Rockpile.

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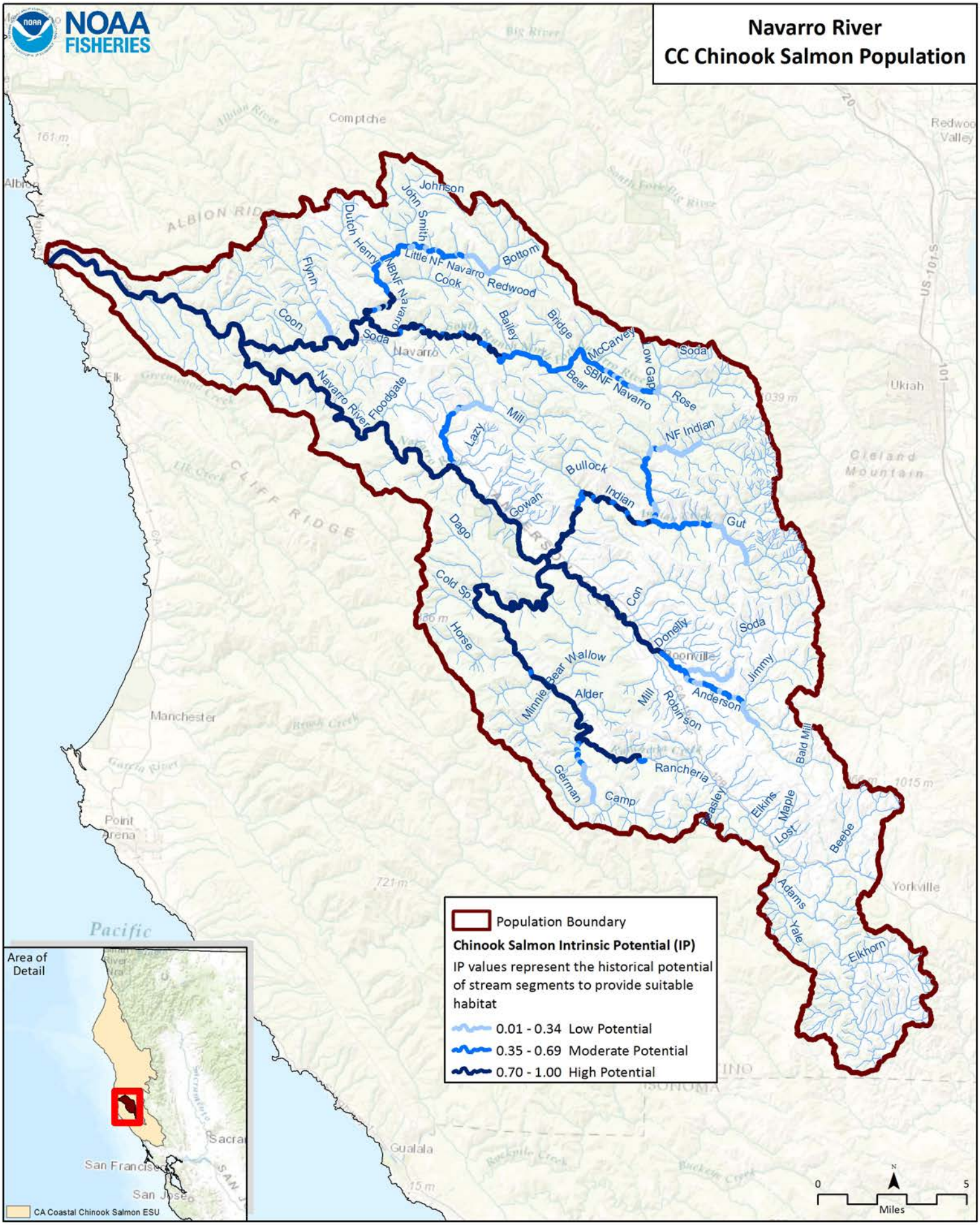
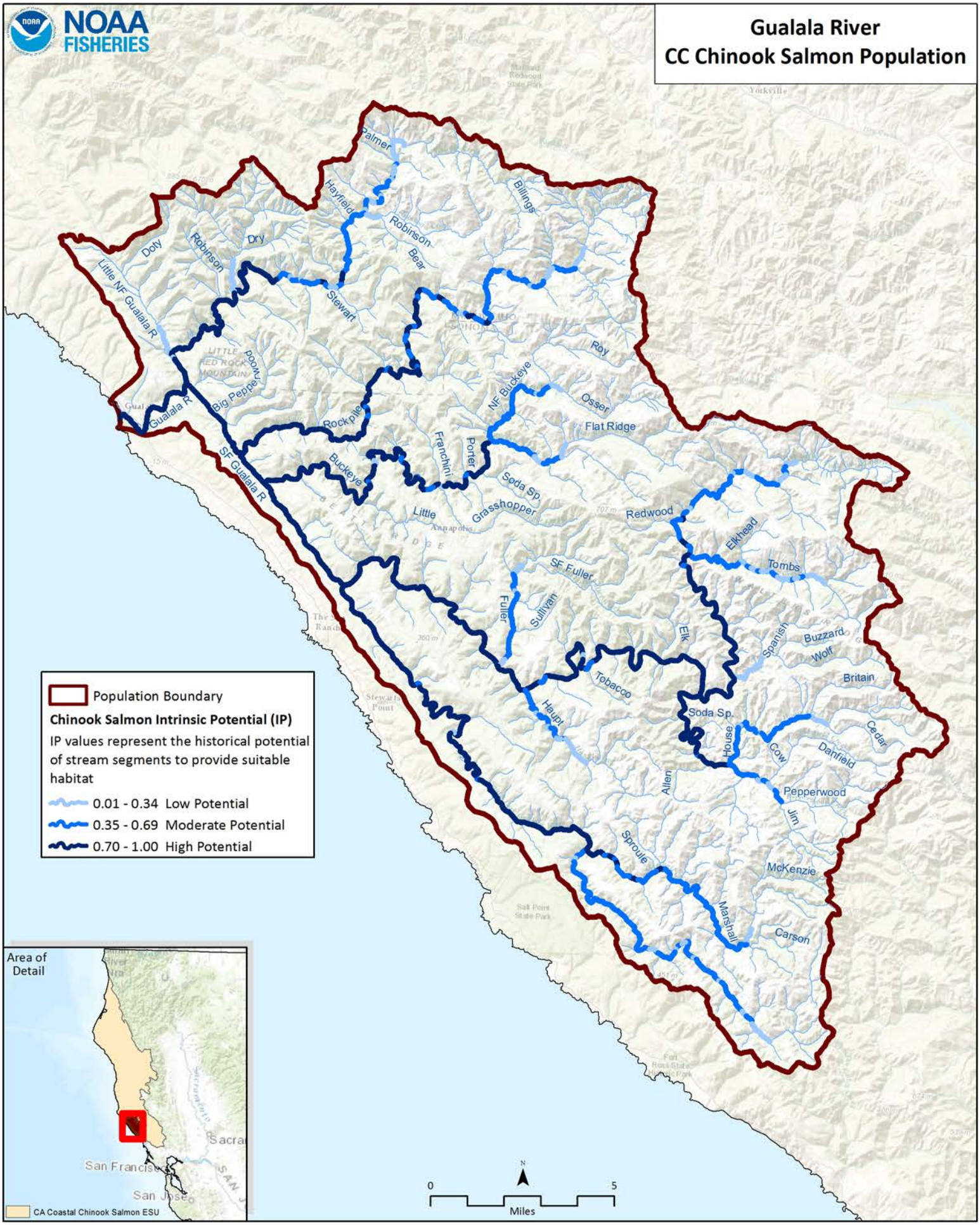

NOAA FISHERIES
Navarro River
CC Chinook Salmon Population
Comptche
Albion
Elk
Navarro
Ukiah
Manchester
Point Arena
Yorkville
Gualala
Pacific
Johnson
John Smith
Dutch Henry
Little NF Navarro
Bottom
Flynn
NBNF Navarro
Cook
Redwood
Coon
Soda
Bailey
Bridge
McCarvey
Low Gap
Soda
Bear
SBNF Navarro
Rose
Navarro River
Floodgate
Mill
Lazy
NF Indian
Bullock
Indian
Gowan
Gut
Dago
Cold Sp
Con
Horse
Donelly
Soda
Wallow
Jimmy
Minnie
Bear
Alder
Mill
Robinson
Anderson
Bald Mill
German
Rancheria
Camp
Grasley
Elkins
Maple
Lost
Beebe
Adams
Yale
Elkhorn
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Area of Detail
CA Coastal Chinook Salmon ESU
0
5
Miles


NOAA FISHERIES
Gualala River
CC Chinook Salmon Population
Palmer
Hayfield
Billings
Robinson
Bear
Dody
Robinson
Dry
Little NF Gualala R
Stewart
Roy
Big Pepper
Gualala R
NF Buckeye
Osser
Flat Ridge
Rockpile
Franchini
Porter
SF Gualala R
Buckeye
Soda Sp.
Little
Grasshopper
Redwood
Elkhead
Tombs
SF Fuller
Fuller
Sullivan
Elk
Spanish
Buzzard
Wolf
Britain
Tobacco
Haupt
Soda Sp.
House
Cedar
Cow
Danfield
Allen
Pepperwood
Jim
Sproule
McKenzie
Marshall
Carson
Population Boundary
Chinook Salmon Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Area of Detail
San Francisco
San Jose
CA Coastal Chinook Salmon ESU
0
5
Miles

CC Chinook Salmon ESU: Central Coastal Diversity Stratum (Navarro/Gualala)

Habitat & Population Condition Scores By Life Stage: VG = Very Good G = Good F = Fair P = Poor		Chinook Salmon Life History Stages			
		Adults	Eggs	Pre-Smolt	Smolts
Stresses: Key Attribute: Indicators	Estuary: Quality & Extent	F		G	G
	Velocity Refuge: Floodplain Connectivity	VG		G	G
	Hydrology: Redd Scour		F		
	Hydrology: Baseflow & Passage Flows	G	G	G	G
	Passage/Migration: Mouth or Confluence & Physical Barriers	VG		VG	VG
	Habitat Complexity: Percent Primary/Staging Pools & Pool/Riffle/Flatwater Ratios	F		F	F
	Habitat Complexity: Large Wood & Shelter	F		F	F
	Sediment: Gravel Quality & Distribution of Spawning Gravels	G	F	G	G
	Viability: Density, Abundance & Spatial Structure	P		P	P
	Water Quality: Turbidity & Toxicity	G		G	G

CC Chinook Salmon ESU: Central Coastal Diversity Stratum (Navarro/Gualala)

Threat Scores
L: Low
M: Medium
H: High

Threats - Sources of Stress	Stresses: Estuary: Impaired Quality & Extent	Floodplain Connectivity: Impaired Quality & Extent	Hydrology: Gravel Scouring Events	Hydrology: Impaired Water Flow	Impaired Passage & Migration	Instream Habitat Complexity: Altered Pool Frequency and/or Pool/Riffle Ratios	Instream Habitat Complexity: Reduced Large Wood and/or Shelter	Instream Substrate/Food Productivity: Impaired Gravel Quality & Quantity	Reduced Density, Abundance & Diversity	Water Quality: Increased Turbidity or Toxicity
Agriculture	L	L	L		L	L	L	L		L
Channel Modification	L	L	L	L	L	L	L	L		L
Disease, Predation, and Competition	L	L			L	L	L		L	L
Fire, Fuel Management, and Fire Suppression	L	L	L		L	L	L	L		L
Livestock Farming and Ranching	L	L	L		L	L	L	L		L
Logging and Wood Harvesting	L	L	L		L	L	L	L		L
Mining	L	L	L		L	L	L	L		L
Recreational Areas and Activities	L	L	L		L	L	L	L		L
Residential and Commercial Development	L	L	L	L	L	L	L	M		L
Roads and Railroads	L	L	L	L	L	L	L	M		L
Severe Weather Patterns	L	L	M	L	L	L	L	L		L
Water Diversions and Impoundments	M	L	L	L	L	L	L	L	M	L
Fishing and Collecting									M	
Hatcheries and Aquaculture									L	L

Navarro River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
NavR-CCCh-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NavR-CCCh-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
NavR-CCCh-2.1.1.1	Action Step	Floodplain Connectivity	Delineate reaches possessing both potential winter rearing habitat and floodplain areas, and develop and implement restoration action plans.	3	5	CDFW, Private Consultants, Private Landowners	
NavR-CCCh-2.1.1.2	Action Step	Floodplain Connectivity	Evaluate Highway 128 and associated crossings with focus on the segment from the North Fork Navarro Bridge to Barton Gulch. Modify crossing to provide access to historical floodplain habitats based on the evalation.	1	1	CalTrans, CDFW, NOAA RC	
NavR-CCCh-3.1	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**				
NavR-CCCh-3.1.1	Recovery Action	Hydrology	Improve flow conditions				
NavR-CCCh-3.1.1.1	Action Step	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential Chinook salmon streams.	3	20	CDFW, NMFS, SWRCB	
NavR-CCCh-3.1.1.2	Action Step	Hydrology	Assess and map water diversions (CDFG 2004).	2	5	Private Consultants, Private Landowners, SWRCB	
NavR-CCCh-3.1.1.3	Action Step	Hydrology	Implement Best Management Practices (BMP's) for agriculture land use within Mendocino County (CDFG 2004).	3	100	CDFW, Mendocino County, NMFS, NOAA RC, Private Consultants, Private Landowners, RWQCB	
NavR-CCCh-3.1.1.4	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	20	CDFW, Mendocino County, NMFS, NOAA RC, Private Consultants, Private Landowners, SWRCB	
NavR-CCCh-3.1.1.5	Action Step	Hydrology	Require streamflow gauging devices to determine the level of impairment to natural flow. Focus initial efforts on Mill Creek, Flynn Creek, and North Fork Navarro.	3	5	Private Landowners, SWRCB, USGS	
NavR-CCCh-3.1.1.6	Action Step	Hydrology	Work with SWRCB and landowners to restore and maintain the natural hydrograph between March 1 and May 15 to minimize impacts to salmonid fry due to stranding by implementing alternative frost protection strategies.	1	5	Farm Bureau, NMFS, NMFS OLE, Private Landowners	
NavR-CCCh-3.1.1.7	Action Step	Hydrology	Support SWRCB in regulating the use of streamside wells and groundwater.	2	5	CDFW, , NOAA RC, Private Landowners, RCD, SWRCB	
NavR-CCCh-3.1.1.8	Action Step	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water rights to instream use via petition change of use and §1707 (CDFG 2004).	1	20	CDFW, NOAA RC, Private Landowners, RCD, SWRCB	
NavR-CCCh-3.1.1.9	Action Step	Hydrology	Support a water conservation program for rural residential water users within the Navarro River watershed.	3	50	CDFW, NOAA RC, Private Landowners, RCD, SWRCB	
NavR-CCCh-3.1.1.10	Action Step	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	25	CDFW, NMFS SWRCB	
NavR-CCCh-3.1.1.11	Action Step	Hydrology	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed managers.	3	60	CDFW, NMFS, SWRCB	
NavR-CCCh-3.1.2	Recovery Action	Hydrology	Improve passage flows				
NavR-CCCh-3.1.2.1	Action Step	Hydrology	Develop BMP's (such as off-channel storage) for landowners conducting water diversion actions.	1	20	NMFS, NRCS, Private Landowners, SWRCB	
NavR-CCCh-3.1.2.2	Action Step	Hydrology	Encourage compliance with the most recent update of NMFS' Water Diversion Guidelines.	2	10	CDFW, NMFS, Private Landowners, SWRCB	
NavR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NavR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
NavR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Install or enhance existing LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (CDFG 2004). Focus on tributaries of Flynn Creek, North Fork Navarro, South Branch Navarro, and Mill Creek.	1	10	CDFW, NOAA RC, NRCS, Private Landowners	
NavR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	3	20	CDFW, NOAA RC, NRCS, Private Landowners	
NavR-CCCh-6.1.1.3	Action Step	Habitat Complexity	Maintain current LWD, boulders, and other structure providing features to maintain current stream complexity, pool frequency, and depth (CDFG 2004). Maintain large debris accumulations along Highway 128 on the North Fork Navarro.	2	50	CDFW, NOAA RC, NRCS, Private Landowners	
NavR-CCCh-6.1.2	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD and shelters				

Navarro River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
NavR-CCCh-6.1.2.1	Action Step	Habitat Complexity	Identify historic Chinook salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover.	2	10	Campbell Timberland Management, CDFW, Private Landowners	
NavR-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NavR-CCCh-8.1.1	Recovery Action	Sediment	Improve instream gravel quality				
NavR-CCCh-8.1.1.1	Action Step	Sediment	Address high and medium priority sediment delivery sites as identified by the Mendocino RCD, Mendocino Redwoods Company, or other credible assessments.	1	20	CDFW, Mendocino Redwood Company, Private Landowners, RCD	
NavR-CCCh-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NavR-CCCh-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity				
NavR-CCCh-11.1.1.1	Action Step	Viability	Measure or estimate the condition of key habitat attributes across the watershed.	2	10	CDFW	
NavR-CCCh-11.1.1.2	Action Step	Viability	Conduct monitoring activities to determine the population status of adult and smolt salmonids in major subbasins of the Navarro River.	2	60	CDFW, Mendocino Redwood Company, NOAA SWFSC, Private Landowners	
NavR-CCCh-11.1.1.3	Action Step	Viability	Identify how a conservation hatchery/supplementation/ augmentation program will complement the overall recovery effort.	2	20	NOAA RC, NOAA SWFSC, NOAA/NMFS	
NavR-CCCh-11.1.1.4	Action Step	Viability	If determined necessary, identify an out-of-basin or subwatershed source population that could be used to start a population augmentation/supplementation/broodstock program.	3	30	NOAA RC, NOAA SWFSC, NOAA/NMFS	
NavR-CCCh-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NavR-CCCh-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
NavR-CCCh-12.1.1.1	Action Step	Agriculture	Develop a Road Sediment Reduction Plan for agricultural lands that prioritizes problem sites and outlines implementation and a timeline of necessary actions.	2	10	Private Consultants, Private Landowners	
NavR-CCCh-12.1.1.2	Action Step	Agriculture	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	10	Board of Forestry, CDFW, Farm Bureau, NMFS, Private Landowners	
NavR-CCCh-12.1.1.3	Action Step	Agriculture	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	2	10	Farm Bureau, NMFS, Private Consultants, Private Landowners	
NavR-CCCh-12.1.1.4	Action Step	Agriculture	Continue implementation of the NRCS/RCD coordinated permit program for fishery restoration practices.	2	30	CDFW, NMFS, State	
NavR-CCCh-12.1.2	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
NavR-CCCh-12.1.2.1	Action Step	Agriculture	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.	3	25	CDFW, Farm Bureau, NRCS, RCD	
NavR-CCCh-12.1.2.2	Action Step	Agriculture	Work within the agricultural community to educate landowners and enhance practices that provide for functional watershed processes.	3	3	Farm Bureau, NRCS, RCD	
NavR-CCCh-12.1.2.3	Action Step	Agriculture	Provide technical and staff support to counties to encourage general plan updates that include measures to protect salmonids.	3	25	CDFW, Counties, NMFS, NRCS, RCD	
NavR-CCCh-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
NavR-CCCh-12.1.3.1	Action Step	Agriculture	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	3	20	CDFW, Mendocino County, NMFS, NOAA RC, NRCS, Private Consultants, RCD	
NavR-CCCh-12.1.4	Recovery Action	Agriculture	Prevent or minimize alterations to riparian species composition and structure				
NavR-CCCh-12.1.4.1	Action Step	Agriculture	Maintain and enhance existing natural vegetation types within the Navarro watershed.	3	20	CDFW, Mendocino County, NMFS, NOAA RC, NRCS, Private Consultants, Private Landowners, RCD	
NavR-CCCh-12.2	**Objective**	**Agriculture**	**Address the inadequacy of existing regulatory mechanisms**				
NavR-CCCh-12.2.1	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
NavR-CCCh-12.2.1.1	Action Step	Agriculture	Coordinate with the agencies to minimize conversion of range and forestland in key watersheds.	2	50	CDFW, Counties, NMFS, NRCS	

Navarro River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
NavR-CCCh-12.2.1.2	Action Step	Agriculture	Work with the State and Mendocino County to impose a moratorium on conversion of open space, rangeland, or TPZ to vineyards or other agricultural uses that impact salmonids until a grading ordinance and land conversion ordinance are in place.	1	60	Farm Bureau, Private Consultants, Private Landowners	
NavR-CCCh-12.2.1.3	Action Step	Agriculture	Implement the NRCS/RCD coordinated permit program for fishery restoration practices.	2	40	CDFW, Farm Bureau, NMFS, Private Landowners	
NavR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
NavR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
NavR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Restoration projects that upgrade or decommission high risk roads should be considered a high priority for funding (e.g., PCSRF).	1	10	CDFW, Mendocino County, Mendocino Redwood Company, NOAA RC, Private Landowners	
NavR-CCCh-23.1.1.2	Action Step	Roads/Railroads	For all rural (unpaved) and seasonal dirt roads apply best management practices for road construction maintenance management and decommissioning (e.g. Weaver and Hagans, 1994; Sommarstrom et al., 2002; Oregon Department of Transportation, 1999).	1	10	CDFW, Mendocino County Department of Public Works, Mendocino Redwood Company, NOAA RC, NRCS, Private Landowners, Public, RCD	
NavR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams.	1	5	CDFW, NOAA RC, Private Landowners, RCD	
NavR-CCCh-23.1.1.4	Action Step	Roads/Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Weaver and Hagans, 1994; Sommarstrom et al., 2002; Oregon Department of Transportation, 1999).	2	20	CDFW, Mendocino County Department of Public Works, NOAA RC, NRCS, Private Landowners, Public, RCD	
NavR-CCCh-23.1.1.5	Action Step	Roads/Railroads	Develop and implement a road management plan	2	5	CDFW, Mendocino County Department of Public Works, NRCS	
NavR-CCCh-23.1.1.6	Action Step	Roads/Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until road management plan is created and implemented.	2	2	CDFW, Mendocino County Department of Public Works, NRCS, Private Landowners, Public, RCD	
NavR-CCCh-23.1.1.7	Action Step	Roads/Railroads	Create and implement a management plan for new road construction within floodplains, riparian areas, unstable soils or other sensitive areas	2	5	CDFW, Mendocino County Department of Public Works, NRCS, Private Landowners, Public, RCD	
NavR-CCCh-23.1.1.8	Action Step	Roads/Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (CDFG 2004).	2	30	CDFW, Mendocino County Department of Public Works, Mendocino Redwood Company, NOAA RC, NRCS, Private Landowners, Public, RCD	
NavR-CCCh-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
NavR-CCCh-23.1.2.1	Action Step	Roads/Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	3	60	CalFire, CDFW, Mendocino County, Private Landowners	
NavR-CCCh-23.1.2.2	Action Step	Roads/Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	5	CDFW, , Mendocino County Department of Public Works, Mendocino Redwood Company, NOAA RC, Private Consultants, Private Landowners	
NavR-CCCh-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
NavR-CCCh-23.1.3.1	Action Step	Roads/Railroads	Develop a road database using standardized methods. The methods should document all roads features, apply erosion rates, and compile information into a GIS database.	3	5	NRCS, Private Landowners, Public, RCD	
NavR-CCCh-23.1.3.2	Action Step	Roads/Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	2	100	CalFire, Mendocino Redwood Company, Private Landowners	
NavR-CCCh-23.1.4	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
NavR-CCCh-23.1.4.1	Action Step	Roads/Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	2	10	CalTrans, Mendocino County Department of Public Works, NOAA RC, NRCS, Private Landowners	

Navarro River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
NavR-CCCh-23.1.4.2	Action Step	Roads/Railroads	Continue to refine, update, and maintain the California Fish Passage Assessment Database of barriers to fish passage.	2	10	California Coastal Conservancy, CDFW, Pacific States Marine Fisheries Commission, USFWS	
NavR-CCCh-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
NavR-CCCh-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
NavR-CCCh-23.2.1.1	Action Step	Roads/Railroads	Expand the NRCS/RCD coordinated permit program to a statewide programmatic ESA consultation that gives technical expertise to small land owners and rural residential property owners.	2	20	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD, USACE	
NavR-CCCh-23.2.2	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
NavR-CCCh-23.2.2.1	Action Step	Roads/Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a time line of necessary actions.	2	3	Mendocino Redwood Company, NRCS, Private Consultants, Private Landowners, RCD	
NavR-CCCh-24.1	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
NavR-CCCh-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to watershed hydrology				
NavR-CCCh-24.1.1.1	Action Step	Severe Weather Patterns	If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated by municipal water suppliers and other users in the watershed through conservation programs.	2	60	Mendocino County, NOAA RC, Private Landowners, Public, SWRCB	
NavR-CCCh-24.1.1.2	Action Step	Severe Weather Patterns	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	2	60	CDFW, NMFS, NMFS OLE, Private Landowners, SWRCB	
NavR-CCCh-24.1.1.3	Action Step	Severe Weather Patterns	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	2	20	NOAA RC, Private Landowners, USACE	
NavR-CCCh-24.1.1.4	Action Step	Severe Weather Patterns	Implement mandatory water conservation measures during drought conditions. Each watershed/city should have a plan that establishes drought conservation measures and circumstances for implementation.	2	100	CDFW, NMFS, Private Landowners, SWRCB	
NavR-CCCh-24.1.1.5	Action Step	Severe Weather Patterns	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for salmonid recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection salmonids (Water Code § 1707).	3	40	CDFW, NMFS, SWRCB	
NavR-CCCh-24.1.2	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)				
NavR-CCCh-24.1.2.1	Action Step	Severe Weather Patterns	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.	2	60	Board of Forestry, CalFire, CDFW, Mendocino County, Private Landowners	
NavR-CCCh-24.1.2.2	Action Step	Severe Weather Patterns	New development in all historic Chinook watersheds should meet a zero net increase in storm-water runoff, changes in duration, or magnitude of peak flow by following all BMPs and having retention systems	2	60	Counties, NMFS, RWQCB	
NavR-CCCh-24.1.2.3	Action Step	Severe Weather Patterns	Coordinate with county planners to eliminate or reduce new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historic Chinook salmon watersheds.	2	50	Counties, NMFS, RWQCB	
NavR-CCCh-24.1.2.4	Action Step	Severe Weather Patterns	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	2	50	Counties, NMFS, Private Landowners, RWQCB	

Gualala River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GuR-CCCh-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-1.1.1	Recovery Action	Estuary	Increase the physical extent of estuarine habitat				
GuR-CCCh-1.1.1.1	Action Step	Estuary	Investigate the extent of sedimentation within the estuary/lagoon associated with watershed legacy impacts (logging). Evaluate sediment transport within the estuary and determine if the estuary is "filling" with sediment or "flushing" sediment (recovering).	3	10	CDFW, NMFS, NOAA RC, NRCS, RCD, RWQCB	
GuR-CCCh-1.1.1.2	Action Step	Estuary	Identify past mechanical fill sites (inside of Mill Bend) and develop strategies targeting the re-establishment of wetland marsh habitat (if feasible).	3	10	CDFW, NMFS, NOAA RC, NRCS, RCD	
GuR-CCCh-1.1.1.3	Action Step	Estuary	Develop and implement rehabilitation projects designed to increase the physical extent of high quality habitat for rearing juvenile salmonids within the Gualala River estuary.	3	10	CDFW, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners	
GuR-CCCh-1.1.1.4	Action Step	Estuary	Investigate the historical functions and ecology of the estuary	3	10	CDFW, Gualala Watershed Council	
GuR-CCCh-1.1.2	Recovery Action	Estuary	Increase and enhance estuarine habitat complexity features				
GuR-CCCh-1.1.2.1	Action Step	Estuary	Increase the percentage of area containing high value habitat complexity elements and features (SAV, LWD, boulders, marshes, vegetation, pools > 2 meters).	2	10	CDFW, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners	
GuR-CCCh-1.1.2.2	Action Step	Estuary	Identify strategic locations to install LWD structures designed to increased pool depth and habitat conditions within the Gualala River estuary.	2	10	CDFW, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners	
GuR-CCCh-1.1.3	Recovery Action	Estuary	Improve the quality of freshwater lagoon habitat				
GuR-CCCh-1.1.3.1	Action Step	Estuary	Install continuous water quality monitoring stations in the Gualala estuary during the summer months. Monitor at a minimum temperature, dissolved oxygen, and salinity.	2	5	CDFW, Gualala Watershed Council, NMFS, NOAA RC, North Gualala Water Company, NRCS, Private Landowners, RCD, RWQCB	
GuR-CCCh-1.1.4	Recovery Action	Estuary	Improve freshwater inflow				
GuR-CCCh-1.1.4.1	Action Step	Estuary	Install a stream gauge immediately upstream of the estuary/lagoon to monitor inflow conditions during the dry season.	2	5	CDFW, Gualala Watershed Council, NMFS, NOAA RC, North Gualala Water Company, NRCS, Private Landowners, Public, RWQCB	
GuR-CCCh-1.1.4.2	Action Step	Estuary	Investigate the hydrodynamics of freshwater inflow and estuary water quality conditions relative to juvenile salmonid estuarine summer rearing (osmo-regulating and non-osmoregulating).	2	10	CDFW, Friends of the Gualala River Watershed, Gualala Watershed Council, NMFS, NOAA RC, North Gualala Water Company, NRCS, Private Landowners, RCD, RWQCB, SWRCB	
GuR-CCCh-1.1.4.3	Action Step	Estuary	Identify and implement minimum freshwater inflow thresholds to ensure optimal estuary health and function.	2	5	CDFW, Gualala Watershed Council, NMFS, NOAA RC, North Gualala Water Company, NRCS, RWQCB, SWRCB	
GuR-CCCh-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
GuR-CCCh-3.1.1.1	Action Step	Hydrology	Continue to work with the North Gualala Water Company on water right Permit 14853. Ensure that the Site-specific Study Plan prepared for the NGWC by Stillwater Sciences (11 October 2011) is completed within the next 3-yrs. Implement recommendations within the next 5-years. Ensure salmonid life history requirements targeted in the proposal are evaluate under a range of water year types (dry - wet). Evaluate potential impacts to dry season estuary water quality conditions associated with Permit 14853.	2	20	CDFW, CDFW Law Enforcement, Gualala Watershed Council, NMFS, NMFS OLE, North Gualala Water Company, SWRCB	
GuR-CCCh-3.1.1.2	Action Step	Hydrology	Map all water diversions and upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	2	60	CDFW, NMFS, North Gualala Water Company, Private Landowners, Sea Ranch, SWRCB	
GuR-CCCh-3.1.1.3	Action Step	Hydrology	Monitor, identify problems, and prioritize needed changes to permitted water diversions on current or potential steelhead streams.	2	10	BLM, CDFW, NMFS, North Gualala Water Company, Private Landowners, Sea Ranch, SWRCB	Problems should be identified through mapping diversion and developing stream flow model (other action steps).

Gualala River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GuR-CCCh-3.1.1.4	Action Step	Hydrology	Install and maintain a gauging station immediately upstream of the estuary to monitor freshwater inflow during the dry season.	2	10	CDFW, NMFS, USGS	Provide consistent funding for the North Fork Gualala River and possible funding for the Wheatfield Forks of the Gualala River.
GuR-CCCh-3.1.1.5	Action Step	Hydrology	Develop critical flow values that are the basis for minimum bypass flow requirements to support juvenile rearing habitat conditions during the dry season.	1	5	CDFW, Gualala Watershed Council, NMFS, NOAA RC, North Gualala Water Company, NRCS, Private Landowners, RCD, RWQCB, Sea Ranch, SWRCB	
GuR-CCCh-3.1.1.6	Action Step	Hydrology	Install and maintain a stream gauge at an appropriate location near the base of Rockpile Creek.	3	10	CDFW, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners, RWQCB, SWRCB	
GuR-CCCh-3.1.1.7	Action Step	Hydrology	Install and maintain a stream gauge at an appropriate location near the base of Buckeye Creek.	3	10	CDFW, NMFS, NRCS, Private Landowners, RCD, SWRCB	
GuR-CCCh-3.1.1.8	Action Step	Hydrology	Install and maintain a stream gauge at an appropriate location immediately downstream of the SF Gualala and Wheatfield Fork confluence.	3	10	CDFW, Gualala Watershed Council, NMFS, NRCS, Private Landowners, RCD, Sea Ranch, SWRCB	
GuR-CCCh-3.1.1.9	Action Step	Hydrology	Evaluate and implement off-channel storage facilities to reduce impacts of water diversion (storage tanks for rural residential users). Focus efforts in the NF Gualala and Wheatfield sub-watersheds.	2	20	CDFW, Gualala Watershed Council, NMFS, North Gualala Water Company, NRCS, SWRCB	
GuR-CCCh-4.1	**Objective**	**Landscape Patterns**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-4.1.1	Recovery Action	Landscape Patterns	Prevent or minimize increased landscape disturbance				
GuR-CCCh-4.1.1.1	Action Step	Landscape Patterns	Consider developing and/or identifying Salmonid Preserves. Consider the Gualala River watershed as a Salmonid Preserve.	2	100	CDFW, NMFS, NMFS, NOAA RC	
GuR-CCCh-4.2	**Objective**	**Landscape Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
GuR-CCCh-4.2.1	Recovery Action	Landscape Patterns	Prevent or minimize increased landscape disturbance				
GuR-CCCh-4.2.1.1	Action Step	Landscape Patterns	Discourage counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	2	100	Board of Forestry, CalFire, CDFW, Gualala Redwood Company, Gualala Watershed Council, NMFS, North Gualala Water Company, NRCS, RCD, Sea Ranch, Sonoma County, SWRCB	
GuR-CCCh-4.2.1.2	Action Step	Landscape Patterns	Discourage any forestland to agricultural and/or conversion to rural/urban development.	2	100	Board of Forestry, CalFire, CDFW, Gualala Redwood Company, Gualala Watershed Council, NMFS, NMFS, North Gualala Water Company, NRCS, Private Landowners, Public, RCD, Sea Ranch, Sonoma County, SWRCB	
GuR-CCCh-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
GuR-CCCh-5.1.1.1	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at South Beach Road Crossing on Fuller Creek (Wheatfield Fork sub-basin; See CALFISH: PAD_ID 736904; Passage ID 13268)	2	10	CDFW, Friends of the Gualala River Watershed, Gualala Watershed Council, NMFS, NOAA RC, NRCS, RCD	
GuR-CCCh-5.1.1.2	Action Step	Passage	Evaluate, design, and implement appropriate fish passage designs in Palmer Canyon and McKenzie creeks (Wheatfield Fork sub-basin; Klamt et al. 2003).	2	10	CDFW, Friends of the Gualala River Watershed, Gualala Watershed Council, NMFS, NOAA RC, NRCS, RCD	
GuR-CCCh-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range.**				
GuR-CCCh-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency (BFW 0-10 meters)				

Gualala River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GuR-CCCh-6.1.1.1	Action Step	Habitat Complexity	Increase wood frequency in salmonid spawning and rearing areas to the extent that a minimum of 6 key LWD pieces exists every 100 meters in 0-10 meter BFW streams.	2	10	Board of Forestry, CalFire, CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, North Gualala Water Company, NRCS, Private Landowners, Public, RCD	
GuR-CCCh-6.1.1.2	Action Step	Habitat Complexity	Design and install LWD structures in McKenzie and Wild Hog creeks, and the SF sub-basin to the extent that optimal LWD frequency is achieved at strategic locations.	2	20	Board of Forestry, CalFire, CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, North Gualala Water Company, NRCS, Private Landowners, Public, RWQCB	
GuR-CCCh-6.1.2	Recovery Action	Habitat Complexity	Increase large wood frequency (BFW 10-100 meters)				
GuR-CCCh-6.1.2.1	Action Step	Habitat Complexity	Increase wood frequency in seasonal habitat and migratory reaches to the extent that a minimum of 1.3 to 4 key LWD pieces exists every 100 meters in 10-100 meter BFW streams.	2	10	CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners, Public, RCD, RWQCB	
GuR-CCCh-6.1.2.2	Action Step	Habitat Complexity	Design and implement a SF Gualala mainstem migration project. Focus should include a higher frequency of significantly large wood structures to enhance staging pool development.	2	10	CDFW, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners, Public, RCD	
GuR-CCCh-6.1.2.3	Action Step	Habitat Complexity	Evaluate, design, and implement salmonid habitat improvement structures as appropriate to the stream channel type and hydrologic conditions within the Rockpile Sub-basin	2	5	Conservation Fund, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, North Gualala Water Company, NRCS, Private Landowners, Public, RCD, The Nature Conservancy	
GuR-CCCh-6.1.2.4	Action Step	Habitat Complexity	Evaluate, design, and implement salmonid habitat improvement structures as appropriate to the stream channel type and hydrologic conditions within the Buckeye Sub-basin.	2	5	CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, Private Landowners, Public, RCD, RWQCB	
GuR-CCCh-6.1.3	Recovery Action	Habitat Complexity	Improve pool shelter				
GuR-CCCh-6.1.3.1	Action Step	Habitat Complexity	Evaluate, design, and implement strategies to improve shelter pools ratings within the Rockpile and Buckeye sub-basins and the following tributaries: Boyd, Buckeye, Camper, Carson, Danfield, Doty, Dry, Franchini, Fuller, Grasshopper, Groshong Gulch, House, Little NF GR, Log Cabin, Marshall, McGann, McKenzie, NF Fuller, Lower NF GR, Palmer Canyon, Pepperwood, Rockpile, SF Fuller, Sullivan, Tombs, Wheatfield Fork, and Wild Hog creeks.	2	20	CDFW, Conservation Fund, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners, Public, RCD, The Nature Conservancy	
GuR-CCCh-6.1.4	Recovery Action	Habitat Complexity	Increase primary pools frequency				
GuR-CCCh-6.1.4.1	Action Step	Habitat Complexity	Evaluate, develop, and implement strategies to increase primary pool frequency in high priority reaches within the following tributaries: Boyd, Doty, Dry, Fuller, Little NF GR, Log Cabin, Marshall, McGann, McKenzie, Palmer, Robinson, Tombs, and West Fork Fuller.	2	20	CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners, Public, RCD	
GuR-CCCh-6.1.4.2	Action Step	Habitat Complexity	Identify historic salmonid habitats lacking in channel complexity and implement restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize areas with IP greater than 75%	2	20	CDFW, NOAA RC, Private Landowners	
GuR-CCCh-6.1.4.3	Action Step	Habitat Complexity	Encourage coordination of LWD placement in streams as part of logging operations and road upgrades to maximize size, quality, and efficiency of effort (CDFG 2004).	2	20	CalFire, CDFW, NOAA RC, Private Landowners	
GuR-CCCh-6.1.4.4	Action Step	Habitat Complexity	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	CDFW, NOAA RC, Private Landowners	

Gualala River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GuR-CCCh-6.1.4.5	Action Step	Habitat Complexity	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (CDFG 2004).	2	60	CDFW, NMFS, NRCS, Private Landowners	
GuR-CCCh-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-7.1.1	Recovery Action	Riparian	Improve tree diameter				
GuR-CCCh-7.1.1.1	Action Step	Riparian	Increase tree diameter to a minimum of 80% CWHR density rating "D" across all current and potential spawning and juvenile rearing areas.	2	20	Board of Forestry, CalFire, CDFW, Conservation Fund, Gualala Redwood Company, NMFS, The Nature Conservancy	
GuR-CCCh-7.1.1.2	Action Step	Riparian	Encourage large tree retention along the SF Gualala River. Focus areas with IP greater than 50%.	2	50	Board of Forestry, CalFire, CDFW, Gualala Redwood Company, NMFS	
GuR-CCCh-7.1.1.3	Action Step	Riparian	Conduct conifer release to promote growth of larger diameter trees where appropriate.	2	10	Board of Forestry, CalFire, CDFW, Gualala Redwood Company, NMFS, NRCS, RCD	
GuR-CCCh-7.1.2	Recovery Action	Riparian	Improve canopy cover				
GuR-CCCh-7.1.2.1	Action Step	Riparian	Increase the average stream canopy cover within potential spawning and rearing reaches to a minimum of 80%.	2	20	Board of Forestry, CalFire, CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, NRCS, The Nature Conservancy	
GuR-CCCh-7.1.2.2	Action Step	Riparian	Evaluate buffers width and/or timber harvest in terms of light penetration and potential changes to micro-climate conditions along the SF Gualala River.	2	50	Board of Forestry, CalFire, CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS	
GuR-CCCh-7.1.2.3	Action Step	Riparian	Identify and implement riparian enhancement projects where current canopy density and diversity are inadequate and site conditions are appropriate to: initiate tree planting, thinning, and other vegetation management to encourage the development of a denser more extensive riparian canopy in the following reaches and tributaries of the NF Gualala sub-basin: upper reaches of Dry Creek, Robinson Creek, the central and higher reaches of the mainstem, and the lower reaches of Bear and Stewart Creeks (Klamt et al. 2003).	2	20	Board of Forestry, CalFire, CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners, RCD	
GuR-CCCh-7.1.2.4	Action Step	Riparian	Identify and implement riparian enhancement projects where current canopy density and diversity are inadequate and site conditions are appropriate to: initiate tree planting, thinning, and other vegetation management to encourage the development of a denser more extensive riparian canopy in the following reaches and tributaries of the Rockpile sub-basin: mainstem Rockpile Creek, Red Rock Creek, and Horsetheif (Klamt et al. 2003).	2	20	Board of Forestry, CalFire, CDFW, Conservation Fund, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners, RCD, The Nature Conservancy	
GuR-CCCh-7.1.2.5	Action Step	Riparian	Identify and implement riparian enhancement projects where current canopy density and diversity are inadequate and site conditions are appropriate to: initiate tree planting, thinning, and other vegetation management to encourage the development of a denser more extensive riparian canopy in the following reaches and tributaries of the Buckeye sub-basin: upper reaches of Buckeye Creek, Franchini, Grasshopper, and Soda Springs creeks (Klamt et al. 2003).	2	20	Board of Forestry, CalFire, CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, NRCS, Private Landowners, RCD	
GuR-CCCh-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-8.1.1	Recovery Action	Sediment	Improve instream gravel quality				
GuR-CCCh-8.1.1.1	Action Step	Sediment	Treat high priority slides and landings identified in credible landowner assessments.	2	20	CDFW, NOAA RC, Private Landowners	
GuR-CCCh-8.1.1.2	Action Step	Sediment	Continue efforts such as erosion proofing, improvements, and decommissioning, through the Rockpile sub-basin to reduce sediment delivery to central Rockpile Creeks and Rockpile tributaries.	2	10	Board of Forestry, CalFire, CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, NRCS, RCD	

Gualala River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GuR-CCCh-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions				
GuR-CCCh-10.1.1.1	Action Step	Water Quality	Expand continuous temperature monitoring efforts into the upper sub-basins and tributaries that provide summer rearing for salmonids. Investigate canopy composition and monitoring air temperature to examine the relationship between canopy, temperature, and other micro-climate effects on water temperature (Klamt et al. 2003).	2	5	CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC	
GuR-CCCh-10.1.1.2	Action Step	Water Quality	Evaluate the current adequacy of buffer zones in recently logged areas and determine whether stream temperatures have increased due to these activities.	2	30	Board of Forestry, CalFire, CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, Private Landowners, RCD	
GuR-CCCh-10.1.1.3	Action Step	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for salmonids in specific streams (CDFG 2004).	2		CDFW, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NRCS, Private Landowners	
GuR-CCCh-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity				
GuR-CCCh-11.1.1.1	Action Step	Viability	Measure or estimate the condition of key habitat attributes across the watershed.	2	10	CDFW	
GuR-CCCh-11.1.1.2	Action Step	Viability	Identify where a conservation hatchery/supplementation/ augmentation program will complement the overall recovery effort.	2	20	NOAA RC, NOAA SWFSC, NOAA/NMFS	
GuR-CCCh-11.1.1.3	Action Step	Viability	If determined necessary, identify an out-of-basin or subwatershed source population that could be used to start a population augmentation/supplementation/broodstock program.	3	30	NOAA RC, NOAA SWFSC, NOAA/NMFS	
GuR-CCCh-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to instream habitat complexity (altered pool complexity and/or pool riffle ratio)				
GuR-CCCh-12.1.1.1	Action Step	Agriculture	Discourage forest-to-vineyard land conversions or other agricultural activities that may impact natural stream channel morphology.	2	30	Board of Forestry, CalFire, CDFW, NMFS, Sonoma County	
GuR-CCCh-12.1.2	Recovery Action	Agriculture	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
GuR-CCCh-12.1.2.1	Action Step	Agriculture	Assess sources from agricultural activities that deliver sediment and runoff to stream channels.	3	10	CA Coastal Commission, CDFW, DWR, NOAA RC, NRCS, Private Landowners, RCD	
GuR-CCCh-12.1.2.2	Action Step	Agriculture	Work with vineyard owners to assess the effectiveness of erosion control measures throughout the winter period.	3	5	CalFire, CDFW, NMFS, RWQCB, Sonoma County	
GuR-CCCh-12.1.2.3	Action Step	Agriculture	Encourage and assist the NRCS and RCD to increase the number of landowners participating in sediment reduction planning and implementation.	3	25	CDFW, NMFS, NOAA RC, Private Landowners	
GuR-CCCh-12.1.2.4	Action Step	Agriculture	Establish appropriately sized and properly functioning riparian buffers adjacent to watercourses that have a potential to deliver sediment to spawning and rearing habitat.	3	50	NRCS, Private Landowners, RCD	
GuR-CCCh-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (instream water temperature)				
GuR-CCCh-12.1.3.1	Action Step	Agriculture	Maintain functional riparian stream buffers that provide desirable stream canopy cover adjacent to agricultural land activities.	2	20	NOAA RC, Private Landowners, Sonoma County	
GuR-CCCh-12.1.4	Recovery Action	Agriculture	Prevent or minimize impairment to watershed hydrology				
GuR-CCCh-12.1.4.1	Action Step	Agriculture	Promote off-channel storage facilities (e.g. winter diversion ponds) in efforts to reduce in-stream flow impacts associated with agricultural water use.	2	10	CalFire, CDFW, NMFS, NMFS OLE, Private Landowners, Sonoma County, SWRCB	
GuR-CCCh-12.1.5	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
GuR-CCCh-12.1.5.1	Action Step	Agriculture	Work within the agricultural community to educate landowners and enhance practices that provide for functional watershed processes.	3	20	Farm Bureau, Private Landowners, Sonoma County	

Gualala River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GuR-CCCh-12.1.5.2	Action Step	Agriculture	Improve education and awareness to agencies, landowners, and the general public regarding salmonid recovery and habitat requirements.	3	30	NMFS, NOAA RC, NRCS, Private Landowners, Public, RCD	
GuR-CCCh-12.2	**Objective**	**Agriculture**	**Address the inadequacy of existing regulatory mechanisms**				
GuR-CCCh-12.2.1	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
GuR-CCCh-12.2.1.1	Action Step	Agriculture	Coordinate with regulatory agencies authorizing/permitting forestland-to-agriculture conversions to ensure consistency with salmonid recovery goals.	2	50	CalFire, CDFW, NMFS, Sonoma County	
GuR-CCCh-12.2.1.2	Action Step	Agriculture	Streamline permit processing where landowners are conducting actions aligned with recovery priorities.	2	30	CDFW, NMFS, NOAA RC, Private Landowners, RCD	
GuR-CCCh-12.2.1.3	Action Step	Agriculture	Technical support to counties by NMFS staff should be conducted to encourage county general plan updates that include measures to conserve and protect salmonids and their habitats.	3	50	NMFS, NOAA RC, NRCS, Private Landowners, Public Works, RCD, Sonoma County	
GuR-CCCh-12.2.2	Recovery Action	Agriculture	Prevent or minimize impairment to watershed hydrology				
GuR-CCCh-12.2.2.1	Action Step	Agriculture	Identify and eliminate depletion of summer base flows from unauthorized water users.	2	10	CDFW, NMFS, NMFS OLE, NOAA RC, North Gualala Water Company, SWRCB	
GuR-CCCh-12.2.2.2	Action Step	Agriculture	Develop legislation to fund county planning for environmentally sound agricultural growth and water supply.	2	30	CDFW, NMFS, Sonoma County, SWRCB	
GuR-CCCh-16.1	**Objective**	**Fishing/Collecting**	**Address the inadequacy of existing regulatory mechanisms**				
GuR-CCCh-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity based on based on the biological recovery criteria				
GuR-CCCh-16.1.1.1	Action Step	Fishing/Collecting	Work with CDFW to modify 14 California Code of Regulations, section 8.00(b)(1) low flow minimum flow closure for Mendocino, Sonoma, and Marin counties to restrict fishing during low flows. Discontinue using the Russian River at Guerneville gauging station for angling closures and use the Navarro River USGS gauging station (11468000) which better reflects hydrologic conditions in smaller unregulated coastal Sonoma/Mendocino streams.	2	100	CDFW, NMFS	
GuR-CCCh-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-18.1.1	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
GuR-CCCh-18.1.1.1	Action Step	Livestock	Reduce livestock and feral pig access to the riparian zone to encourage bank stabilization and re-vegetation of riparian areas within the following sub-basins: Gualala Main stem/ SF Garcia, Wheatfield Fork, Rockpile (Klamt et al. 2003).	3	10	CDFW, Friends of the Gualala River Watershed, Gualala Watershed Council, NMFS, NOAA RC, NRCS, RCD	
GuR-CCCh-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to floodplain connectivity (quality & extent)				
GuR-CCCh-19.1.1.1	Action Step	Logging	Ensure that timber harvest plans evaluate and avoid impacts to off channel habitat, floodplains, ponds, and oxbows.	2	50	Board of Forestry, CalFire, CDFW, Gualala Redwood Company, NMFS, NRCS, RCD	
GuR-CCCh-19.1.2	Recovery Action	Logging	Prevent or minimize impairment to instream habitat complexity (reduced large wood and/or shelter)				
GuR-CCCh-19.1.2.1	Action Step	Logging	Encourage coordination of LWD placement projects in streams (as necessary) as part of logging operations.	3	30	Board of Forestry, CalFire, CDFW, Gualala Redwood Company, NMFS, NOAA RC, RCD	
GuR-CCCh-19.1.2.2	Action Step	Logging	Asses and identify for retainment the largest trees in all riparian zones (including intermittent and ephemeral streams) for bank stability and long-term wood recruitment.	2	100	Board of Forestry, CalFire, Gualala Redwood Company, NMFS, NRCS, RCD	
GuR-CCCh-19.1.3	Recovery Action	Logging	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
GuR-CCCh-19.1.3.1	Action Step	Logging	Encourage all permanent and year-round access roads beyond the THP parcel be surfaced after harvest completion with base rock and road gravel, asphalt, or chipseal, as appropriate.	3	60	CalFire, Private Landowners	
GuR-CCCh-19.1.3.2	Action Step	Logging	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	3	20	CalFire, California Geological Survey, Private Consultants, Private Landowners, RWQCB	

Gualala River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GuR-CCCh-19.1.3.3	Action Step	Logging	Establish equipment limitation zones on headwater streams and swales.	3	50	Board of Forestry, CalFire, CDFW, NMFS, NRCS, RCD	
GuR-CCCh-19.1.3.4	Action Step	Logging	Decommission legacy roads, upgrade road networks, and plan and implement other rehabilitation work targeting reductions in fine sediment inputs to stream networks.	2	20	Board of Forestry, CalFire, CDFW, Conservation Fund, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, Private Landowners, RCD	
GuR-CCCh-19.1.4	Recovery Action	Logging	Prevent or minimize impairment to water quality (instream water temperature)				
GuR-CCCh-19.1.4.1	Action Step	Logging	Encourage wider riparian buffer zones in areas where stream temperatures or riparian canopy are found limiting.	2	30	Board of Forestry, CalFire, Friends of the Gualala River Watershed, Gualala Redwood Company, Gualala Watershed Council, NMFS, NOAA RC, NRCS, RCD	
GuR-CCCh-19.1.4.2	Action Step	Logging	Protect current riparian zones in all summer salmonid rearing areas to the extent that they are able to mature, provide, and maintain a minimum of 80% canopy cover.	2	100	Board of Forestry, CalFire, CDFW, Gualala Redwood Company, NMFS, Private Landowners, RCD	
GuR-CCCh-19.1.5	Recovery Action	Logging	Prevent or minimize adverse alterations to riparian species composition and structure				
GuR-CCCh-19.1.5.1	Action Step	Logging	Conserve and manage forestlands for older forest stages.	2	100	Board of Forestry, CalFire, CDFW, Gualala Redwood Company, NMFS	
GuR-CCCh-19.1.5.2	Action Step	Logging	Manage riparian areas for their potential to provide shade and rearing habitat for salmonids.	2	60	Board of Forestry, CalFire, CDFW, NMFS	
GuR-CCCh-19.1.6	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
GuR-CCCh-19.1.6.1	Action Step	Logging	Consider the development of a Watershed Database (similar to the CDFW Northern Spotted Owl database) for salmonids that provides watershed data and information in a consistent fashion to all foresters for consideration in their harvest plans.	3	20	Board of Forestry, CDFW, NMFS	
GuR-CCCh-19.1.6.2	Action Step	Logging	Acquire key large tracts of forestlands identified as a priority by Federal, State, local government, and non-governmental organizations	2	30	CDFW, NMFS, NOAA RC	
GuR-CCCh-19.1.6.3	Action Step	Logging	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support salmonid habitats.	2	100	Board of Forestry, CalFire, CDFW, NMFS, RWQCB	
GuR-CCCh-19.1.6.4	Action Step	Logging	Should large tracts of forestlands within the Gualala River watershed become available for purchase, the State of California or other entities should consider purchasing the area as a Demonstration Forest or State Park.	2	20	BLM, CalFire, California Coastal Conservancy, CDFW, Conservation Fund, NMFS, Private Landowners, Sonoma County, State Parks, The Nature Conservancy	
GuR-CCCh-19.1.6.5	Action Step	Logging	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	3	60	CalFire, CDFW, NMFS, Private Landowners, Sonoma County	
GuR-CCCh-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
GuR-CCCh-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
GuR-CCCh-19.2.1.1	Action Step	Logging	Work with Sonoma county planning staff to minimize rezoning forestlands to rural residential or other land uses (e.g., vineyards).	2	60	CalFire, NMFS, Sonoma County	
GuR-CCCh-19.2.1.2	Action Step	Logging	Coordinate with regulatory agencies to minimize conversions in key watersheds and discourage forestland conversions.	2	30	Board of Forestry, CalFire, CDFW, NMFS	
GuR-CCCh-19.2.1.3	Action Step	Logging	Establish greater oversight and post-harvest monitoring by the permitting agency for operations.	2	20	Board of Forestry, CalFire, CDFW, NMFS, RWQCB	
GuR-CCCh-19.2.1.4	Action Step	Logging	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	10	CalFire, NMFS	
GuR-CCCh-19.2.1.5	Action Step	Logging	Require tree retention on the axis of headwall swales Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	2	60	CalFire, California Geological Survey, CDFW, NMFS, Private Landowners, RWQCB	
GuR-CCCh-19.2.1.6	Action Step	Logging	Extend the monitoring period and upgrade THP road maintenance after harvest.	2	10	CalFire, CDFW, NMFS, Private Landowners, RWQCB	

Gualala River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GuR-CCCh-19.2.1.7	Action Step	Logging	Investigate opportunities to programmatically permit the forest certification program to authorize incidental take for landowners through Endangered Species Act Section 10(a)(1)(B).	3	10	Board of Forestry, CalFire, CDFW, NMFS	
GuR-CCCh-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
GuR-CCCh-23.1.1.1	Action Step	Roads/Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (CDFG 2004).	2	10	CDFW, NOAA RC, Private Landowners, RCD, Sonoma County	
GuR-CCCh-23.1.1.2	Action Step	Roads/Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Weaver and Hagans, 1994; Sommarstrom et al., 2002; Oregon Department of Transportation, 1999).	2	60	Private Landowners, RCD, Sonoma County	
GuR-CCCh-23.1.1.3	Action Step	Roads/Railroads	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.	2	5	NRCS, Private Consultants, Private Landowners, RCD	
GuR-CCCh-23.1.1.4	Action Step	Roads/Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	2	5	CDFW, Private Consultants, Private Landowners, RWQCB	
GuR-CCCh-23.1.1.5	Action Step	Roads/Railroads	Encourage, when necessary and appropriate, restricted access to unpaved roads in winter to reduce road degradation and sediment release. Where restricted access is not feasible, encourage measures such as rocking to prevent sediment from reaching streams with steelhead (CDFG 2004).	2	20	Private Landowners	
GuR-CCCh-23.1.1.6	Action Step	Roads/Railroads	Evaluate, develop, and implement strategies to address decommissioning old roads, maintaining existing roads, and constructing new roads in the following Gualala mainstem/ SF Gualala Subbasin tributaries: McKenzie Creek, Marchall Creek, Palmer Canyon Creek, Wild Hog Creek, South Fork, and Marshall Creek.	2	20	CDFW, Gualala Redwood Company, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB	
GuR-CCCh-23.1.1.7	Action Step	Roads/Railroads	Evaluate, develop, and implement strategies to address decommissioning old roads, maintaining existing roads, and constructing new roads in the following Wheatfield Fork sub-basin tributary reaches: Lower reaches of Haupt and Tabacco Creeks; Lower to middle reaches of Tombs, Wolf, and Elk creeks, and unnamed trib to the mainstem Wheatfield Fork upstream from Tombs Creek, to Elk Creek, and flanked by Bear and Gibson ridges; larger watercourses to the lower reaches of House Creek; middle to higher reaches of House, Pepperwood, Danfield, and Cedar creeks (Klamt et al. 2003).	2	20	CDFW, NMFS, NOAA RC, NRCS, RCD, RWQCB	
GuR-CCCh-23.1.1.8	Action Step	Roads/Railroads	Evaluate, develop, and implement strategies to address decommissioning old roads, maintaining existing roads, and constructing new roads in the following North Fork sub-basin tributaries: Stewart, Dry, Upper Billings, upper Robinson, Doty, Log Cabin creeks, and McGann Gulch (Klamt et al. 2003).	2	20	CDFW, Friends of the Gualala River Watershed, Gualala Watershed Council, NMFS, NOAA RC, NRCS, RCD, RWQCB	
GuR-CCCh-23.1.1.9	Action Step	Roads/Railroads	Use appropriately sized culverts in steep terrain to accommodate flashy, debris-laden flows and maintain trash racks to prevent culvert plugging and subsequent road failure in the Buckeye sub-basin (GRWA 2003).	2	50	CDFW, Friends of the Gualala River Watershed, Gualala Watershed Council, NMFS, NOAA RC, NRCS, RCD, RWQCB	
GuR-CCCh-23.1.1.10	Action Step	Roads/Railroads	Install locked gates at river access points to prevent 4wd vehicles from driving in the river.	2	10	CDFW, FOGualalaR, Gualala Redwood Company, Gualala Watershed Council	
GuR-CCCh-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
GuR-CCCh-23.1.2.1	Action Step	Roads/Railroads	Prevent future barriers on newly constructed roads utilizing NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a)	2	20	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD, RWQCB	
GuR-CCCh-23.1.2.2	Action Step	Roads/Railroads	Work with partner agencies to ensure that all future road or bridge repairs at stream crossing provide unimpaired fish passage for all salmonid life stages.	2	20	CDFW, NMFS, NOAA RC, NRCS, RCD, RWQCB	
GuR-CCCh-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
GuR-CCCh-23.1.3.1	Action Step	Roads/Railroads	Design new roads that avoid riparian areas to the extent feasible and are hydrologically disconnected from the stream network.	2	60	Private Consultants, Private Landowners, Sonoma County	
GuR-CCCh-23.1.4	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				

Gualala River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GuR-CCCh-23.1.4.1	Action Step	Roads/Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or salmonid watersheds.	2	10	Private Landowners, RCD	
GuR-CCCh-23.1.4.2	Action Step	Roads/Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions.	3	5	Board of Forestry, CDFW, NMFS, NRCS, RCD, RWQCB	
GuR-CCCh-23.1.4.3	Action Step	Roads/Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.	3	30	Board of Forestry, CDFW, NMFS, NOAA RC, NRCS, RCD, RWQCB	
GuR-CCCh-23.1.4.4	Action Step	Roads/Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	10	CDFW	
GuR-CCCh-24.1	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
GuR-CCCh-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (stream flow)				
GuR-CCCh-24.1.1.1	Action Step	Severe Weather Patterns	Use the emergency drought operations center (EDOC) or other similar group to oversee implementation of water conservation measures and alternatives.	2	60	CDFW, CDFW Law Enforcement, NMFS OLE, North Gualala Water Company, Private Landowners, Public, Sea Ranch, Sonoma County	
GuR-CCCh-24.1.1.2	Action Step	Severe Weather Patterns	Work with CDFW, Counties, other agencies, and knowledgeable biologists to develop emergency flow regulations to ensure there is enough water instream for salmonids and adopt implementation agreements.	2	10	CDFW, NMFS, North Gualala Water Company, Sea Ranch, Sonoma County Water Agency, SWRCB	
GuR-CCCh-25.1	**Objective**	**Water Diversion/ Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GuR-CCCh-25.1.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (stream flow)				
GuR-CCCh-25.1.1.1	Action Step	Water Diversion/ Impoundment	Work with partner agencies to monitor and ensure water supply demands can be met without impacting flow either directly or indirectly through groundwater withdrawals and aquifer depletion.	1	20	CDFW, CDFW Law Enforcement, NMFS, SWRCB	
GuR-CCCh-25.1.1.2	Action Step	Water Diversion/ Impoundment	Provide incentives to water rights holders willing to convert some or all of their water rights to instream use via petition change of use and §1707 (CDFG 2004).	2	20	CDFW, NMFS, SWRCB	
GuR-CCCh-25.1.2	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to passage and migration				
GuR-CCCh-25.1.2.1	Action Step	Water Diversion/ Impoundment	Establish flow related adult and smolt migration thresholds prior to authorizing future water diversions.	1	10	CDFW, NMFS, North Gualala Water Company, SWRCB	
GuR-CCCh-25.1.3	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to the estuary (quality and extent)				
GuR-CCCh-25.1.3.1	Action Step	Water Diversion/ Impoundment	Discourage the development of any surface water diversions in the watershed that independently or cumulatively have significant impact on reducing inflow to the estuary during spring/summer/fall months (ECORP and Kamman Hydrology & Engineering 2005).	1	10	CDFW, Gualala Watershed Council, NMFS, North Gualala Water Company, SWRCB	
GuR-CCCh-25.1.3.2	Action Step	Water Diversion/ Impoundment	Develop and implement Estuary Inflow Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.	2	10	CDFW, NMFS, SWRCB	
GuR-CCCh-25.1.4	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to water quality (instream temperature)				
GuR-CCCh-25.1.4.1	Action Step	Water Diversion/ Impoundment	Ensure future water diversions do not impair instream water temperatures during the dry season.	1	10	CDFW, Gualala Watershed Council, NMFS, North Gualala Water Company, NRCS, RCD, Sea Ranch, SWRCB	
GuR-CCCh-25.2	**Objective**	**Water Diversion/ Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				

Gualala River Chinook Salmon (Central Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GuR-CCCh-25.2.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (stream flow)				
GuR-CCCh-25.2.1.1	Action Step	Water Diversion/ Impoundment	Ensure all water diversions and impoundments are compliant with AB2121 or other appropriate protective measures.	1	10	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	
GuR-CCCh-25.2.1.2	Action Step	Water Diversion/ Impoundment	Identify and work with the SWRCB to eliminate depletion of summer base flows from unauthorized water uses. Coordinate efforts by Federal and State, and County law enforcement agencies to remove illegal diversions from streams.	1	10	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	
GuR-CCCh-25.2.1.3	Action Step	Water Diversion/ Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of steelhead and their habitats, and avoidance of adverse impacts caused by water diversion (CDFG 2004).	2	10	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	