North Coastal Diversity Stratum

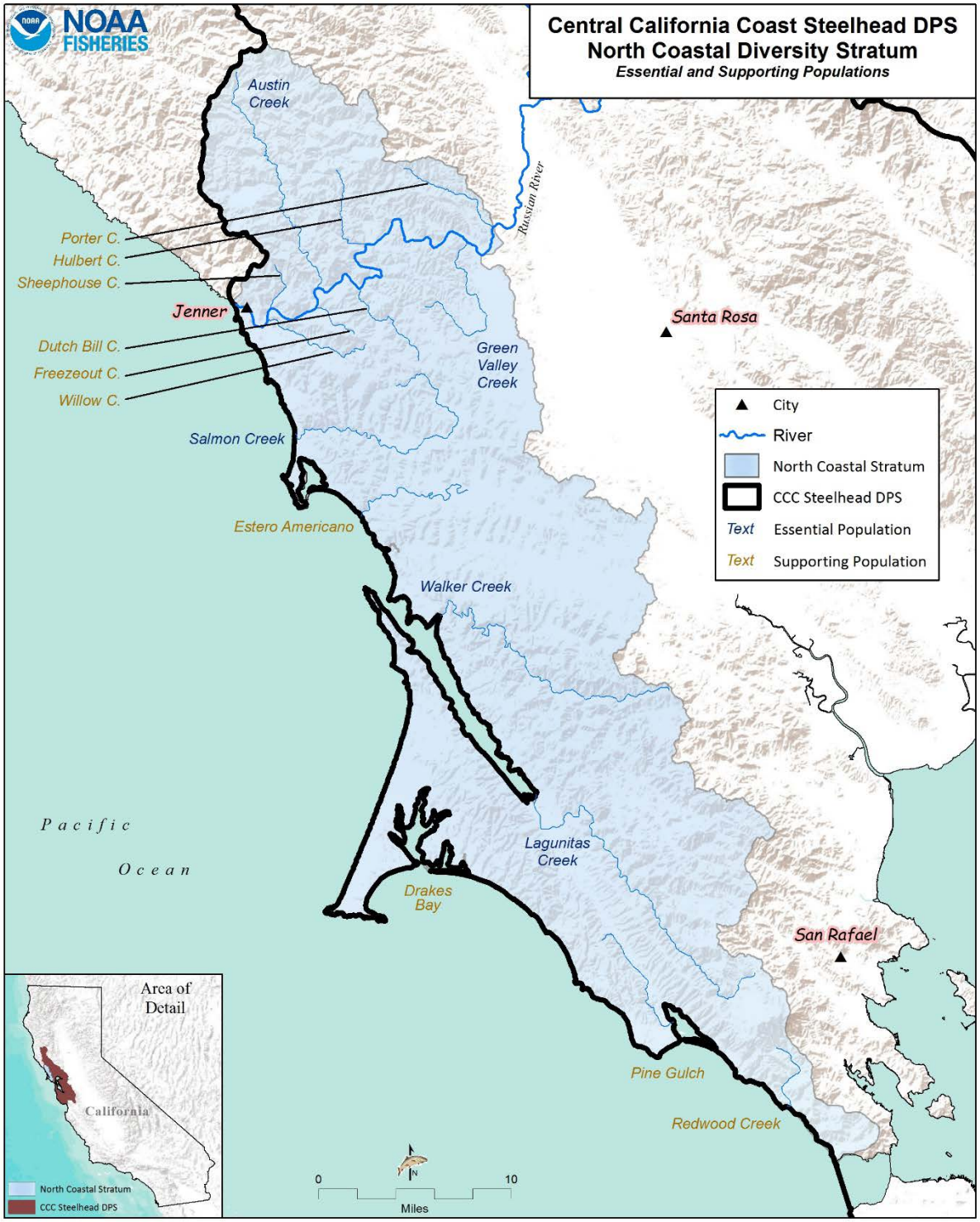
This stratum includes populations of steelhead spawning in direct tributaries to the Pacific Ocean north of the Golden Gate for which proximity to the coast strongly mediates climatic conditions, and tributaries of the Russian River exposed to coastally mediated climate.

The populations that have been selected for 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 Assessments of the Supporting populations:

- Austin Creek
- Green Valley Creek
- Lagunitas Creek
- Salmon Creek
- Walker Creek
- North Coastal Diversity Strata Rapid Assessment
    - Drakes Bay Tributaries
    - Estero Americano Creek
    - Pine Gulch
    - Redwood Creek (Marin Co.)
- North Coastal Diversity Strata: Russian River Populations Rapid Assessment
    - Dutch Bill Creek
    - Freezeout Creek
    - Hulbert Creek
    - Porter Creek
    - Sheephouse Creek
    - Willow Creek

CCC steelhead North Coastal Diversity Stratum Populations, Historical Status, Population's Role in Recovery, Current IP-km, and Spawner Density and Abundance Targets for Delisting.
* IP was not developed for these populations by the SWFSC.

Diversity Stratum	CCC Steelhead Population	Historical Population Status	Population's Role In Recovery	Current Weighted IP-km	Spawner Density	Spawner Abundance
North Coastal	Austin Creek	I	Essential	95.1	29.0	2,800
	Drakes Bay Tributaries*	D	Supporting	N/A	N/A	N/A
	Dutch Bill Creek	D	Supporting	13.2	6-12	77-156
	Estero Americano Creek	I	Supporting	35.4	6-12	210-423
	Freezeout Creek	D	Supporting	1.3	6-12	6-14
	Green Valley Creek	I	Essential	24.9	38.8	1,000
	Hulbert Creek	D	Supporting	10.2	6-12	59-120
	Lagunitas Creek	I	Essential	53.3	34.8	1,900
	Pine Gulch	D	Supporting	9.7	6-12	56-114
	Porter Creek	D	Supporting	10.3	6-12	60-122
	Redwood Creek (Marin Co.)	D	Supporting	6.7	6-12	38-78
	Salmon Creek	I	Essential	33.6	37.6	1,300
	Sheephouse Creek	D	Supporting	3.8	6-12	21-44
	Walker Creek	I	Essential	54.2	34.7	1900
	Willow Creek	D	Supporting	8.0	6-12	46-94
	North Coastal Diversity Stratum Recovery Target					**8,900**



CCC steelhead North Coastal Diversity Stratum

Austin Creek Population

CCC Steelhead Winter-Run

- Potentially Independent Population
- Diversity Stratum: North Coastal
- Spawner Density Target: 2,800 adults
- Current Intrinsic Potential: 95.1 IP-km

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

Abundance and Distribution

Historical fish surveys dating back to the 1950s exist for Austin Creek and its many tributary streams, and recently the lower mainstem has been monitored to quantify the numbers and sources of out-migrating juveniles. However, rigorous abundance surveys do not exist for the basin. Sporadic historical surveys indicate that steelhead were once abundant, and coho salmon were documented occasionally. Steelhead were commonly rescued and relocated to tributary streams both within and from out of the basin through the 1960s. In fall 2002, NMFS conducted systematic summer juvenile sampling in mainstem Austin Creek (at the music camp), East Austin Creek, Gilliam, Thompson, Ward, Kidd, and Bearpen Creeks. Though the data report was never finalized, the draft report indicates that Bearpen Creek had the highest densities, though steelhead in all age classes were documented at each of the other sites in fair numbers (NMFS 2003). From 2003 to 2007, the Sonoma County Water Agency (SCWA), Trout Unlimited (TU) and NMFS collaborated in an out-migrant trapping effort to quantify steelhead and salmon smolt migrations and aid the evaluation of efforts to mitigate impacts of gravel mining in the most downstream segment of Austin Creek (Katz and Hines 2007). SCWA resumed annual out-migrant trapping in 2010 for purposes of monitoring movement of juvenile steelhead from Austin Creek into the Russian River estuary. Juvenile salmon are trapped at a site located about 0.3 miles from the mouth of Austin Creek where they are tagged with Passive Integrated Transponder (PIT) tags that are used to document their subsequent movements. All age classes of juvenile steelhead have been documented moving in fair numbers to the estuary. During the springs of 2010 and 2011, the fish trap in lower Austin Creek respectively collected a total of 4,682 and, 1,974 juvenile steelhead.

History of Land Use

The steelhead population in Austin Creek occupies three major subwatersheds (Big Austin Creek, East Austin Creek and Ward Creek), which collectively contain 21 other perennial tributaries and numerous un-named intermittent streams (See Austin Creek Map). The Austin Creek watershed has had an active land use history with timber harvest occurring from the late 1800s through the turn of the century and again after World War II. The timber industry boom was short-lived, as the vast majority of harvestable redwoods had been removed by the 1900s (Clar 1954). During World War II, tractor logging of Douglas fir forests followed to provide lumber for the ever-expanding urban population in California, but as Northwestern Railroad's freight business plummeted, the same railways carried vacationers and weekend travelers who constructed vacation homes in popular destinations throughout the Lower Russian River from Rio Nido to Duncan's Mills. By the 1930s, logging roads and residences were being converted to residential roads and vacation homes to capitalize on Russian River recreation and fishing opportunities. The remains of the narrow gauge railroad, which ran from Cazadero to the headwaters of East Austin and Austin Creeks to mine magnetite, is still evident on high terraces in East Austin Creek. Effects from these mines still linger in the form of large instream gravel deposits below their source. A wild fire in the 1960s further contributed to unstable slopes and sediment erosion.

Until the early 1990s, summer dams were annually constructed out of gravel, rubble, and flashboards on the mainstem and tributaries to provide swimming opportunity for residents and the burgeoning Bay Area vacationer population. The lower 1.5 miles of Austin Creek have been mined continuously for over 60 years by Bohan and Canelis/Austin Creek Ready Mix, and periodically by early predecessors such as the railroad to Cazadero and the Sonoma County Road Department. Since 1949, approximately 1.5 million tons of aggregate material have been mined from lower Austin Creek (Cluer *et al.* 2010). Together with historic watershed uses that supplied the sediment source, these two practices reduced the channel's capacity for sediment transport, flattening the channel and filling in historic pools which provided year round summer habitat for fish.

Current Resources and Land Management

Austin Creek enters the Russian River downstream of the town of Cazadero, near the Bohan Canelis Gravel Mining Operations and Berry's Saw Mill, a currently operating sawmill. The watershed is primarily privately owned, except for portions under California State Park System ownership [e.g., Armstrong Woods State Park and Austin Creek State Recreation Areas (5,683 acres)]. Year-round residential and summer homes are scattered along the mainstem corridor and the lower 1.5 miles of East Austin Creek, though the watershed is generally lightly populated. Large acre parcels (120-320 acre minimums) are designated by Sonoma County throughout the

majority of the watershed, though 0.3 to10 acre minimums exist in Cazadero and along the lower mainstem. These riparian parcels are all on septic systems and wells, and are crisscrossed with dirt service roads (Laurel Marcus and Associates 2005).

Major land uses in the Austin Creek watershed include timber production, gravel mining and rural development. In 1991, after 116 years of ongoing practice, the construction of summer recreational dams in Austin Creek was stopped by the California Department of Fish & Game due to lack of permits and impacts on salmonid habitat. Addressing the impacts of historic gravel mining practices, NMFS recommended in 2003 that mining practices be changed so that instream gravel bars would be retained in order to confine the low flow channel, and maintain natural physical processes that scour and sort sediments and maintain fish habitat (Cluer *et al.* 2010). Logging continues on a smaller scale in the watershed and has been controversial in recent years due to concerns regarding listed salmonids and their habitat.

Resource management on private lands is largely carried out by private landowners with assistance from various Federal and state agencies (e.g., CDFW, NMFS, and Sonoma Resource Conservation District with the assistance of National Resource Conservation Service). A systematic habitat assessment of the entire watershed was conducted by the CDFW Watershed Restoration Program in the 1990s.

Salmonid Viability and Watershed Conditions

Compared to other watersheds within the Russian River basin, Austin Creek has a fairly undisturbed hydrologic regime. Habitat surveys conducted by CDFW (1998) indicate that mainstem Austin Creek has impaired salmonid rearing habitat due to low stream canopy, aggraded conditions and high levels of fine sediment. The Ward Creek, mainstem Austin, and East Austin Creek sub-basins are major areas of steelhead production due to the deep forested canyons that provide cool water and year round pools for over-summering fish. Thompson, Pole Mountain, Saint Elmo and Big Oak Creeks have natural bedrock waterfalls that inhibit anadromous fish migration, though resident rainbow trout reside above the falls.

The following indicators were rated Poor through the CAP analysis for steelhead: Habitat Complexity, Sediment Transport, Riparian Vegetation, and Estuary Lagoon. 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 were rated Fair or Poor as a result of our CAP viability analysis. The Austin Creek CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Riparian Vegetation: Composition, Cover & Tree Diameter

Altered riparian composition, often caused by stream bank armoring/clearing, invasive species establishment, historic logging, channel modification, or riparian grazing, has been identified as a limiting factor within the Russian River in CDFW stream habitat reports. In the Austin Creek watershed, riparian composition has been impacted within many of the east-side tributaries of the East Austin Creek sub-basin. Only 31% of the riparian zone is made up of larger trees that provide for bank stabilization and the future recruitment of LWD, which is lacking in this watershed. Though 12 of 16 (75% of surveyed tributaries) streams met optimal criteria (>70% canopy averaged for the stream), only 54% of the potential steelhead habitat in the Austin Creek watershed exceeds criteria. Specifically Sulphur, Bearpen, East Austin and Austin Creeks did not meet optimal canopy criteria (though these latter two are not expected to perform optimally for this variable, due to their wider channel width).

Sediment Transport: Road Density

Altered sediment transport has aggraded the mainstem of Austin Creek, reducing the number and quality of staging pools for resting adult steelhead and primary pools for juvenile steelhead rearing. Accelerated erosion from roads has increased sediment levels in the stream. Historic logging roads crisscross the headwater areas of Austin Creek. Many former logging roads have been converted to rural residential without appropriate upgrading for handling year round traffic. Frequent landslides provide adequate gravel for spawning although the increased sediment loading from roads above natural conditions reduces the quality of spawning habitat. The uppermost reaches of Austin Creek provide only fair habitat as a result of the high gravel load. Some road improvement projects have been implemented on private lands in the Ward Creek sub-basin and State Park property in the East Austin Creek sub-basin.

Estuary: Quality & Extent

The altered flow regimes caused by regulated flows out of Coyote Dam and Lake Sonoma has changed the natural hydrology of the Russian River mainstem and estuary, and artificial breaching of the barrier beach at the mouth of the river is often required to prevent flooding adjacent to the estuary. Prior to these projects, the river's estuary likely closed during summer months with a barrier beach that formed a large freshwater lagoon, providing high-quality rearing habitat for steelhead and coho salmon (NMFS 2008). Recent monitoring conducted by

SCWA indicate that a large number of juvenile steelhead originating in Austin Creek utilize the Russian River estuary for extended juvenile rearing at a rate greater than the six other Russian River steelhead populations. This heavy reliance on estuarine rearing may be due to Austin Creeks' proximity to the estuary.

Passage/Migration: Mouth of Confluence & Physical Barriers

Within the first several miles of mainstem Austin Creek, adult steelhead passage can be limited during the early and late portion of the run in some years. Road building activities and historic hard rock mining in the headwaters have aggraded and flattened the channel, reducing pool volumes and surface water flow over riffles. Previously, gravel skimming in the lower reaches and sub-surface baseflow conditions interrupted steelhead migration. Though recent progressive changes to gravel mining practices have narrowed and deepened the low flow channel, when early storms do not materialize, or storm events are spaced infrequently, the aggraded condition of the channel can inhibit out-migration of smolts during late winter and spring. Passage is also inhibited in Pole Mountain and Kidd Creeks due to County road culverts.

Habitat Complexity: Large Wood & Shelter

Data from CDFW habitat inventories indicate shelter ratings throughout the Austin Creek watershed are poor within most sampled reaches. Only 5 of 16 streams (31%) meet optimal criteria; however, mainstem Austin, Black Rock, Kidd, Clear, Ward, Bearpen, Pole Mountain, Blue Jay, Ward Creek Tributary 1, and Holmes Canyon creeks are below optimal criteria. Poor to Fair LWD ratings were also documented within tributaries, due largely to a lack of functional riparian corridors and insufficient recruitment of large conifer species from adjacent upslope areas. Only 31% of available forest timber is of a size class that could recruit to the stream channel and function as high-quality LWD.

Sediment: Gravel Quality and Quantity

Sediment: Gravel Quality conditions have a rating of Good; however, a few subwatersheds have high gravel embededdness that likely compromises spawning, egg incubation and macro-invertebrate food production. Specifically, mainstem Austin, Gray and Ward Creek Tributaries did not meet optimal criteria for gravel embededdness. Kidd Creek, which has not been habitat typed, has high embededdness levels due to the many roads and stream crossings in the watershed (Laurel Marcus and Associates 2005).

Viability: Density, Abundance & Spatial Structure

While habitat conditions exist for the transition of steelhead between lifestages, the production of smolts from the watershed may be the bottleneck in the population. This is primarily due outmigration issues related to aggradation of the watershed from the historic land uses, and more

recently from floodplain channelization of the lower mainstem, and until recently, gravel mining practices which have flattened the channel. Recent changes to gravel mining practices, and migration enhancement projects should continue to improve survivability of smolts if they continue.

Water Quality: Temperature

Significant alterations to the riparian corridor have resulted in accelerated thermal warming to many sections of the watershed. Temperatures in Bear Pen, Black Rock, Blue Jay, Lawhead, and Sulphur Creeks exceeded optimal conditions.

Other Current Conditions

Floodplain and redd scour conditions have a rating of Good for Austin Creek. These two parameters are related in that lack of floodplain increases stream velocities above natural conditions which can result in the scouring of redds that impacts the egg lifestage as well as winter rearing. These are issues for steelhead in the lower mainstem and where tributaries have been channelized for road construction and flood control and where channel incision has occurred.

Threats

The following discussion focuses on those threats that are rated as High or Very High (See Austin 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.

Agriculture

Although agriculture currently comprises less than 1% of the land acreage of Austin Creek, it remains a real future threat to this relatively undisturbed watershed. Should native forests be converted from forestland to vineyards or other crops, or to rural residential development, many of the resulting impacts can disproportionally adversely affect steelhead and their habitat, especially the increase of sediment sources from bare slopes, removal of riparian vegetation and water diversion for irrigation.

Fire, Fuel Management and Fire Suppression

Fire, Fuel Management and Fire Suppression is rated as a Medium threat in the threat summary for Austin Creek and is a historic threat. The Creighton Ridge fire (1978) burned large areas of the Austin Creek drainage, and the effects from this fire continue to substantially impair riparian and aquatic habitat throughout much of the basin (Laurel Marcus and Associates 2005). The

intense logging and land clearing during the latter half of the 18th century, combined with the Creighton Ridge fire in 1978, has shifted forest composition within much of the watershed from historical conifer/redwood stands to younger stands of conifer and oak chaparral forest in the upper and middle portion of the watershed (Laurel Marcus and Associates 2005). This shift in forest type has likely lowered wood volumes available for delivery into the stream environment. Following the fire, many areas failed to re-establish redwood/conifer dominated forests. That failure is a large reason why quality LWD and adequate shade are lacking in most of Austin Creek.

Logging and Wood Harvesting

Timber harvest remains a threat to steelhead habitat in Austin Creek, mainly from smaller, fractured ownerships which cumulatively can contribute to erosion and reduced large wood recruitment. Although much of the larger trees were removed during the previous century, forest tracts exist that could be of marketable size in the next decades. The general lack of wood within Austin Creek stream channels is likely the result of adjacent harvest and the highly flashy nature of the system, which transports out smaller woody debris during storm events.

Mining

The historic magnetite mine in the headwaters continues to bleed sediment, contributing to the aggraded condition of the channel throughout mainstem Austin Creek. Active gravel mining in the lower mainstem channel could contribute further to juvenile and adult passage issues if current gravel mining practices recommended by NMFS and CDFW are not adhered to. Recently, restoration projects and changes to gravel mining practices have improved the first mile of channel, though conditions upstream of this reach could be improved with similar treatments working cooperatively with local mining interests.

Residential and Commercial Development

Though portions of East Austin Creek are within protected ownership of the State Recreation Area, the upper portion of East Austin and the remaining watershed within the western portion is highly susceptible to increased residential development (Laurel Marcus and Associates 2005), which could greatly offset the benefits of the largely undisturbed hydrologic regime. Residential development can increase road densities, increase water diversions and groundwater pumping, remove or alter riparian habitat, and reduce water quality.

Roads and Railroads

Legacy roads from past logging and mining activity, having been adopted as year-round roads as the basin was rurally subdivided, continue to impact the Austin Creek watershed. Road densities within higher elevation, conifer-dominated landscapes increased between the 1930s and

1960s, largely the result of increased rural development in the basin (Laurel Marcus and Associates 2005). Many of these roads were poorly built due to the lack of County road standards at the time, and they are not properly maintained. Abandoned legacy timber roads may still contribute sediment to the stream channel or alter drainage patterns.

Severe Weather Patterns

Although winters in the Austin Creek watershed exhibit a coastal-type climate with an average rainfall between 75 and 120 inches, the summer and fall can be arid and more representative of a Mediterranean summer. Daytime temperatures sometime exceed 100F. Given that summer streamflows are already pressured by rural residential water extraction along the mainstem and some tributaries (e.g., Kidd Creek), long-lasting drought patterns could pose a significant threat to maintaining adequate stream flows and aquatic habitat. Severe flooding caused by climate change could also contribute to road, mining, and fire-related erosion that would increase sediment input into the already aggraded mainstem and further reduce tributary habitat quality.

Water Diversion and Impoundments

Increased water diversion resulting from residential development within Austin Creek could offset the current benefits of the relatively undisturbed hydraulic regime, impacting juvenile steelhead during summer and upstream migrating adults in late fall. Flows in mainstem Austin Creek are already compromised due to the highly aggraded nature of the channel, and further flow reductions would exacerbate this condition.

Limiting Stresses, Lifestages, and Habitats

Threat and stress analysis within the CAP workbook suggests summer juvenile and smolt survival are likely limiting steelhead abundance within the Austin Creek watershed. Increased sediment load, altered sediment transport processes, and reduced large wood quantity and recruitment are a result of landscape disturbance from historic land uses, including timber harvest, mining, and fire. Residential development and severe weather are additional future threats to existing habitat conditions.

General Recovery Strategy

Improve Habitat Complexity: LWD Volume and Shelter

Austin Creek would benefit from improved forest management that fosters eventual LWD recruitment and improved riparian composition and structure. The protection of riparian zones from timber harvest would provide a long term source of instream LWD that would create shelter for adult and juvenile fish. Adding LWD through the development of restoration projects would benefit shelter values in a shorter time span and is recommended below for specific tributaries.

Shelter ratings are Low within many surveyed stream reaches of Austin Creek. Due largely to an absence of LWD, quality pool habitat is absent and shelter components are comprised mainly of undercut banks and boulders. Specifically, mainstem Austin, Black Rock, Kidd, Clear, Ward, Bearpen, Pole MT, Blue Jay, Ward Creek and its tributaries, and Holmes Canyon Creek would benefit from LWD enhancement. A range of treatments including unanchored, and anchored LWD and boulder structures should be considered depending upon site specific conditions, access and land ownership.

Decrease Sediment Sources/Improve Substrate Quality

Maintenance on existing private roads should be improved per the recommendations of *Forest and Ranch Roads* (Weaver and Hagans 1994). Maintenance on public roads should be increased and follow the standards of the *Fishnet 4c Road Manual*. Problem roads and active erosion sites should be prioritized and addressed as part of a comprehensive sediment reduction plan for the entire Austin Creek basin. While sediment source surveys have been conducted in the Ward and East Austin Creek sub-basins, not all recommendations have been implemented and some abandoned roads remain un-surveyed. All remaining road recommendations should be implemented, and assessments should be conducted in the Black Rock, Kidd Creek, and Redslide subwatersheds. The Gilliam Creek watershed is crisscrossed with legacy logging roads, and a large landslide exists half-way upstream, which initiated as a result of un-maintained culverts on closed roads. The slide has been periodically a barrier for steelhead.

Improve Smolt and Adult Passage

Passage improvements for adult salmonids on Pole Mountain Creek should be implemented as identified in current assessments. Potential barriers on Bear Pen Creek (an old flashboard dam) and on Gilliam Creek (a debris slide) should be evaluated and remediated. Cooperative projects between NMFS, CDFW, TU and the local gravel mining company have proven to be effective in expanding the window of migration in the lower mainstem, and should be expanded further upstream where possible. These projects and passage improvements should continue to be monitored to expand the temporal window for adult and smolt migrations.

Improve Estuary Conditions

Estuarine residency has been shown to improve juvenile salmonid growth rates, which can, in turn, increase ocean survival and return rates of adult salmonids. The NMFS 2008 Russian River Biological Opinion calls for implementation of a suite of measures by the Sonoma County Water Agency to improve conditions for rearing juvenile steelhead including modification of its approach to managing water levels and flood protection in the Russian River estuary. These

activities should be implemented to improve estuarine habitat. Monitoring of estuarine water quality, fisheries, aquatic biota, and physical conditions in the estuary (depth, beach contours, etc.), continued public education, and full implementation of recommended alternatives in the Biological Opinion are all important elements to estuarine health and are critical elements to the recovery Austin Creek steelhead, as well as all other populations of steelhead and chinook in the Russian River basin.

Improve and Protect Riparian Corridors

Rural residential expansion should be discouraged except where General Plan elements are protective enough to offset impacts to this largely undeveloped watershed. Conservation easements to protect riparian resources should be evaluated and implemented where refugia areas have been identified. The Devils Creek Coho Conservation Bank is an example that may have applicability elsewhere in the watershed.

Improve Water Quality: Temperature

Re-establishing native riparian species in high priority riparian corridors will lower water temperatures, improve LWD recruitment, and limit bank erosion. Planting native riparian species and overstory species such as conifer and hardwoods in the upland areas is recommended in the East Austin Creek and upper portion of Big Austin Creek mainstem, and its tributaries, specifically Bear Pen, Black Rock, Blue Jay, Devils, Gray, Lawhead, and Sulphur Creek.

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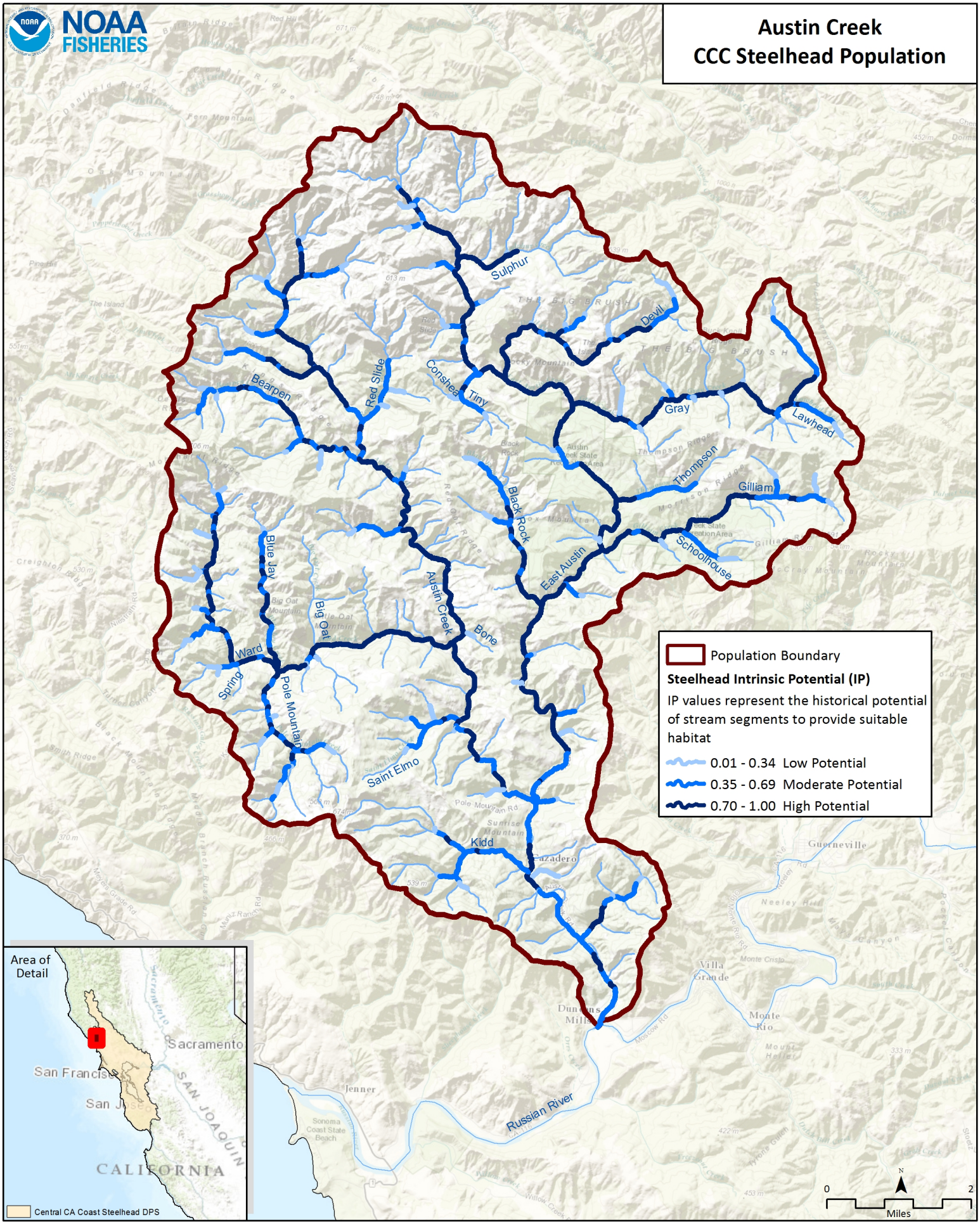
NOAA FISHERIES
Austin Creek
CCC Steelhead Population
Sulphur
Devil
Red Slide
Conshea
Tiny
Bearpen
Gray
Lawhead
Thompson
Gilliam
Black Rock
Schoolhouse
East Austin
Blue Jay
Austin Creek
Big Oat
Bone
Ward
Spring
Pole Mountain
Saint Elmo
Kidd
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values 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 Francisco
San Jose
SAN JOAQUIN
CALIFORNIA
Central CA Coast Steelhead DPS
Russian River
Jenner
Guerneville
Villa Grande
Monte Rio
0
2
Miles
N

CCC Steelhead Austin Creek CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	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% to 74% of streams/ IP-km (>1.3 Key Pieces/100 meters)	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)	76% of streams/ 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)	51% of streams/ IP-km (>80 stream average)	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 25	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% 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	80% 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	31% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		

			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	>90% of IP-km	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	75% to 90% of streams/ IP-km maintains severity score of 3 or lower	Good
		Size	Viability	Density	<1 Spawner per IP-km (Reference Spence)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		7-20 Spawners IP-km: low risk spawner density per Spence (2008)	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 25	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 25	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)	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)	75% streams/ IP-km (>50% stream average scores of 1 & 2)	Good
3	Summer Rearing Juveniles	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% 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 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)	47% of streams/ 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)	76% of streams/ 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)	51% of streams/ IP-km (>80 stream average)	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 58	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	1.19 Diversions/10 IP-km	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	80% 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	80% of IP-km	Good

			Riparian Vegetation	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy)	50% to 74% of streams/ IP-Km (>70% average stream canopy)	75% to 90% of streams/ IP-Km (>70% average stream canopy)	>90% of streams/ IP-Km (>70% average stream canopy)	54% of streams/ IP-km (>70% average stream canopy)	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	31% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			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% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT)	50 to 74% IP km (<20 C MWMT)	75 to 89% IP km (<20 C MWMT)	>90% IP km (<20 C MWMT)	75 to 89% IP-km (<20 C MWMT)	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	Density	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	0.2 - 0.6 Fish/m^2	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
4	Winter Rearing Juveniles	Condition	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	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)	76% of streams/ 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)	51% of streams/ IP-km (>80 stream average)	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	80% 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	31% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			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% 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	>80% Response Reach Connectivity	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
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)	51% of streams/ IP-km (>80 stream average)	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	1.19 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 25	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% of IP-km	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
			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)	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	0.075% 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	0.028% 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	5% 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	2.3 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	3.2 Miles/Square Mile	Poor

CCC Steelhead Austin Creek CAP Threat Results

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

Austin Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Potential Lead	Comment
AuC-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat				
AuC-CCCS-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. Projects would focus on areas near the mouth of Austin creek and the confluence of the Russian River estuary.	2	5	California Coastal Conservancy, CDFW, NMFS, NOAA NOS, NOAA RC, Private Landowners, Public Works, RWQCB, Sonoma County, Sonoma County Water Agency, State Parks, USACE	
AuC-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
AuC-CCCS-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) at existing County culvert barriers on Pole Mountain Creek and Kid Creek.	1	10	CDFW, NOAA RC, Sonoma County	
AuC-CCCS-5.1.1.2	Action Step	Passage	Continue restoration projects which employ improved gravel mining practices upstream of mile 1	1	25	CDFW, NMFS, NOAA RC, Sonoma County, Trout Unlimited, USACE	
AuC-CCCS-5.1.2	Recovery Action	Passage	Rehabilitate and enhance passage into tributaries (aggradation/degradation)				
AuC-CCCS-5.1.2.1	Action Step	Passage	Assess the log jam/slide barrier on Gilliam and Schoolhouse Creeks and implement recommendations to improve passage	1	5	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
AuC-CCCS-5.1.2.2	Action Step	Passage	Assess the old flashboard dam on Bear Pen Creek, and implement recommendations to improve passage.	1	5	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
AuC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Improve large wood frequency				
AuC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in select reaches of Bearpen, Black Rock, Kidd, Pole Mtn, and Blue Jay Creeks	2	10	CDFW, NOAA RC, Private Landowners, State Parks, Trout Unlimited	
AuC-CCCS-6.1.1.2	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>2 key LWD pieces/100 meters) in select reaches of Austin and Ward Creeks	2	5	CDFW, NOAA RC, Private Landowners	
AuC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Improve frequency of primary pools				
AuC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase primary pool frequency in 25% of streams within the Austin Creek watershed to improve conditions for adults, and summer/winter juveniles. Increase primary pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order streams; >3 feet in third order or larger streams)) in select reaches of Austin, Bear Pen, Black Rock, Blue Jay, Conshea, Devils, Gray, Holmes Canyon, Kidd, Kohute Gulch, Pole Mtn, and Schoolhouse Creeks	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
AuC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter				
AuC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase shelters in 25% of streams across the Austin Creek watershed to improve conditions for adults, and winter/summer rearing juveniles. Increase shelters to optimal conditions (>80 pool shelter value) in select reaches of Austin, Bearpen, Black Rock, Kidd, Kohute Gulch, Clear, Ward, Pole Mtn, Blue Jay, Tiny, and Ward Creeks and Holmes Canyon Creeks	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
AuC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover				
AuC-CCCS-7.1.1.1	Action Step	Riparian	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (CDFG 2004).	3	10	CDFW, NOAA RC, Private Landowners, RCD	

Austin Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Potential Lead	Comment
AuC-CCCS-7.1.1.2	Action Step	Riparian	Increase canopy in 25% of streams across the watershed. Plant native riparian species and native upland species (conifers/hardwoods), to increase canopy to optimal conditions (80% stream average) in select reaches of Sulphur, Bearpen and upper East Austin Creeks.	2	10	CDFW, NOAA RC, Private Landowners, RCD	
AuC-CCCS-7.1.2	Recovery Action	Riparian	Improve tree diameter				
AuC-CCCS-7.1.2.1	Action Step	Riparian	Increase tree diameter within 25% of watershed to achieve optimal riparian forest conditions (55 - 69% Class 5 & 6 tree) Plant native riparian species and native conifers/hardwoods in the riparian zone within the Upper and Lower Gray Creek sub-basin to increase overall tree diameter	2	20	CDFW, NOAA RC, Private Landowners, RCD	
AuC-CCCS-7.1.2.2	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers throughout the watershed (CDFG 2004).	3	25	City Planning, Land Trusts, Sonoma County	
AuC-CCCS-7.1.2.3	Action Step	Riparian	Conduct conifer release to promote growth of larger diameter trees where appropriate throughout the watershed.	3	10	Board of Forestry, Private Landowners	
AuC-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-8.1.1	Recovery Action	Sediment	Improve gravel quantity and distribution for macro-invertebrate productivity (food)				
AuC-CCCS-8.1.1.1	Action Step	Sediment	Reduce embeddedness levels to the extent that 75% to 90% of streams within the Austin Creek watershed meet optimal criteria (>50% stream average scores of 1 & 2). Implement recommendations of completed sediment source surveys in Austin and East Austin Creek mainstems, Gray Creek, and Pole Mountain Creeks (See ROADS for specific actions)	2	5	CDFW, Private Landowners, RCD, Sonoma County, Trout Unlimited	
AuC-CCCS-8.1.1.2	Action Step	Sediment	Conduct sediment source surveys in Black Rock Creek, Kidd Creek and other tributaries to identify existing sources of high sediment yield using accepted protocols and implement recommendations	3	10	Private Landowners, RCD, Sonoma County	
AuC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions				
AuC-CCCS-10.1.1.1	Action Step	Water Quality	Increase canopy in 25% of streams across the watershed. Plant native riparian species and native upland species (conifers/hardwoods), to increase canopy to optimal conditions (80% stream average) in select reaches of Sulphur, Bearpen and upper East Austin Creeks.	2	5	California Conservation Corps, CDFW, Private Landowners, State Parks	
AuC-CCCS-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria				
AuC-CCCS-11.1.1.1	Action Step	Viability	Improve smolt condition factor through the addition of Salmon Analog pellets until adult population returns reach nutrient sustaining levels.	1	10	CDFW, NMFS	
AuC-CCCS-11.1.1.2	Action Step	Viability	Continue to operate outmigrant traps in Austin Creek	2	10	CDFW, NMFS, Sonoma County Water Agency, Trout Unlimited, UC Extension	
AuC-CCCS-11.1.1.3	Action Step	Viability	Continue to monitor fish passage improvements in the lower reaches of Austin Creek	2	10	CDFW, NMFS, Private Landowners, Sonoma County Water Agency, Trout Unlimited	
AuC-CCCS-11.1.1.4	Action Step	Viability	Monitor population status for response to habitat improvements, and threat abatement through recovery action implementation	3	10	NMFS	
AuC-CCCS-11.1.1.5	Action Step	Viability	Adjust population targets and indicator ratings to reflect new habitat improvements and accessible habitat expansions	3	10	NMFS	
AuC-CCCS-11.1.1.6	Action Step	Viability	Monitor key habitat attribute indicators to ensure they move from poor or fair condition towards good condition.	3	10	NMFS	
AuC-CCCS-11.1.1.7	Action Step	Viability	Use monitoring and trend information to adjust and adapt recovery actions/strategies.	3	10	CDFW, NMFS, Sonoma County Water Agency, UC Extension	
AuC-CCCS-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				

Austin Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Potential Lead	Comment
AuC-CCCS-12.1.1.1	Action Step	Agriculture	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels (see Roads for specific actions/areas)	2	20	CDFW, Private Landowners, RCD	
AuC-CCCS-12.1.1.2	Action Step	Agriculture	Implement Best Management Practices such as those in the Fish Friendly Farming program (California Land Stewardship Institute), or other cooperative conservation programs.	3	20	NRCS, Private Landowners, RCD	
AuC-CCCS-12.1.1.3	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	
AuC-CCCS-12.1.1.4	Action Step	Agriculture	Complete Farm Conservation Plans (through the SRCD, 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	
AuC-CCCS-12.1.1.5	Action Step	Agriculture	Assess the effectiveness of erosion control measures throughout the winter period.	3	20	CDFW, NMFS, NRCS, Private Landowners, RCD	
AuC-CCCS-12.1.1.6	Action Step	Agriculture	Continue the use of cover crops in agriculture fields.	3	25	NRCS, Private Landowners, RCD	
AuC-CCCS-12.1.1.7	Action Step	Agriculture	Public works Dept.'s should utilize the Fishnet 4C Road Manual or a similar manual.	3	25	City Planning, Public Works, Sonoma County	
AuC-CCCS-12.1.1.8	Action Step	Agriculture	Livestock and Ranch Managers should 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 (Sonoma RCD, 2007), and The Grazing Handbook (Sonoma RCD, 2007)	3	20	Farm Bureau, Private Landowners, RCD	
AuC-CCCS-12.1.1.9	Action Step	Agriculture	Residential landowners should utilize the Stewardship Guide for the Russian River (Sonoma RCD, 2011), and 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 (Sonoma RCD, 2007)	3	25	CDFW, Private Landowners, RCD, RWQCB, Sonoma County Water Agency	
AuC-CCCS-12.1.1.10	Action Step	Agriculture	Forest and ranch managers should utilize the Handbook for Forest and Ranch Roads (PWA, 1994)	3	20	Private Landowners, RCD	
AuC-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure				
AuC-CCCS-12.1.2.1	Action Step	Agriculture	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to provide future recruitment of large wood and other shelter components	2	25	NRCS, Private Landowners, RCD	
AuC-CCCS-12.1.2.2	Action Step	Agriculture	Implement programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	25	Land Trusts, Sonoma County	
AuC-CCCS-12.1.2.3	Action Step	Agriculture	Utilize native plants when landscaping and discourage the use of exotic invasive	3	25	Private Landowners, RCD, UC Extension	
AuC-CCCS-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
AuC-CCCS-12.1.3.1	Action Step	Agriculture	Avoid the removal of large wood and other shelter components from the stream system	3	20	NRCS, Private Landowners, RCD	
AuC-CCCS-12.1.4	Recovery Action	Agriculture	Prevent or minimize impairment to stream hydrology (impaired water flow)				
AuC-CCCS-12.1.4.1	Action Step	Agriculture	Promote off-channel storage to reduce impacts of water diversion during the spring and summer (e.g. diversion during winter high flow).	2	10	NRCS, Private Landowners, RCD, UC Extension	
AuC-CCCS-12.1.4.2	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	3	20	NRCS, Private Landowners, RCD	
AuC-CCCS-12.2	**Objective**	**Agriculture**	**Address the inadequacies of regulatory mechanisms**				
AuC-CCCS-12.2.1	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
AuC-CCCS-12.2.1.1	Action Step	Agriculture	Develop legislation that will fund county planning for environmentally sound agricultural growth and water supply	2	20	Farm Bureau, NRCS, Sonoma County, UC Extension	
AuC-CCCS-12.2.1.2	Action Step	Agriculture	Coordinate with the agencies that authorize forest land conversions to discourage conversions to agriculture.	3	20	Board of Forestry, CDFW, Sonoma County	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Potential Lead	Comment
AuC-CCCS-12.2.1.3	Action Step	Agriculture	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do	3	25	City Planning, RWQCB, Sonoma County	
AuC-CCCS-12.2.1.4	Action Step	Agriculture	Increase setbacks of existing agricultural activities from the top of bank to 100'	3	20	City Planning, NRCS, RCD, Sonoma County	
AuC-CCCS-12.2.1.5	Action Step	Agriculture	Streamline permit processing where landowners are conducting actions aligned with recovery priorities.	3	5	CDFW, NMFS, NRCS, RCD, SWRCB, USACE	
AuC-CCCS-12.2.1.6	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	
AuC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
AuC-CCCS-13.1.1.1	Action Step	Channel Modification	In lower Austin Creek, Gray Creek and other areas where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats. (See HABITAT COMPLEXITY for specific actions/criteria).	2	10	CDFW, NOAA RC, Private Landowners, USACE	
AuC-CCCS-13.1.1.2	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. carefully evaluate feasibility where critical infrastructure is located) for bank hardening projects.	2	50	CDFW, NMFS, USACE	
AuC-CCCS-13.1.1.3	Action Step	Channel Modification	Evaluate design alternatives to riprap bank repairs. Where riprap is necessary, evaluate integration of other habitat-forming features – including large woody debris to ensure improved habitat at the restoration site.	3	25	CDFW, NMFS, USACE	
AuC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize increased landscape disturbance				
AuC-CCCS-13.1.2.1	Action Step	Channel Modification	Conduct rehabilitation activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows.	3	20	CDFW, NOAA RC, NRCS, Private Landowners, Sonoma County, USACE	
AuC-CCCS-13.1.2.2	Action Step	Channel Modification	Evaluate undeveloped and developed floodplain property for potential function and conservation easement and/or acquisition potential.	3	10	RCD, Sonoma County	
AuC-CCCS-13.1.2.3	Action Step	Channel Modification	Ensure that all future and existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	3	25	NMFS, USACE	
AuC-CCCS-13.2	**Objective**	**Channel Modification**	**Address the inadequacy of existing regulatory mechanisms**				
AuC-CCCS-13.2.1	Recovery Action	Channel Modification	Prevent or minimize increased landscape disturbance				
AuC-CCCS-13.2.1.1	Action Step	Channel Modification	Channel modifying projects should be designed to ensure potential effects to CCC steelhead habitat are fully minimized or mitigated, and where possible, existing poor conditions should be remediated.	3	20	NMFS, USACE	
AuC-CCCS-13.2.1.2	Action Step	Channel Modification	All proposed flood control projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.	3	25	NMFS, Sonoma County, USACE	
AuC-CCCS-13.2.1.3	Action Step	Channel Modification	Modify city and county regulatory and planning processes to minimize provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historical CCC steelhead watersheds.	3	20	City Planning, Sonoma County, USACE	
AuC-CCCS-13.2.1.4	Action Step	Channel Modification	Local agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	3	20	City Planning, Sonoma County	
AuC-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
AuC-CCCS-18.1.1.1	Action Step	Livestock	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take first priority for riparian fencing programs over steer operations.	2	60	CDFW, NOAA RC, NRCS, RCD	
AuC-CCCS-18.1.1.2	Action Step	Livestock	Encourage develop and fund riparian restoration projects to regain riparian corridors damaged from livestock and other causes.	2	30	NRCS, RCD	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Potential Lead	Comment
AuC-CCCS-18.1.1.3	Action Step	Livestock	Substitute continuous season-long use of pastures in favor of rotational grazing strategies to reduce runoff. Short term, seasonal and long term rest from grazing in overgrazed areas would improve soil conditions for native revegetation and land values as well.	3	60	NRCS, Private Landowners, RCD	
AuC-CCCS-18.1.1.4	Action Step	Livestock	Manage rotational grazing to aid in the reduction of noxious weeds.	3	60	NRCS, Private Landowners, RCD	
AuC-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
AuC-CCCS-18.1.2.1	Action Step	Livestock	Aid landowners willing to fence off riparian areas with development of offstream alternative water sources	2	30	CDFW, NOAA RC, NRCS, RCD	
AuC-CCCS-18.1.2.2	Action Step	Livestock	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	60	NRCS, Private Landowners, RCD	
AuC-CCCS-18.1.2.3	Action Step	Livestock	To minimize gully initiation, grazing should be kept at relatively low intensities on steeper slopes	3	60	NRCS, Private Landowners, RCD	
AuC-CCCS-18.1.2.4	Action Step	Livestock	Establish conservative residual dry matter (RDM) target per acre that ensures area is not overgrazed with 1000 lbs RDM (residual dry matter)/acre left at end of grazing season. Remove cattle from pasture before soils dry out.	3	25	NRCS, Private Landowners, RCD	
AuC-CCCS-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
AuC-CCCS-19.1.1.1	Action Step	Logging	Encourage forest management which allows for optimal levels of natural LWD recruitment of larger older trees into stream channels	2	60	Board of Forestry, NMFS, Private Landowners, Sonoma County, State Parks, US EPA	
AuC-CCCS-19.1.1.2	Action Step	Logging	Acquire key large tracts of forestlands identified as a priority by Federal, State, local government, and non-governmental organizations	3	60	CDFW, NMFS, RCD, Sonoma County, State Parks	
AuC-CCCS-19.1.1.3	Action Step	Logging	Conserve and manage forestlands for older forest stages.	3	60	Board of Forestry, CDFW, NMFS, Sonoma County, State Parks, USEPA	
AuC-CCCS-19.1.2	Recovery Action	Logging	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
AuC-CCCS-19.1.2.1	Action Step	Logging	Develop a Road Sediment Reduction Plan that prioritizes problem sites and outlines implementation and a timeline of necessary actions.	3	5	Board of Forestry, CalFire, CDFW, Private Landowners, RCD	
AuC-CCCS-19.1.2.2	Action Step	Logging	Prevent or minimize future sediment and runoff sources from logging by utilizing BMP's that prevent or minimize delivery of sediment and runoff to stream channels.	3	25	CalFire, Private Landowners, RCD	
AuC-CCCS-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
AuC-CCCS-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
AuC-CCCS-19.2.1.1	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	2	CalFire, CDFW, NMFS	
AuC-CCCS-19.2.1.2	Action Step	Logging	Establish greater oversight and post-harvest monitoring by the permitting agency for operations within high value habitat areas	3	10	NMFS, State	
AuC-CCCS-19.2.1.3	Action Step	Logging	Provide information to BOF regarding CCC steelhead priorities and recommend upgrading relevant forest practices.	3	2	CalFire, CDFW, NMFS	
AuC-CCCS-20.1	**Objective**	**Mining**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-20.1.1	Recovery Action	Mining	Prevent or minimize impairment to passage and migration				
AuC-CCCS-20.1.1.1	Action Step	Mining	Improve passage where mining and other activities have resulted in diminished migration windows	1	20	CDFW, NMFS, Private Landowners, Sonoma County, USACE	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Potential Lead	Comment
AuC-CCCS-20.1.1.2	Action Step	Mining	Continue projects to improve adult and smolt migration, habitat complexity and maintenance of low flow channels in reaches upstream of active mining areas in cooperation with existing gravel mining operations (e.g.. construction of pools, alcoves, and LWD)	2	20	CDFW, NMFS, Private Landowners, Sonoma County, Trout Unlimited, USACE	
AuC-CCCS-20.1.1.3	Action Step	Mining	Gravel mining practices recommended by NMFS and CDFW should be used and followed in new mining practices.	2	20	CDFW, NMFS, Private Landowners, Sonoma County, USACE	
AuC-CCCS-20.1.1.4	Action Step	Mining	Outmigrant monitoring and physical monitoring (cross sections, longitudinal profiles, etc.) should continue to document channel conditions, and expand knowledge of migrating smolt patterns	3	10	CDFW, NMFS, Private Landowners, Sonoma County Water Agency, Trout Unlimited	
AuC-CCCS-20.1.2	Recovery Action	Mining	Prevent or minimize impairment to instream habitat complexity (altered pool complexity and/or pool riffle ratio)				
AuC-CCCS-20.1.2.1	Action Step	Mining	Develop and enhance staging pool habitats and thalweg depth where geomorphic conditions dictate and allow	2	5	CDFW, Counties, NMFS, Private Landowners, USACE	
AuC-CCCS-20.1.2.2	Action Step	Mining	Continue to implement and support BMP's which improve, maintain or prevent impacts to habitat complexity when reviewing new mining plans.	3	5	CDFW, Counties, NMFS, Private Landowners, USACE	
AuC-CCCS-20.1.3	Recovery Action	Mining	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
AuC-CCCS-20.1.3.1	Action Step	Mining	Develop and enhance offchannel habitats such as alcoves to promote fry and juvenile rearing habitat	2	10	CDFW, Counties, NMFS, Private Landowners, USACE	
AuC-CCCS-20.1.3.2	Action Step	Mining	Retain LWD, boulders and vegetation on riffles where structure is beneficial to migration and resting cover	3	20	CDFW, Counties, NMFS, Private Landowners, USACE	
AuC-CCCS-22.1	**Objective**	**Residential/Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-22.1.1	Recovery Action	Residential/Commercial Development	Prevent or minimize reduced density, abundance, and diversity				
AuC-CCCS-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	
AuC-CCCS-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	
AuC-CCCS-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	
AuC-CCCS-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	
AuC-CCCS-22.1.2	Recovery Action	Residential/Commercial Development	Prevent or minimize increased landscape disturbance				
AuC-CCCS-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	
AuC-CCCS-22.1.2.2	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	
AuC-CCCS-22.1.2.3	Action Step	Residential/Commercial Development	Identify areas at high risk of conversion from forest land to rural resident etc., and develop incentives and alternatives for landowners that discourage conversion.	3	25	CDFW, Counties, NMFS, Private Landowners, RCD	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Potential Lead	Comment
AuC-CCCS-22.1.2.4	Action Step	Residential/Commercial Development	Design new developments to minimize the impacts to 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	
AuC-CCCS-22.1.2.5	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	
AuC-CCCS-22.1.2.6	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	
AuC-CCCS-22.1.3	Recovery Action	Residential/Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
AuC-CCCS-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	
AuC-CCCS-22.1.3.2	Action Step	Residential/Commercial Development	Residential landowners should utilize BMP's from Basins Of Relations: A Citizen's Guide to Protecting and Restoring Our Watersheds (OAEC, 2007), Slow it. Spread it. Sink it! (Santa Cruz Resource Conservations District, 2009) to conserve water resources	3	25	CDFW, City Planning, Private Landowners, Public Works, Sonoma County Water Agency, SWRCB	
AuC-CCCS-22.2	**Objective**	**Residential/Commercial Development**	**Address the inadequacy of existing regulatory mechanisms**				
AuC-CCCS-22.2.1	Recovery Action	Residential/Commercial Development	Prevent or minimize reduced density, abundance, and diversity				
AuC-CCCS-22.2.1.1	Action Step	Residential/Commercial Development	Implement performance standards in Stormwater Management Plans.	3	100	Mendocino County, Private Landowners, Sonoma County	
AuC-CCCS-22.2.2	Recovery Action	Residential/Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
AuC-CCCS-22.2.2.1	Action Step	Residential/Commercial Development	Avoid, or at a minimum 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, USEPA	
AuC-CCCS-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, RWQCB	
AuC-CCCS-22.2.3	Recovery Action	Residential/Commercial Development	Prevent or minimize increased landscape disturbance				
AuC-CCCS-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	
AuC-CCCS-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	
AuC-CCCS-22.2.3.3	Action Step	Residential/Commercial Development	Enforce existing building permit programs to minimize unpermitted construction.	3	100	Cities, Counties	
AuC-CCCS-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	
AuC-CCCS-22.2.3.5	Action Step	Residential/Commercial Development	Minimize new construction in undeveloped areas within the 100-year flood prone zones in all historical CCC steelhead watersheds.	3	5	CDFW, NMFS, Sonoma County	
AuC-CCCS-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	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Potential Lead	Comment
AuC-CCCS-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	
AuC-CCCS-22.2.3.8	Action Step	Residential/Commercial Development	Explore the use of conservation easements to provide incentives for private landowners to preserve riparian corridors	2	10	Land Trusts, Private Landowners, RCD	
AuC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
AuC-CCCS-23.1.1.1	Action Step	Roads/Railroads	In the Big Austin Creek watershed, implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources.	2	10	Private Landowners, Public Works, RCD	
AuC-CCCS-23.1.1.2	Action Step	Roads/Railroads	In the East Austin Creek watershed, implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources. Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	2	10	Private Landowners, Public Works, RCD, State Parks	
AuC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	2	10	Private Landowners, Public Works	
AuC-CCCS-23.1.1.4	Action Step	Roads/Railroads	Decommission riparian roads and skid trails on forestlands that deliver sediment into adjacent watercourses. High priority streams identified by DFG habitat reports include Sheephouse Creek, Austin and East Austin Creeks, Blackrock Creek, Kidd Creek, Gilliam Creek, Pole Mountain, Conshea Creek, and Schoolhouse Creek (CDFG 2009).	3	20	NRCS, Private Landowners, Public Works, State Parks	
AuC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
AuC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Assess private road stream crossings for barrier potential and implement recommendations	1	5	CDFW, Private Landowners, RCD, Trout Unlimited	
AuC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Implement public road barrier survey recommendations in high then medium value areas as a priority (See Passage)	2	5	CDFW, Private Landowners, Sonoma County, State Parks	
AuC-CCCS-23.1.2.3	Action Step	Roads/Railroads	Utilize BMP's to upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	3	25	Private Landowners, Public Works, State Parks	
AuC-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
AuC-CCCS-23.1.3.1	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips	2	25	Private Landowners, Public Works, RCD, State Parks	
AuC-CCCS-23.1.3.2	Action Step	Roads/Railroads	Utilize BMP's to upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	2	25	Private Landowners, Public Works, State Parks	
AuC-CCCS-23.1.3.3	Action Step	Roads/Railroads	Utilize best management practices for road construction, maintenance, management and decommissioning (e.g. Fishnet 4c County Roads Manual; Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	2	20	Private Landowners, Public Works	
AuC-CCCS-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
AuC-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
AuC-CCCS-23.2.1.1	Action Step	Roads/Railroads	Prevent or minimize sediment sources on newly constructed roads	3	60	CalFire, CalTrans, County Planning, NMFS, NRCS, Private Landowners, Public, RCD, Sonoma County	
AuC-CCCS-23.2.1.2	Action Step	Roads/Railroads	Utilize best management practices for road construction (e.g. Fishnet 4c County Roads Manual; Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	3	25	Private Landowners, Public Works, Sonoma County	

Austin Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Potential Lead	Comment
AuC-CCCS-23.2.1.3	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	60	CalTrans, CDFW, Sonoma County, State Parks	
AuC-CCCS-24.1	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
AuC-CCCS-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to watershed hydrology				
AuC-CCCS-24.1.1.1	Action Step	Severe Weather Patterns	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts and floods while also providing for salmonid recovery needs.	3	20	Board of Forestry, CA Coastal Commission, California Coastal Conservancy, California Department of Mines and Geology, Caltrans, CDFW, CDFW Law Enforcement, City Planning, Farm Bureau, FEMA, NMFS, NRCS, Public Works, RWQCB, State Parks, SWRCB, USACE, USEPA, USGS, Water Agencies	
AuC-CCCS-24.2	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species continued existence**				
AuC-CCCS-24.2.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to watershed hydrology				
AuC-CCCS-24.2.1.1	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	
AuC-CCCS-24.2.2	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
AuC-CCCS-24.2.2.1	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	
AuC-CCCS-24.2.2.2	Action Step	Severe Weather Patterns	Evaluate the rate and volume of water diversions and in streams and tributaries and, where appropriate, minimize water withdrawals that could impact steelhead and Chinook salmon.	3	10	CDFW, NMFS, Private Landowners, SWRCB	
AuC-CCCS-24.2.2.3	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).	3	100	CDFW, NMFS, Private Landowners, SWRCB	
AuC-CCCS-24.2.2.4	Action Step	Severe Weather Patterns	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	3	10	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	
AuC-CCCS-24.2.2.5	Action Step	Severe Weather Patterns	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.	3	10	CDFW, RWQCB, Sonoma County Water Agency, State Parks	
AuC-CCCS-24.2.3	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to water quality (impaired stream temperature)				
AuC-CCCS-24.2.3.1	Action Step	Severe Weather Patterns	Maintain canopy levels at desirable levels in all streams and restore canopy levels to desirable levels in high value habitat areas (See WATER QUALITY for specific actions/areas	2	25	CDFW, NOAA RC, Private Landowners, State Parks, Trout Unlimited	
AuC-CCCS-25.1	**Objective**	**Water Diversion/Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
AuC-CCCS-25.1.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				

Austin Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Potential Lead	Comment
AuC-CCCS-25.1.1.1	Action Step	Water Diversion/Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	3	20	CDFW, Farm Bureau, NRCS, Sonoma County Water Agency, SWRCB	
AuC-CCCS-25.1.1.2	Action Step	Water Diversion/Impoundment	Promote the use of reclaimed water for agricultural or other uses.	3	60	CDFW, RCD, Sonoma County Water Agency, State Parks	
AuC-CCCS-25.1.1.3	Action Step	Water Diversion/Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	1	20	CDFW, NMFS, NOAA RC, Private Landowners, RCD, RWQCB, Sonoma County, Sonoma County Water Agency, SWRCB	
AuC-CCCS-25.1.1.4	Action Step	Water Diversion/Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	3	30	NMFS, RCD, RWQCB, Sonoma County Water Agency, SWRCB	
AuC-CCCS-25.1.2	Recovery Action	Water Diversion/Impoundment	Prevent or minimize reduced density, abundance, and diversity				
AuC-CCCS-25.1.2.1	Action Step	Water Diversion/Impoundment	Adequately screen water diversions to prevent juvenile salmonid mortalities.	1	10	CDFW, NMFS, NOAA RC	
AuC-CCCS-25.2	**Objective**	**Water Diversion/Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
AuC-CCCS-25.2.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
AuC-CCCS-25.2.1.1	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.	1	5	CDFW, County Planning, Farm Bureau, NMFS, NOAA NWS, NOAA RC, NRCS, Private Landowners, RCD	
AuC-CCCS-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.	1	5	CDFW, County Planning, Farm Bureau, NMFS, NOAA NWS, NOAA RC, NRCS, Private Landowners, RCD, Water Agencies	
AuC-CCCS-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.	1	5	CDFW, County Planning, Farm Bureau, NMFS, NOAA NWS, NOAA RC, NRCS, Private Landowners, RCD, Water Agencies	
AuC-CCCS-25.2.1.4	Action Step	Water Diversion/Impoundment	Request that SWRCB review and/or modify water use based on the needs of steelhead and authorized diverters (CDFG 2004).	3	5	CDFW, RCD, RWQCB, Sonoma County, Sonoma County Water Agency, SWRCB	
AuC-CCCS-25.2.1.5	Action Step	Water Diversion/Impoundment	Evaluate requests for on-stream dams above migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (CDFG 2004).	3	5	CDFW, SWRCB, USACE	
AuC-CCCS-25.2.1.6	Action Step	Water Diversion/Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	15	NMFS, RWQCB, SWRCB	

Green Valley Creek Population

CCC Steelhead Winter-Run

- Role within DPS: Potentially Independent Population
- Diversity Stratum: North Coastal
- Spawner Density Target: 1,000 adults
- Current Intrinsic Potential: 24.9 IP-km

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

Abundance and Distribution

Historical fish surveys dating back to the 1950s and 1960s exist for Green Valley and its tributary streams and describe in general the habitat conditions and distribution of native fishes, though no rigorous historical abundance surveys exist for the basin (CDFG 2006). Steelhead were commonly rescued and relocated to tributary streams both within and from out of the basin through the 1960s, reflecting low baseflow conditions that still persist today. The first extensive historical survey occurred in 1966, reporting steelhead commonly throughout the sixteen miles of the survey. In 1969, it was reported that the numbers of non-game fish moving downstream toward the confluence with the Russian River increased, while the number of juvenile steelhead decreased through the same area (a reflection of poorer habitat conditions still existing today). No non-game fish were observed upstream of the confluence with Atascadero Creek. Approximately 4.4 miles of stream was estimated to be suitable for steelhead spawning (near the Highway 116 bridge and upstream of the confluence with Atascadero Creek). Through the 1970s sporadic surveys were conducted. In 1984, over 30,000 juvenile steelhead were released into Green Valley and Atascadero creeks from the Warm Springs Hatchery. Abundance and distribution surveys were conducted in 1991 though few steelhead were documented over the three reaches sampled. In 1994, the California Department of Fish and Wildlife (CDFW) conducted a systematic habitat survey of the entire watershed that also included biological inventories to describe summer juvenile and adult general abundance and distribution in all tributaries (CDFG 2006).

Since 2005, annual juvenile, smolt and adult monitoring has been conducted in Green Valley Creek by the University of California Cooperative Extension (UCCE) under contract to CDFW as part of the Russian River Captive Broodstock Program, and more recently to assist estuarine monitoring being conducted by the Sonoma County Water Agency (SCWA). While the focus of

this program has been coho salmon, juvenile steelhead have been incidentally captured and enumerated, though adult and smolt numbers provide limited information as the trapping timeline has only covered a portion of the steelhead adult/smolt migration period (R. Coey, NMFS, personal communication, 2012).

History of Land Use

European settlement brought large scale logging in the Green Valley Creek watershed during the first half of the 20th Century, followed by extensive grazing and tree cutting for coal production. Agricultural activities and small ranchettes expanded during the mid-1900s with cultivation of apple orchards, followed by prunes, then wine grapes. The Boudreau report was part of a 1978 Sonoma County Green Valley study that addressed groundwater concerns in the lower watershed area as well as the concerns of many residents at the time regarding conversion of agricultural land to rural residential development (Sonoma County Community and Environmental Services 1978). The study recognized that almost all the housing in the watershed used domestic wells and septic systems, and that additional housing development could reduce groundwater below levels needed to support the housing. Despite this 1978 study, rural residential housing development in the watershed has continued without additional municipal water supply development (Laurel Marcus and Associates 2003). Seasonal flashboard dams used for irrigation, frost protection, and domestic water supply were common in Green Valley, Atascadero and Purrington Creeks, and although the structures remain, few of these are operational today.

Current Resources and Land Management

The Green Valley watershed encompasses approximately 38 square miles, stretching from Barnett Valley Road and the town of Occidental at its southern end and joining the mainstem of the Russian River at Rio Dell (Laurel Marcus and Associates 2003). Primary tributary streams are Atascadero Creek, Jonive Creek, Purrington Creek, and Green Valley Creek (See Green Valley Creek map showing the overall watershed and its subwatersheds). Current land uses include orchards, vineyards, pasture, and rural development. There are two sewage disposal facilities and two quarries (CDFG 2006).

In general, the watershed has a mixture of land uses: urban/rural residential, intensive agriculture, and a relatively large number of public and private roads (Laurel Marcus and Associates 2003). Resource management on private lands is largely carried out by private landowners with assistance from various Federal and state agencies (e.g., CDFW, NMFS and Goldridge Resource Conservation District with the assistance of National Resource Conservation Service). A systematic habitat assessment of the entire watershed was conducted by the CDFW

Watershed Restoration Program in the 1990s. Recently, Trout Unlimited has conducted numerous restoration projects primarily for erosion control, fish passage, and instream habitat enhancement.

Salmonid Viability and Watershed Conditions

Habitat surveys conducted by CDFW (CDFG 2006) indicate that the lower reaches of Green Valley Creek and much of Atascadero Creek are marginal for salmon and steelhead habitat, consisting of long, deep glide habitats constrained by poor shelter levels, high water temperatures and high gravel embededdness (CDFG 2006). The unstable and steep banks in these reaches limit instream habitat improvement alternatives. Upstream of the Atascadero Creek confluence and within Purrington, Redwood, and Jonive creeks, conditions are better with ample rearing habitat and canopy shading, although instream shelter and riffle habitat for spawning is lacking. Stream bank erosion is prevalent in many areas due to the incised nature of the channel. The following indicators were rated Poor through the CAP analysis for steelhead: Riparian Vegetation, Sediment, Velocity Refuge, Habitat Complexity, Hydrology, Passage/Migration, Water Quality, Landscape Patterns, Sediment Transport, and Viability (Smolts). 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 were rated Fair or Poor as a result of our CAP viability analysis. The Green Valley Creek CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Estuary: Quality & Extent

Please see the Russian River Overview for a complete Estuary discussion.

Sediment Transport: Road Density

Sediment transport function in the watershed has been interrupted by historic logging roads and culverts which crisscrossed the headwater areas of Green Valley Creek. Roads in the lower floodplain have been converted to rural residential usage without appropriate upgrading for handling year round traffic or minimizing surface erosion, and culvert sizes are inadequate to handle higher runoff from impervious surfaces and ditching resulting in increased channel velocities. County and private roads often parallel the riparian zone, limiting the natural meandering of the stream. Though passage improvements have been conducted by the County and private organizations to assist adult migration, the retro-fits have not improved sediment transport through these undersized culverts. Consequently, the uppermost reaches of Green

Valley Creek provide only fair spawning habitat quantity and quality, due to high embeddedness and infrequent gravel deposits.

Velocity Refuge: Floodplain Connectivity

Low large woody debris volume and limited access to seasonally inundated floodplain habitat likely impact the winter survival of juveniles throughout the Green Valley Creek watershed. Over-wintering fish require adequate resting and feeding cover to survive long winters with high velocities. Channel modification and incision have separated the stream channel from its natural floodplain throughout the year, except at extreme flood flows when salmonids can be flushed out to agricultural and grazing lands. Displaced fish may become trapped and stranded outside the stream channel during the declining limb of the hydrograph.

Hydrology: Redd Scour

In incised or channelized reaches, winter storms are confined within the channel due to the lack of near-stream floodplain, increasing stream velocities over and through riffles where steelhead lay their eggs in redds. Steelhead redds already hampered by high fine sediment levels are further threatened by these high winter flows, which can scour out and expose steelhead eggs to sediments, light and fungus.

Hydrology: Baseflow & Passage Flows

Impaired water flow is the primary concern for summer rearing juvenile salmonids in Green Valley Creek watershed. Though bedrock reaches maintain year-round pools, the thin riparian corridor in most reaches does not buffer against high temperatures in hotter months/years. UCCE has documented pools in alluvial reaches which have routinely dried up during July or August in recent years. Recently, fish rescues, which have been performed by CDFW, UCCE and dedicated volunteers in the Green Valley Creek mainstem to relocate stocked captive broodstock released coho salmon (and incidentally steelhead), have helped to improve summer survivability of steelhead juveniles when they are moved to pools/reaches with available carrying capacity.

Hydrology: Impervious Surfaces

Watershed hydrology has been highly altered by channel modification, floodplain loss, roads and culverts, and residential/agricultural development. Spawning gravel recruitment is limited, while high velocity winter flows continue to erode finer sediments from incised channels that are deposited in the flatter mainstem channels of Green Valley and Atascadero Creeks. Fine sediment aggradation limits macro-invertebrate production in these lower reaches, offsetting the benefits of year-round flows and the wetland, backwater nature of these habitats. Though the percentage of impervious surfaces within the watershed is rated as very good, the numerous roads, ditches and culverts have altered the natural hydrograph, and flood flows can be characterized as flashy.

These conditions impact winter rearing in the higher gradient reaches, and summer rearing in the lower gradient reaches. Adult steelhead spawning is limited to relatively few reaches in higher gradient channels, where gravels can be retained by boulders or bedrock, and which can be susceptible to high embeddedness or redd scouring from high flows.

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

Riffle habitats utilized by spawning adults are lacking throughout the watershed, due largely to undersized culverts, an absence of gravel-retaining LWD, and stabilization of stream banks. Quality pool habitat for juvenile rearing is absent in many areas where the channel bed has lowered, and water demand from diversions exceed water supply from headwater areas. A few deep pools exist where flows persist year-round over bedrock outcrops in the upper watershed.

Habitat Complexity: Large Wood & Shelter

None of the nine tributaries surveyed meet optimal criteria for shelter, rating Poor to Fair; available shelter habitat is comprised mainly of undercut banks and boulders. The Poor shelter ratings are due largely to a lack of functional riparian corridors and limited recruitment of large conifer or evergreen species from adjacent upslope areas (CDFG 2006). GIS data indicated only 15% of forest timber is in size classes that would allow future recruitment to the stream channel. Large woody debris that is recruited naturally is often removed by landowners due to concerns for erosion in the highly incised areas of the channel.

Sediment: Gravel Quality & Distribution of Spawning Gravels

Although the CAP workbook indicates gravel quality rates Fair for the watershed, embeddedness levels are only good in the smaller tributaries, including Jonive, Redwood and Castellini Creeks. Green Valley, Atascadero, and Purrington creeks have high gravel embededdness that likely compromises spawning, egg incubation, and macro-invertebrate food production.

Viability: Density, Abundance & Spatial Structure

Summer and winter rearing are the primary bottlenecks to steelhead production in Green Valley Creek. Migration of adults is now relatively unimpaired, and outmigration of smolts should be fair given the lack of barriers and low gradient. Summer rearing conditions can be improved through pool and shelter development throughout the watershed; however, the enhancement of winter rearing conditions in higher gradient areas is limited to areas where the incised channel is flanked by bedrock or coarse substrate. Decreasing sediment sources and improving water quality would improve food supply for winter rearing steelhead in lower gradient reaches. Expanding riparian corridors for LWD and gravel recruitment would improve adult spawning potential.

Water Quality: Turbidity or Toxicity

A lack of juvenile and resident steelhead, and a general lack of other aquatic fishes and invertebrates in lower Green Valley and Atascadero Creeks may suggest that water quality may be limiting fish abundance, as upstream of the Atascadero Creek confluence, salmonids and other fishes are routinely encountered. Water quality monitoring should be performed to document the cause and source of these observations.

Other Current Conditions

Recent abundance and distribution surveys by UCCE have documented high numbers of predatory non-native piscivores fish species, such as bluegill and green sunfish. Presumably, these fish are flushed from stock ponds during high flow events and become summer residents in Green Valley Creek. UCCE biologists have theorized that low survival estimates previously enumerated may be confounded by predacious fish within isolated pools, or incidentally caught together with salmonids during trapping events (M. Obedzinski, UCCE, personal communication, 2012).

Threats

The following discussion focuses on those threats that rate as High or Very High (See Green Valley Creek CAP Results). Recovery strategies will likely focus on ameliorating threats rated as High; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts.

Agriculture

The expansion of agricultural practices that have reduced riparian corridors and the recruitment of LWD has taken place throughout the lower gradient reaches of Green Valley and Atascadero Creeks. Only 15% of the watershed riparian forest is made up of larger tree classes that have the potential to stabilize banks and provide a long term source of LWD. Domestic and agricultural water diversions likely lower summer baseflows, disconnecting aquatic habitat and elevating instream temperatures. Agriculture operations that encroach into adjacent riparian areas, reducing buffer width and increasing soil exposure, can increase sediment delivery to the stream as well as impact shading and wood recruitment.

Channel Modification

Channel modification (e.g., floodplain and riparian removal) has been the largest impact to salmonid resources in Green Valley Creek and its tributaries. Only an estimated 30 percent of the stream channel network is connected to the floodplain. This compromises winter rearing success because juveniles cannot find refugia from high velocities and are flushed from high quality

headwater rearing habitat into downstream marginal mainstem or river habitat. In many areas, channel modification has caused channel incision, over-steepened banks, high stream velocities, bank erosion, gravel embeddedness, and the loss of mature riparian trees.

Livestock Farming and Ranching

Cattle and other livestock grazing have decreased the density of under-story riparian species that provide habitat for terrestrial invertebrates, which are food for rearing juvenile salmonids. Cattle grazing and loafing within riparian corridors have led to bank erosion and high gravel embeddedness, impacting egg incubation and spawning success.

Mining

Gravel mining is an ongoing and future threat that can alter sediment transport processes. Channel aggradation can occur if mining practices remove instream bars, thereby flattening the channel, whereas channel degradation can occur if mining practices exceed the sediment replenishment rate of the watershed. Active gravel mining in the mainstem lower channel could contribute further to juvenile and adult passage issues if current gravel mining practices recommended by NMFS and CDFW are not strictly adhered to.

Residential and Commercial Development

Existing residential and commercial developments and the potential future conversion of rural larger ranchette and agricultural parcels to residential or commercial are the primary future threat for Green Valley Creek salmonids. Increased road densities associated with residential/commercial development can increase fine sediment delivery to streams. The conversion of large ranchettes to water-intensive uses, such as agriculture or residential development, can stress already depleted summer streamflows. Summer juvenile habitat is currently lacking and in poor quality within Green Valley Creek, and summer baseflows are often absent where domestic/agricultural water demand exceeds recharge capacity.

Roads and Railroads

Road density is high in Green Valley Creek, both within the riparian zone and upslope areas. Road development has altered the natural flow of water through the watershed as well as interrupted sediment transport, often causing channel degradation below undersized culverts. This has led to channel incision and fish passage issues at several crossings. The 2008 Green Valley Creek Watershed Assessment and Erosion Prevention Planning Project (PWA 2008) identified that many existing roads are not maintained adequately, which contributes sediment to streams, and culverts are undersized, which reduces spawning gravel availability. Many culverts within the watershed are at risk of failing or causing flow diversion.

Severe Weather Patterns

Though winters in the Green Valley Creek watershed exhibit a coastal-type climate, summer streamflows are pressured by rural residential diversions/pumping along the mainstem and tributaries to such a degree that long-lasting drought patterns could pose a significant threat to maintaining adequate streamflows and aquatic habitat during the late summer and fall. Flooding can either improve or degrade streams through the initiation or acceleration of erosional processes, respectively depending upon the stability or resiliency of the stream channel. However, for Green Valley Creek, severe flooding accelerates erosion and scours redds in the incised channels and increases road surface erosion in this developed watershed.

Water Diversion and Impoundments

Though several earthen dams occur in the upper watershed, the number of reported stream diversions is low, with the chief water demand occurring in the summer from creek-side residential and agricultural development. Frost protection in the spring is also potentially of concern. Currently, studies by UCCE and National Fish and Wildlife Foundation are being conducted to quantify water demand and supply within the basin and to identify water conservation projects and opportunities in cooperation with watershed landowners.

Limiting Conditions, Lifestages, and Habitats

Threat and condition analysis within the CAP workbook suggests summer and winter juvenile survival are the factors limiting steelhead abundance within the Green Valley Creek watershed. Altered watershed processes, increased sediment load, altered sediment transport processes, and reduced large wood quantity and recruitment are a result of landscape disturbance from historic adjacent land-uses including historic timber harvest, and current agriculture, livestock raising, mining, and the effects of residential development. Increased residential development and severe weather are future threats to existing habitat conditions. Restoration actions should target addressing these issues within high-potential habitat stream reaches.

General Recovery Strategy

In general, recovery strategies will 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.

Improve & Conserve Water Resources

Efforts need to focus on continuing and supporting studies being conducted to quantify water demand and supply, and identifying water conservation projects and opportunities in

cooperation with watershed landowners in Green Valley Creek mainstem (consider expanding these studies to include Purrington Creek). One example of such an opportunity is the imprinting of coho salmon from the captive broodstock program in a small instream flashboard dam temporarily installed in cooperation with landowners and CDFW. Ironically, several flashboard dams in the upper watershed that are no longer operated may have ameliorated or masked the effects of high residential water demand. We recommend reevaluating the benefits of these types of structures, which may have provided recharge or persistent baseflow benefits (simulating beaver dams that are no longer present) to rearing steelhead.

Improve Water Temperatures and Water Quality

Planting trees to improve over-story conditions and stream temperatures is recommended for lower Green Valley and Atascadero Creeks. Investigating sources of poor water quality conditions and remediating them is recommended for Atascadero Creek.

Address Upslope Sediment Sources

Maintenance on existing private roads should be improved per the recommendations of *Forest and Ranch Roads* (Weaver and Hagans 1994). Maintenance on public roads should be increased and follow the standards of the *Fishnet 4c Road Manual* (FishNet 4C 2004). PWA (2008) identifies a total of 145 sites with the potential to deliver over 15,182 yd^3 of sediment to streams if left untreated and recommends that 127 of these sites and road segments be treated for erosion control, and an additional 11 miles of road surfaces and/or ditches (representing over 39% of the total inventoried road mileage) currently draining to stream channels either directly or via gullies be treated for prevention. From these hydrologically connected road segments, it is estimated that over 9,703 yd^3 of sediment could be delivered to stream channels within the watershed area over the next decade if no efforts are made to change road drainage patterns. The expected benefit of completing the erosion control and prevention planning work outlined in this report lies in the reduction of long-term sediment delivery to Green Valley Creek, its tributaries, and the Russian River.

Improve Habitat Complexity and Shelter Ratings

Shelter ratings are low within many surveyed stream reaches of Green Valley Creek. Where applicable, restoration efforts should incorporate instream wood/boulder structures into degraded reaches to improve habitat complexity and shelter availability. Specifically, Green Valley and Purrington creeks would benefit from LWD enhancement. A range of treatments, including un-anchored and anchored structures, should be considered depending upon site-specific conditions, access and land ownership.

Expanding opportunities for spawning and rearing habitat, such as constructing structures for pool development and enhancement, and trapping of spawning gravels, is recommended for upper Green Valley, Purrington Creeks and tributaries to Atascadero.

Protect Riparian Corridors and Refugia Areas

Existing riparian corridors should be protected and where opportunities exist, riparian buffers should be widened and/or floodplain areas lowered to benefit wintertime rearing. Rural residential expansion should be discouraged except where General Plan elements are protective enough to offset impacts to this largely undeveloped watershed. Conservation easements to protect riparian resources should be evaluated and implemented where refugia areas have been identified with willing landowners. Confining livestock out of riparian corridors in upper Green Valley and Atascadero creeks has been conducted and will continue to eliminate concerns for temperature and/or poor water quality from livestock browsing and loafing if fences are maintained. Projects to limit access by livestock in any areas where livestock currently have access should be implemented. Existing and future agricultural practices should follow accepted best management practices such as those used in the Fish Friendly Farming program to protect and enhance salmonid resources and water quality.

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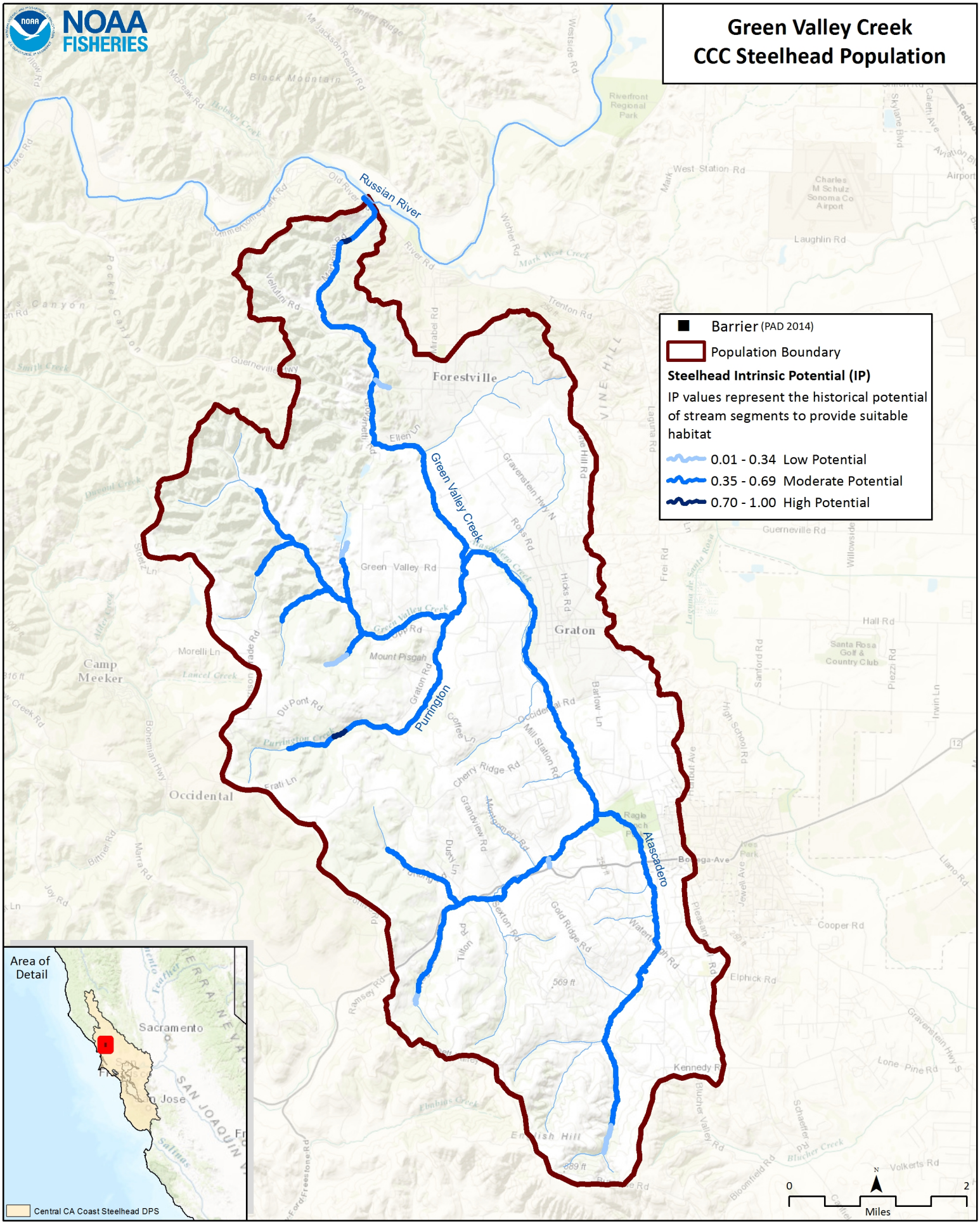
NOAA FISHERIES
Green Valley Creek
CCC Steelhead Population
Barrier (PAD 2014)
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Russian River
Green Valley Creek
Purrington
Atascadero
Forestville
Graton
Camp Meeker
Occidental
Area of Detail
Sacramento
San Jose
Central CA Coast Steelhead DPS
0
2
Miles

CCC Steelhead Green Valley Creek CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	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	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)	17% streams/ 13% 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)	0% streams/ 0% IP-km (>80 stream average)	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 58	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% 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	70% 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	15% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		

			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	30% 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
		Size	Viability	Density	<1 spawner per IP-km to < low risk spawner density per Spence (2008)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		<7 spawners per IP-km	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 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 83	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)	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)	67% streams/ 28% IP-km (>50% stream average scores of 1 & 2)	Poor
3	Summer Rearing Juveniles	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% 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 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)	56% streams 63% 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)	17% streams 13% 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)	0% streams/ 0% 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 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 83	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	2.7 Diversions/10 IP-km	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	<50% of IP-km or <16 IP-km accessible*	Poor

			Riparian Vegetation	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy)	50% to 74% of streams/ IP-Km (>70% average stream canopy)	75% to 90% of streams/ IP-Km (>70% average stream canopy)	>90% of streams/ IP-Km (>70% average stream canopy)	100% streams /100% IP-km (>70% average stream canopy)	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	15% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			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)	67% streams/ 28% IP-km (>50% stream average scores of 1 & 2)	Poor
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT)	50 to 74% IP km (<20 C MWMT)	75 to 89% IP km (<20 C MWMT)	>90% IP km (<20 C MWMT)	50 to 74% IP-km (<20 C MWMT)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Acute	Poor
			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	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	0.2 - 0.6 Fish/m^2	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
4	Winter Rearing Juveniles	Condition	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	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)	17% streams 13% 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)	0% streams/ 0% IP-km (>80 stream average)	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	80% 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	15% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			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)	67% 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	30% 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

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% streams/ 0% IP-km (>80 stream average)	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	2.7 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	<50% of IP-Km or <16 IP-Km accessible*	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)	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% 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	1.9% 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	21.9% 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	25-15% 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	93% 1 Unit / 5 Acres to 2 Units / Acre (48%)	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	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	4.8 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	4.6 Miles/Square Mile	Poor

CCC Steelhead Green Valley Creek CAP Threat Results

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

Green Valley Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
GVC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches of lower Green Valley and Atascadero Creek mainstem.	2	10	Farm Bureau, NMFS, Public Works, RCD	
GVC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target winter and summer rearing habitat for juvenile steelhead. Improve conditions to re-create, and restore alcove, backwater, or perennial pond habitats in lower Green Valley, lower Atascadero and lower Purrington Creeks or other areas where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats.	2	10	NMFS, Private Landowners, Public Works, RCD, Sonoma County	
GVC-CCCS-2.1.2	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
GVC-CCCS-2.1.2.1	Action Step	Floodplain Connectivity	Add or incorporate features to enhance winter habitat refugia to existing and new habitat projects.	2	10	Farm Bureau, Private Landowners, Public Works, RCD, Sonoma County	
GVC-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
GVC-CCCS-3.1.1.1	Action Step	Hydrology	Continue and support the Russian River Resources Partnership led by NFWF to model flows and water usage.	2	5	CDFW, NFWF, NMFS, Private Landowners, RCD, UC Extension	
GVC-CCCS-3.1.1.2	Action Step	Hydrology	Develop cooperative projects with private landowners to conserve summer flows based on results of the NFWF efforts.	1	5	CDFW, NFWF, NMFS, Private Landowners, RCD	
GVC-CCCS-3.1.1.3	Action Step	Hydrology	Develop rearing habitat curves in Green Valley Creek to identify optimal base flow conditions.	3	10	CDFW, SWRCB	
GVC-CCCS-3.1.2	Recovery Action	Hydrology	Improve flow conditions (instantaneous conditions)				
GVC-CCCS-3.1.2.1	Action Step	Hydrology	Reduce the rate of frost protection and domestic drawdown in the spring.	2	5	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, Private Landowners, RCD, SWRCB, UC Extension	
GVC-CCCS-3.1.3	Recovery Action	Hydrology	Minimize redd scour				
GVC-CCCS-3.1.3.1	Action Step	Hydrology	Develop floodplain enhancement and LWD projects in modified areas of Green Valley and Atascadero Creeks, and in incised channel areas of major tributaries.	2	10	California Conservation Corps, CDFW, NOAA RC, Private Landowners, Trout Unlimited	
GVC-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
GVC-CCCS-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) at multiple sites along Atascadero Creek and tributaries.	1	5	CDFW, NOAA RC, Private Landowners, Sonoma County	
GVC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
GVC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase large wood frequency in 75% of streams within the watershed to improve conditions for adults, and winter/summer rearing juveniles. Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in all reaches of Green Valley, Purrington, Atascadero, Redwood, Jonive, Castellini and Sexton Creeks	2	10	CDFW, NOAA RC, Private Landowners, State Parks, Trout Unlimited	
GVC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools				

Green Valley Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase primary pool frequency in 25% of streams within the watershed to improve conditions for adults, and summer/winter juveniles. Increase primary pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order streams; >3 feet in third order or larger streams)) in all reaches of Purrington, Atascadero, and Castellini Creeks.	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
GVC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Increase pool/riffle/flatwater ratio				
GVC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase the frequencies of riffles in 55% of the streams within the watershed. Increase riffle frequency to 20% by converting flatwater habitats (glides, runs, etc.) utilizing boulders and log structures in select reaches of Green Valley, Atascadero, Jonive, Castellini and Sexton Creeks.	2	5	CDFW, NOAA RC, Private Landowners, RCD, Trout Unlimited	
GVC-CCCS-6.1.4	Recovery Action	Habitat Complexity	Improve shelter				
GVC-CCCS-6.1.4.1	Action Step	Habitat Complexity	Increase shelters in 75% of streams across the watershed to improve conditions for adults, and winter/summer rearing juveniles. Increase shelters to optimal conditions (>80 pool shelter value) in all reaches of Green Valley, Purrington, Atascadero, Redwood, Jonive, Castellini and Sexton Creeks.	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
GVC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover				
GVC-CCCS-7.1.1.1	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers throughout the watershed (CDFG 2004).	2	25	City Planning, Land Trusts, Sonoma County	
GVC-CCCS-7.1.2	Recovery Action	Riparian	Improve tree diameter				
GVC-CCCS-7.1.2.1	Action Step	Riparian	Increase tree diameter within 40% of watershed to achieve optimal riparian forest conditions (55 - 69% Class 5 & 6 tree). Plant native riparian species and native conifers/hardwoods throughout riparian zones within the eastern and southern portions of the watershed to increase overall tree diameter.	2	25	CDFW, NOAA RC, Private Landowners, RCD	
GVC-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality				
GVC-CCCS-8.1.1.1	Action Step	Sediment	Implement recommendations of completed sediment source surveys in Green Valley and Purrington Creeks (See ROADS for specific actions).	2	5	CDFW, Private Landowners, RCD, Sonoma County, Trout Unlimited	
GVC-CCCS-8.1.1.2	Action Step	Sediment	Conduct instream and upslope sediment source surveys in Atascadero Creek to identify existing sources of high sediment yield using accepted protocols and implement recommendations.	2	10	Private Landowners, RCD, Sonoma County	
GVC-CCCS-8.1.2	Recovery Action	Sediment	Improve quantity and distribution of spawning gravels				
GVC-CCCS-8.1.2.1	Action Step	Sediment	Develop habitat enhancement projects to establish additional riffle habitat and import spawning gravel from mining operations in the Russian River basin to select reaches of Green Valley, Atascadero, Jonive, Castellini and Sexton Creeks.	2	5	CDFW, NMFS, NOAA SWFSC, Private Landowners, RCD, Trout Unlimited	
GVC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream water quality conditions				
GVC-CCCS-10.1.1.1	Action Step	Water Quality	Install continuous water quality monitoring stations in lower Green Valley and within Atascadero Creek.	1	5	NMFS, Private Landowners, RWQCB	
GVC-CCCS-10.1.1.2	Action Step	Water Quality	Identify and provide solutions for point and non-point sources contributing to poor water quality and pollution.	1	5	CDFW, CDFW Law Enforcement, RWQCB, USEPA	
GVC-CCCS-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria				

Green Valley Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-11.1.1.1	Action Step	Viability	Continue to operate UCCE/SCWA outmigrant traps in Lower Green Valley Creek to develop smolt abundance estimates.	1	10	CDFW, NMFS, Sonoma County Water Agency, Trout Unlimited, UC Extension	
GVC-CCCS-11.1.1.2	Action Step	Viability	Conduct habitat surveys to monitor change in key habitat variables.	3	10	CDFW, NMFS, Sonoma County Water Agency, Trout Unlimited, UC Extension	
GVC-CCCS-11.1.1.3	Action Step	Viability	Use monitoring and trend information to adjust and adapt recovery actions/strategies.	1	10	CDFW, NMFS, Sonoma County Water Agency, UC Extension	
GVC-CCCS-11.1.1.4	Action Step	Viability	Monitor fish passage on Purrington and Green Valley Creeks where passage projects are occurring in cooperation with Public Works.	2	10	CDFW, Public Works, Trout Unlimited	
GVC-CCCS-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
GVC-CCCS-12.1.1.1	Action Step	Agriculture	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels (see Roads for specific actions/areas)	2	25	CDFW, Private Landowners, RCD	
GVC-CCCS-12.1.1.2	Action Step	Agriculture	Implement Best Management Practices such as those in the Fish Friendly Farming program (California Land Stewardship Institute), or other cooperative conservation programs.	3	25	NRCS, Private Landowners, RCD	
GVC-CCCS-12.1.1.3	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	
GVC-CCCS-12.1.1.4	Action Step	Agriculture	Complete Farm Conservation Plans (through the SRCD, 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	
GVC-CCCS-12.1.1.5	Action Step	Agriculture	Assess the effectiveness of erosion control measures throughout the winter period.	3	20	CDFW, NMFS, NRCS, Private Landowners, RCD	
GVC-CCCS-12.1.1.6	Action Step	Agriculture	Continue the use of cover crops in agriculture fields.	3	25	NRCS, Private Landowners, RCD	
GVC-CCCS-12.1.1.7	Action Step	Agriculture	Forest and ranch managers should utilize the Handbook for Forest and Ranch Roads (PWA, 1994).	3	20	NRCS, Private Landowners, RCD	
GVC-CCCS-12.1.1.8	Action Step	Agriculture	Public works Dept.'s should utilize the Fishnet 4C Road Manual or a similar manual.	3	25	City Planning, Public Works, Sonoma County	
GVC-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure				
GVC-CCCS-12.1.2.1	Action Step	Agriculture	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to provide future recruitment of large wood and other shelter components.	2	10	NRCS, Private Landowners, RCD	
GVC-CCCS-12.1.2.2	Action Step	Agriculture	Implement programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	20	Land Trusts, Sonoma County	
GVC-CCCS-12.1.2.3	Action Step	Agriculture	Utilize native plants when landscaping and discourage the use of exotic invasives.	3	30	Private Landowners, RCD, UC Extension	
GVC-CCCS-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
GVC-CCCS-12.1.3.1	Action Step	Agriculture	Add large woody debris to reach optimal frequencies	2	10	CDFW, Private Landowners, RCD	
GVC-CCCS-12.1.3.2	Action Step	Agriculture	Avoid the removal of large wood and other shelter components from the stream system	3	20	NRCS, Private Landowners, RCD	
GVC-CCCS-12.1.4	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (impaired stream temperature)				
GVC-CCCS-12.1.4.1	Action Step	Agriculture	Re-establish native plant communities in riparian zones to increase stream canopy to 80%.	2	20	CDFW, Private Landowners, RCD, UC Extension	
GVC-CCCS-12.1.5	Recovery Action	Agriculture	Prevent or minimize impairment to stream hydrology (impaired water flow)				

Green Valley Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-12.1.5.1	Action Step	Agriculture	Promote off-channel storage to reduce impacts of water diversion during the spring and summer (e.g. diversion during winter high flow).	2	15	NRCS, Private Landowners, RCD, UC Extension	
GVC-CCCS-12.1.5.2	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.	3	20	NRCS, Private Landowners, RCD	
GVC-CCCS-12.2	**Objective**	**Agriculture**	**Address the inadequacies of regulatory mechanisms**				
GVC-CCCS-12.2.1	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
GVC-CCCS-12.2.1.1	Action Step	Agriculture	Develop legislation that will fund county planning for environmentally sound agricultural growth and water supply.	2	10	Farm Bureau, NRCS, Sonoma County, UC Extension	
GVC-CCCS-12.2.1.2	Action Step	Agriculture	Coordinate with the agencies that authorize forest land conversions to discourage conversions to agriculture.	3	20	Board of Forestry, CDFW, Sonoma County	
GVC-CCCS-12.2.1.3	Action Step	Agriculture	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do.	3	20	City Planning, RWQCB, Sonoma County	
GVC-CCCS-12.2.1.4	Action Step	Agriculture	Increase setbacks of existing agricultural activities from the top of bank to 100'.	3	20	City Planning, NRCS, RCD, Sonoma County	
GVC-CCCS-12.2.1.5	Action Step	Agriculture	Streamline permit processing where landowners are conducting actions aligned with recovery priorities.	3	5	CDFW, NMFS, NRCS, RCD, SWRCB, USACE	
GVC-CCCS-12.2.1.6	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	
GVC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)				
GVC-CCCS-13.1.1.1	Action Step	Channel Modification	Evaluate undeveloped and developed floodplain property for potential function and conservation easement and/or acquisition potential.	3	10	RCD, Sonoma County	
GVC-CCCS-13.1.1.2	Action Step	Channel Modification	Conduct rehabilitation activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows (see FLOODPLAIN for specific actions).	2	20	CDFW, NOAA RC, NRCS, Private Landowners, Sonoma County, USACE	
GVC-CCCS-13.1.1.3	Action Step	Channel Modification	Set-back existing levees in strategic areas to increase flood-flow detention and promote flood-tolerant land uses.	2	20	CDFW, FEMA, NMFS, NOAA RC, Private Landowners, RCD, Sonoma County, USACE	
GVC-CCCS-13.1.1.4	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	FEMA, Sonoma County, USACE	
GVC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration				
GVC-CCCS-13.1.2.1	Action Step	Channel Modification	Ensure that all future and existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	3	25	NMFS, USACE	
GVC-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize increased landscape disturbances				
GVC-CCCS-13.1.3.1	Action Step	Channel Modification	All proposed flood control projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.	3	20	NMFS, Sonoma County, USACE	
GVC-CCCS-13.1.3.2	Action Step	Channel Modification	Channel modifying projects should be designed to ensure potential effects to CCC steelhead habitat are fully minimized or mitigated, and where possible, existing poor conditions should be remediated.	3	30	NMFS, USACE	
GVC-CCCS-13.1.3.3	Action Step	Channel Modification	Evaluate design alternatives to riprap bank repairs. Where riprap is necessary, evaluate integration of other habitat-forming features – including large woody debris to ensure improved habitat at the restoration site.	3	20	CDFW, NMFS, USACE	
GVC-CCCS-13.1.3.4	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. carefully evaluate feasibility where critical infrastructure is located) for bank hardening projects.	2	20	CDFW, NMFS, USACE	

Green Valley Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-13.2	**Objective**	**Channel Modification**	**Address the inadequacy of existing regulatory mechanisms**				
GVC-CCCS-13.2.1	Recovery Action	Channel Modification	Prevent or minimize increased landscape disturbances				
GVC-CCCS-13.2.1.1	Action Step	Channel Modification	Modify city and county regulatory and planning processes to eliminate or minimize the provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historical CCC steelhead watersheds.	3	10	City Planning, Sonoma County, USACE	
GVC-CCCS-13.2.1.2	Action Step	Channel Modification	Local agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	3	10	City Planning, Sonoma County	
GVC-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
GVC-CCCS-18.1.1.1	Action Step	Livestock	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take first priority for riparian fencing programs over steer operations.	2	10	CDFW, NOAA RC, NRCS, RCD	
GVC-CCCS-18.1.1.2	Action Step	Livestock	Encourage develop and fund riparian restoration projects to regain riparian corridors damaged from livestock and other causes.	2	30	NRCS, RCD	
GVC-CCCS-18.1.1.3	Action Step	Livestock	Substitute continuous season-long use of pastures in favor of rotational grazing strategies to reduce runoff. Short term, seasonal and long term rest from grazing in overgrazed areas would improve soil conditions for native revegetation and land values as well.	3	60	NRCS, RCD, Private Landowners	
GVC-CCCS-18.1.1.4	Action Step	Livestock	Manage rotational grazing to aid in the reduction of noxious weeds.	3	60	NRCS, RCD, Private Landowners	
GVC-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
GVC-CCCS-18.1.2.1	Action Step	Livestock	Aid landowners willing to fence off riparian areas with development of offstream alternative water sources.	2	30	CDFW, NOAA RC, NRCS, RCD	
GVC-CCCS-18.1.2.2	Action Step	Livestock	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	60	NRCS, RCD, Private Landowners	
GVC-CCCS-18.1.2.3	Action Step	Livestock	To minimize gully initiation, grazing should be kept at relatively low intensities on steeper slopes	3	60	NRCS, RCD, Private Landowners	
GVC-CCCS-18.1.2.4	Action Step	Livestock	Establish conservative residual dry matter (RDM) target per acre that ensures area is not overgrazed with 1000 lbs RDM (residual dry matter)/acre left at end of grazing season. Remove cattle from pasture before soils dry out.	3		NRCS, RCD, Private Landowners	
GVC-CCCS-18.1.2.5	Action Step	Livestock	Livestock and Ranch Managers should 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 (Sonoma RCD, 2007), and The Grazing Handbook (Sonoma RCD, 2007).	3	20	Farm Bureau, Private Landowners, RCD	
GVC-CCCS-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
GVC-CCCS-19.1.1.1	Action Step	Logging	Acquire key large tracts of forestlands identified as a priority by Federal, State, local government, and non-governmental organizations.	3	60	CDFW, NMFS, RCD, Sonoma County, State Parks	
GVC-CCCS-19.1.1.2	Action Step	Logging	Conserve and manage forestlands for older forest stages.	3	60	Board of Forestry, CDFW, NMFS, Sonoma County, State Parks, USEPA	
GVC-CCCS-19.1.1.3	Action Step	Logging	Encourage forest management which allows for optimal levels of natural LWD recruitment of larger older trees into stream channels	3	60	Board of Forestry, NMFS, Private Landowners, Sonoma County, State Parks, US EPA	
GVC-CCCS-19.1.2	Recovery Action	Logging	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				

Green Valley Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-19.1.2.1	Action Step	Logging	Prevent or minimize future sediment and runoff sources from logging by utilizing BMP's that prevent or minimize the delivery of sediment and runoff to stream channels.	3	50	CalFire, Private Landowners, RCD	
GVC-CCCS-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
GVC-CCCS-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
GVC-CCCS-19.2.1.1	Action Step	Logging	Prevent or minimize future conversion of forestlands to agriculture or other land uses.	2	60	CalFire, NMFS, Private Landowners	
GVC-CCCS-19.2.1.2	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	2	CalFire, CDFW, NMFS	
GVC-CCCS-19.2.1.3	Action Step	Logging	Provide information to BOF regarding CCC steelhead priorities and recommend upgrading relevant forest practices.	3	2	CalFire, CDFW, NMFS	
GVC-CCCS-20.1	**Objective**	**Mining**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-20.1.1	Recovery Action	Mining	Prevent or minimize impairment to passage and migration				
GVC-CCCS-20.1.1.1	Action Step	Mining	Improve passage where mining and other activities have resulted in diminished migration windows.	2	10	CDFW, NMFS, Private Landowners, Sonoma County, USACE	
GVC-CCCS-20.1.1.2	Action Step	Mining	Use gravel mining practices recommended by NMFS and CDFW.	2	25	CDFG, NMFS, Private Landowners, Sonoma County, USACE	
GVC-CCCS-20.1.2	Recovery Action	Mining	Prevent or minimize impairment to instream habitat complexity (altered pool complexity and/or pool riffle ratio)				
GVC-CCCS-20.1.2.1	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	
GVC-CCCS-20.1.2.2	Action Step	Mining	Continue to implement and support BMP's which improve, maintain or prevent impacts to habitat complexity when reviewing new mining plans.	3	5	CDFW, Counties, NMFS, Private Landowners, USACE	
GVC-CCCS-20.1.3	Recovery Action	Mining	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
GVC-CCCS-20.1.3.1	Action Step	Mining	Develop and enhance offchannel habitats such as alcoves to promote fry and juvenile rearing habitat	2	10	CDFW, Counties, NMFS, Private Landowners, USACE	
GVC-CCCS-20.1.3.2	Action Step	Mining	Retain LWD, boulders and vegetation on riffles where structure is beneficial to migration and resting cover.	3	50	CDFW, Counties, NMFS, Private Landowners, USACE	
GVC-CCCS-22.1	**Objective**	**Residential /Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-22.1.1	Recovery Action	Residential /Commercial Development	Prevent or minimize reduced density, abundance, and diversity				
GVC-CCCS-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	
GVC-CCCS-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	
GVC-CCCS-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	
GVC-CCCS-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	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-22.1.2	Recovery Action	Residential /Commercial Development	Prevent or minimize increased landscape disturbance				
GVC-CCCS-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	
GVC-CCCS-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	
GVC-CCCS-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, CDFG, Counties, NMFS, Private Landowners, RCD	
GVC-CCCS-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	
GVC-CCCS-22.1.2.6	Action Step	Residential /Commercial Development	Design new developments to minimize impacts to 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	
GVC-CCCS-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	
GVC-CCCS-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	
GVC-CCCS-22.1.2.9	Action Step	Residential /Commercial Development	Minimize new development, or road construction within floodplains, riparian areas, unstable soils or other sensitive areas	3	20	Cities, Counties, Public Works, USACE	
GVC-CCCS-22.1.2.10	Action Step	Residential /Commercial Development	Conserve open space in un-fractured landscapes, protect floodplain areas and riparian corridors, and develop conservation easements.	3	20	Cities, Counties, Public Works, USACE	
GVC-CCCS-22.1.2.11	Action Step	Residential /Commercial Development	Residential landowners should utilize the Stewardship Guide for the Russian River (Sonoma RCD, 2011), and 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 (Sonoma RCD, 2007).	3	20	CDFW, Private Landowners, RCD, RWQCB, Sonoma County Water Agency	
GVC-CCCS-22.1.3	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
GVC-CCCS-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	
GVC-CCCS-22.1.3.2	Action Step	Residential /Commercial Development	Residential landowners should utilize the Stewardship Guide for the Russian River (Sonoma RCD, 2011), and 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 (Sonoma RCD, 2007).	3	20	CDFW, Private Landowners, RCD, RWQCB, Sonoma County Water Agency	
GVC-CCCS-22.2	**Objective**	**Residential /Commercial Development**	**Address the inadequacy of existing regulatory mechanisms**				
GVC-CCCS-22.2.1	Recovery Action	Residential /Commercial Development	Prevent or minimize reduced density, abundance, and diversity				
GVC-CCCS-22.2.1.1	Action Step	Residential /Commercial Development	Implement performance standards in Stormwater Management Plans.	3	100	Mendocino County, Private Landowners, Sonoma County	
GVC-CCCS-22.2.2	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-22.2.2.1	Action Step	Residential /Commercial Development	Avoid, or at a minimum 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, USEPA	
GVC-CCCS-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, RWQCB, Public	
GVC-CCCS-22.2.2.3	Action Step	Residential /Commercial Development	Residential landowners should utilize BMP's from Basins Of Relations: A Citizen's Guide to Protecting and Restoring Our Watersheds (OAEC, 2007), Slow it. Spread it. Sink it! (Santa Cruz Resource Conservations District, 2009) to conserve water resources.	3	20	CDFW, City Planning, Private Landowners, Public Works, Sonoma County Water Agency, SWRCB	
GVC-CCCS-22.2.3	Recovery Action	Residential /Commercial Development	Prevent or minimize increased landscape disturbance				
GVC-CCCS-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	
GVC-CCCS-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	
GVC-CCCS-22.2.3.3	Action Step	Residential /Commercial Development	Enforce existing building permit programs to minimize unpermitted construction.	3	100	Cities, Counties	
GVC-CCCS-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	
GVC-CCCS-22.2.3.5	Action Step	Residential /Commercial Development	Minimize new construction in undeveloped areas within the 100-year flood prone zones in all historical CCC steelhead watersheds	3	5	CDFW, NMFS, Sonoma County	
GVC-CCCS-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	
GVC-CCCS-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	
GVC-CCCS-22.2.3.8	Action Step	Residential /Commercial Development	Explore the use of conservation easements to provide incentives for private landowners to preserve riparian corridors	2	10	Land Trusts, Private Landowners, RCD	
GVC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
GVC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Assess existing road networks and implement actions that hydrologically disconnect roads and reduce sediment sources.	2	5	CDFW, NOAA RC, NRCS, Private Landowners, RCD	
GVC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources. Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	2	20	Private Landowners, Public Works, RCD, State Parks	
GVC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	3	20	Private Landowners, Public Works	
GVC-CCCS-23.1.1.4	Action Step	Roads/Railroads	Utilize best management practices for road construction (e.g. Fishnet 4c County Roads Manual; Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	3	20	Private Landowners, Public Works, Sonoma County	
GVC-CCCS-23.1.1.5	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips.	3	20	Private Landowners, Public Works, RCD, State Parks	
GVC-CCCS-23.1.1.6	Action Step	Roads/Railroads	Utilize BMP's to upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	3	20	Private Landowners, Public Works, State Parks	

Green Valley Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
GVC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Assess private road stream crossings for barrier potential and implement recommendations.	2	10	CDFW, NOAA RC, Private Landowners	
GVC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Implement public road barrier survey recommendations in high then medium value areas as a priority (See Passage).	2	5	CDFW, NOAA RC, Private Landowners, RCD	
GVC-CCCS-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
GVC-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
GVC-CCCS-23.2.1.1	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	5	CDFW, RCD	
GVC-CCCS-23.2.1.2	Action Step	Roads/Railroads	Utilize the Fishnet 4C or similar manual in training and operations.	3	10	City Planning, Public Works, Sonoma County	
GVC-CCCS-23.2.1.3	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	60	Board of Forestry, CalTrans, CDFW, City Planning, Private Landowners, RCD, Sonoma County	
GVC-CCCS-23.2.1.4	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	Sonoma County, State Parks	
GVC-CCCS-24.1	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
GVC-CCCS-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to watershed hydrology				
GVC-CCCS-24.1.1.1	Action Step	Severe Weather Patterns	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts and floods while also providing for salmonid recovery needs.	3	50	Board of Forestry, CA Coastal Commission, California Coastal Conservancy, California Department of Mines and Geology, Caltrans, CDFW, CDFW Law Enforcement, City Planning, Farm Bureau, FEMA, NMFS, NRCS, Public Works, RWQCB, State Parks, SWRCB, USACE, USEPA, USGS, Water Agencies	
GVC-CCCS-24.2	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species continued existence**				
GVC-CCCS-24.2.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to watershed hydrology				
GVC-CCCS-24.2.1.1	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	
GVC-CCCS-24.2.2	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
GVC-CCCS-24.2.2.1	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	100	CDFW, NMFS, Private Landowners, SWRCB	
GVC-CCCS-24.2.2.2	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	

Green Valley Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-24.2.2.3	Action Step	Severe Weather Patterns	Evaluate the rate and volume of water diversions and in streams and tributaries and, where appropriate, minimize water withdrawals that could impact steelhead and Chinook salmon.	3	20	CDFW, NMFS, Private Landowners, SWRCB	
GVC-CCCS-24.2.2.4	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).	3	100	CDFW, NMFS, Private Landowners, SWRCB	
GVC-CCCS-24.2.2.5	Action Step	Severe Weather Patterns	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	3	10	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB	
GVC-CCCS-24.2.2.6	Action Step	Severe Weather Patterns	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.	3	10	CDFW, RWQCB, Sonoma County Water Agency, State Parks	
GVC-CCCS-25.1	**Objective**	**Water Diversion /Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
GVC-CCCS-25.1.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
GVC-CCCS-25.1.1.1	Action Step	Water Diversion /Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	2	20	CDFW, NMFS, NOAA RC, Private Landowners, RCD, RWQCB, Sonoma County, Sonoma County Water Agency, SWRCB	
GVC-CCCS-25.1.1.2	Action Step	Water Diversion /Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	3	20	CDFW, Farm Bureau, NRCS, Sonoma County Water Agency, SWRCB	
GVC-CCCS-25.1.1.3	Action Step	Water Diversion /Impoundment	Promote the use of reclaimed water for agricultural or other uses.	3	60	CDFW, RCD, Sonoma County Water Agency, State Parks	
GVC-CCCS-25.1.1.4	Action Step	Water Diversion /Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	3	30	NMFS, RCD, RWQCB, Sonoma County Water Agency, SWRCB	
GVC-CCCS-25.1.2	Recovery Action	Water Diversion /Impoundment	Prevent or minimize reduced density, abundance, and diversity				
GVC-CCCS-25.1.2.1	Action Step	Water Diversion /Impoundment	Adequately screen water diversions to prevent juvenile salmonid mortalities.	1	10	CDFW, NMFS, NOAA RC	
GVC-CCCS-25.2	**Objective**	**Water Diversion /Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
GVC-CCCS-25.2.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
GVC-CCCS-25.2.1.1	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.	1	5	CDFW, County Planning, Farm Bureau, NMFS, NOAA NWS, NOAA RC, NRCS, Private Landowners, RCD	
GVC-CCCS-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	

Green Valley Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
GVC-CCCS-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	
GVC-CCCS-25.2.1.4	Action Step	Water Diversion /Impoundment	Request that SWRCB review and/or modify water use based on the needs of steelhead and authorized diverters (CDFG 2004).	3	5	CDFW, RCD, RWQCB, Sonoma County, Sonoma County Water Agency, SWRCB	
GVC-CCCS-25.2.1.5	Action Step	Water Diversion /Impoundment	Evaluate requests for on-stream dams above migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (CDFG 2004).	3	5	CDFW, SWRCB, USACE	
GVC-CCCS-25.2.1.6	Action Step	Water Diversion /Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	15	NMFS, RWQCB, SWRCB	

Lagunitas Creek Population

CCC Steelhead Winter-Run

- Role within DPS: Potentially Independent Population
- Diversity Stratum: North Coastal
- Spawner Abundance Target: 1,900 adults
- Current Intrinsic Potential: 53.3 IP-km

For information regarding CCC coho salmon for this watershed, please see the CCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

In contrast to coho salmon, production of steelhead smolts appears more evenly distributed across the Lagunitas watershed with winter habitat being the limiting factor for the survival of fry, and poor estuarine conditions limiting the production of smolts. Steelhead population dynamics in Lagunitas Creek are less well understood than for coho salmon (MMWD 2011). Until recently, spawner surveys focused almost exclusively on coho salmon, and even now are conducted for only part of the steelhead spawning season, so adult steelhead run data is limited (Ettlinger *et al.* 2010). However, adult steelhead escapement estimates are becoming more accurate with use of dual-frequency identification sonar (DIDSON) technology (Atencio and Reichmuth 2014). In the 2012/2013 and 2013-2014 spawner seasons, steelhead escapements were estimated at approximately 400 and 470 respectively (Atencio and Reichmuth 2014). Numbers of age 1+ steelhead are consistently low, regardless of the abundance of age 0+ steelhead in the previous year, indicating winter survival is a key limiting factor (MMWD 2011). Age 0+ steelhead population estimates have ranged from approximately 26,000 to 75,000 since 1995, while the 1+ steelhead estimate has fluctuated between approximately 2,000 and 4,000. National Park Service (NPS) studies (Carlisle *et al.* 2009; Carlisle *et al.* 2010) on Olema Creek reported steelhead juvenile densities from 1999 – 2008 ranging from 1.1 to 2.5 fish per meter. Chinook salmon are also occasionally observed in the watershed, though the Lagunitas Creek population is not a focus of this Recovery Plan for Chinook.

History of Land Use

Commercial logging began in the upper Lagunitas Creek watershed in the 1860s and moved downstream until nearly all of the old growth Douglas fir and redwood trees were harvested (UCCE, 1995). A paper mill was constructed on mainstem Lagunitas Creek near Devils Gulch in 1856, and logging continued in the Olema Creek watershed until 1962 (Prunuske Chatham Inc. 2004). Major fires have burned portions of the watershed several times (e.g. 1878, 1904, 1923, and

1945) (Prunuske Chatham Inc. and Stillwater Sciences 2009). Since the mid-1900's fire suppression has dramatically reduced the number of fires but has also increased the fuel load, and modified the vegetative community. This may result in intense fires when they do occur (Stillwater Sciences 2009).

In the early 1920s, Olema Creek between the town of Olema and its confluence with Lagunitas Creek was straightened into the 3-kilometer long "Olema Canal" that drained the surrounding land for agricultural production. Dairy farming, beef and sheep production, and potato growing dominated the more open landscapes of the lower watershed and San Geronimo, Nicasio and Olema Valleys. Gravel and sand was mined from the streambed at the confluence of Lagunitas and Nicasio Creeks until a short time after Nicasio Dam was constructed in 1960. Ranchers regularly harvested small amounts of streambed gravel to maintain ranch roads through the 1980s.

The first reservoir, Lake Lagunitas, was built in 1872, followed by Alpine Lake in 1918, and then by Bon Tempe in 1948. Peters Dam, built in 1953 to form Kent Lake, was raised 45 feet in 1982, nearly doubling reservoir capacity from 16,600 acre feet to 33,000 acre feet. The last reservoir built in the watershed was Nicasio Reservoir, formed by Seeger Dam in 1960, on Nicasio Creek. In addition to blocking anadromous fish passage to miles of spawning and rearing habitat, the impoundments have altered streamflows and reduced bedload transport from the upper reaches of the watershed.

Recreational use of the extensive public lands in the watershed includes hiking, bicycling, horseback riding, and camping in the state park. The railroad right-of-way from Tocaloma Bridge south through the state park has been converted into a trail.

Current Resources and Land Management

The Lagunitas Creek watershed drains an area of 109 square miles and is the largest drainage into Tomales Bay. Its major tributaries include San Geronimo Creek, Devils Gulch, Cheda Creek, Nicasio Creek, and Olema Creek. At the southwestern edge of the watershed, Olema Creek flows in nearly a straight line through a rift valley along the San Andreas Fault zone.

Over half of the watershed is in public ownership. The watershed experiences a Mediterranean-type climate and supports a varied vegetative community including conifers, riparian forests, shrub lands, and coastal scrub, prairie, and dunes. The upper portions of the Nicasio Creek subwatershed are dominated by grassland habitats while the mainstem of Lagunitas Creek, San Geronimo Creek and Olema Creek are dominated by forest habitats.

The upper part of the watershed is owned and managed by Marin Municipal Water District (MMWD) for water supply, and State and National Parks manage much of the lower watershed and mainstem. The Lagunitas Creek watershed holds many small rural communities including Woodacre, San Geronimo, Forest Knolls, and Lagunitas in San Geronimo Valley, as well as Nicasio, Olema, and Point Reyes Station (Prunuske Chatham Inc. 2004). Ranching on land leased from NPS continues on the east side of Olema Valley and in Lagunitas Valley, within Nicasio Valley, and one private cattle ranch remains in San Geronimo Valley.

Salmonid Viability and Watershed Conditions

The following indicators were rated Poor through the CAP process for steelhead: floodplain, large wood frequency, shelter rating, streamside road density, and riparian vegetation. Other indicators that are identified as impaired include the following: viability, base and passage flow conditions, gravel quality, habitat diversity, redd scour, and estuary/lagoon quality and extent. 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 were rated Fair or Poor as a result of our CAP viability analysis. The Lagunitas Creek CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Riparian Vegetation: Composition, Cover & Tree Diameter

Riparian Vegetation conditions have a rating of Poor due to lower than optimal average forest tree diameter, the extent of agriculture, grazing, and limited LWD recruitment for rearing salmonids. Though lower Lagunitas Creek has a wide riparian corridor dominated by redwoods and conifer species, the corridor is thin elsewhere within the watershed (e.g., San Geronimo Creek). Continued livestock grazing occurs in the lower watershed in the Olema sub-basin, including leases conducted on NPS property.

Sediment Transport: Road Density

Sediment Transport from streamside road density conditions has a rating of Poor. Altered sediment transport due to higher than optimal riparian road density limits spawning gravel recruitment and impacts spawning gravel quality. According to the SF Bay Regional Water Board/EPA TMDL, Lagunitas is impaired by excessive sediment and temperature and the RWQCB just adopted a Basin Plan Amendment TMDL for sediment throughout the watershed.

Velocity Refuge: Floodplain Connectivity

Channelization has occurred in San Geronimo and lower Olema Creeks, and the riparian zone is thin, and residential development and agriculture encroach upon the historic floodplain respectively. Many stream channels have been disconnected from their floodplain, leaving winter rearing juveniles without refugia from high velocities. Juvenile steelhead can be flushed from tributaries during winter storms. The lack of large woody debris or access to refugia in the near stream floodplain impacts the winter survival of juveniles throughout the system. Modification and incision have removed the stream channel from its natural floodplain except at extreme flood flows when salmonids can be flushed out to agricultural and grazing lands, where they may become trapped on the declining limb of the hydrograph.

Hydrology: Redd Scour

In the incised or channelized reaches, winter storms are confined within the channel due to the lack of near stream floodplain. As a result, eggs may be flushed out of redds due to high velocities (Marin Municipal Water District 2011). Adequate incubation of eggs is stressed due to high embeddedness levels and is further stressed by high flows during the winter months which can accelerate erosion sites.

Hydrology: Baseflow and Passage Flows

Though the number of diversions in the Lagunitas Creek watershed is rated Fair, many of these are direct domestic diversions and many more unreported riparian diversions exist, so low summer flows are a concern, especially in highly developed sub-basins such as San Geronimo Creek where diversions reduce viable salmonid summer rearing habitat. In addition, a reduction in groundwater recharge due to increased impervious surfaces in rural residential areas may affect groundwater levels and recharge of San Geronimo Creek and its tributaries during dry season. Low spring and summer flows also increase pool stratification in the estuary to create bottom saline layers too hot and low in oxygen to sustain salmonids (Marin Municipal Water District 2011).

Passage/Migration: Mouth or Confluence and Physical Barriers

Steelhead passage for adults and smolts is limited by road crossings in some tributaries. Additionally, adult migration and winter refugia are affected by the lack of shelter and the incised or channelized conditions of some tributaries. The Nicasio Reservoir and tributaries above the reservoir (Halleck Creek and Nicasio Creek) are historic habitat currently inaccessible to steelhead. The TRT determined that viability targets may be achieved for this watershed without providing passage over or removing Seeger dam on Nicasio Creek (Spence *et al.* 2008). If an opportunity arises to facilitate passage over Seeger Dam, it would reduce the pressure on other

areas in the watershed to produce enough fish to meet adult density targets and assist with meeting the Diversity Strata target.

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

MMWD (2011) outlines the limiting factors for coho salmon and steelhead in the Lagunitas creek watershed. MMWD (2011) found that complex winter refugia habitat for young of the year steelhead likely limits production within the watershed. Ideal winter refugia habitat for young of the year steelhead generally includes complex wood jams because they provide slackwater habitat throughout all stages of the hydrograph, as well as complex configurations of cobble and boulder substrate in the channel to create velocity refuge.

Habitat complexity has been lost in many streams due to poor abundance of complex features (e.g., LWD, boulders, etc.), channel simplification, and sediment aggradation, which are all associated with reservoir construction, channel modification and past logging and wood harvest activities. In addition, riparian zones degraded by these activities have severely limited the natural recruitment of LWD in many historically productive streams within the watershed, limiting the quality of juvenile rearing habitat in many areas of the watershed.

Threats

The following discussion focuses on those threats rated as High or Very High (See Lagunitas Creek CAP Results). Recovery strategies will likely focus on ameliorating High rated threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts.

Agriculture

Historic farming practices have reduced riparian vegetation, causing stream and bank erosion. Erosion leads to increased sedimentation and water temperatures, degrading the quality of marshes and open water area in the estuary. Though GIS spatial analysis showed existing vegetation as less than 1% in agricultural production, 35% of the watershed is in annual grasslands habitats consisting of rangeland, and pasture. Water diversions supporting viticulture in these areas would lower summer baseflows, causing disconnected aquatic habitat. Also, agricultural operations could encroach further into adjacent riparian areas, which could increase sediment delivery to the stream as well as impact shading and wood recruitment.

Channel Modification

Channel modification has had an historic impact to salmonid resources in Lagunitas Creek and several of its tributaries through the removal and transport of timber from the floodplain, riparian, and forest resources. Channel modification has led to channel incision, oversteepened banks, high erosional forces and gravel embeddedness, and ultimately loss of riparian trees and width in some reaches. Road building, bank stabilization, culverts and grazing land development elsewhere have led to channel incision and the lack of large woody debris or access to velocity refugia. Modification and incision have removed the stream channel from its natural floodplain except at extreme flood flows. High density streamside roads limit floodplain enhancement in some portions of the watershed.

Livestock Farming and Ranching

Livestock in streams generally inhibit growth of new trees, exacerbate erosion and reduce summertime survival of juvenile fish by defecating in the water (Flosi *et al.* 2004). Erosion leads to increased sedimentation and water temperatures, degrading the quality of marshes and open water area in the estuary. Currently, 35% of the watershed is in annual grasslands habitats consisting of rangeland and pasture. Grazing occurs in the riparian zone and much of the native forest habitat has been converted to perennial grasslands with higher runoff and sedimentation potential.

Residential and Commercial Development

Residential pressures can result in increased road building, water development, the removal of riparian habitat and reduced water quality. Though Lagunitas Creek currently has a low percentage of development and much of the anadromous portions of the watershed is under state and Federal ownership, conversion of ranches and farms to home tracts and associated impervious surfaces could greatly reduce the benefits of the land uses which remain in open space and have relatively undisturbed hydrologic regimes. San Geronimo Creek and lower Lagunitas Creek are the most heavily developed areas and have been the subject of recent county involvement to address growth and encroachment issues.

Roads and Railroads

Streamside road density is high in the watershed, and the highest in the San Geronimo Creek and Lagunitas mainstem, though overall watershed road density is low, and existing roads have been upgraded. However, considering that few road decommissioning projects occur in the urban areas and within riparian zones, and the likelihood of more road building, this threat is likely to continue in the future.

Severe Weather Patterns

The watershed experiences a Coastal type climate and year-round flows are normal in the Lagunitas Creek watershed. Severe drought conditions were present in the summer of 2004, and streamflows declined rapidly throughout the watershed. During drought periods and annually in August, riffles can become dry, disconnecting surface flow to pools in some tributaries. Given that summer streamflows are already pressured by agricultural and some residential development, long-lasting drought patterns could pose a significant threat to maintaining adequate streamflows and aquatic habitat. Flooding can contribute positive as well as negative changes to streams through the initiation or acceleration of natural processes respectively. For Lagunitas Creek, severe flooding could accelerate erosion sites in channelized and incised reaches, as well as increase the potential for redd scour, which has been identified as a limiting factor (MMWD 2011).

Water Diversion and Impoundments

Four large dams already occur in the upper watershed, and though the number of reported diversions is low, the chief water demand occurs in the summer from creek side residential and agricultural development. Increased water diversion resulting from residential development within Lagunitas Creek system could further stress riparian and aquatic resources. Water diversion in the tributaries could impact rearing juveniles. Flows in the mainstem are already compromised due to the operations of the dams, though management currently is thought to benefit salmonid rearing and migration. Currently no water is release from Nicasio Reservoir. The lack of flow releases from Nicasio Reservoir may pose a significant threat particularly in drought years when flow in Lagunitas creek and elsewhere in the watershed is limiting.

Limiting Stresses, Lifestages, and Habitats

The juvenile lifestages are most limited by lack of floodplain connectivity for winter rearing, and by lack of large wood and low shelter values for summer rearing. Additionally, the estuary is impaired for rearing age 1+ fish through the summer (MMWD 2011). Altered sediment transport and associated impacts to watershed processes is also a major stress limiting recovery of steelhead in the Lagunitas population.

General Recovery Strategy

To improve the inadequate ratings of key habitat attribute indicators in Lagunitas Creek, priority recovery actions include: restoring floodplain connectivity, improvement of riparian vegetation, improve baseflows during the summer months, reducing riparian road density, improving habitat complexity (for rearing and high flow refugia), and continued improvements to water

quality in Tomales Bay to improve the habitat used by summer and winter rearing juveniles, and improve survival of smolts.

Restore Floodplain Connectivity

The Lagunitas Creek watershed would benefit from increased activation of the floodplain to improve over winter survival of steelhead. Floodplain connectivity can be increased through the creation of secondary channels, alcoves and LWD for velocity refuge. This can most cost-effectively be achieved in the reaches known as the Tocoloma reach due to the relative accessibility of the floodplain. Velocity refuge for emerging fry are needed throughout the watershed.

Improve Canopy Cover and Riparian Recruitment

The Lagunitas Creek watershed would benefit from improved riparian composition and structure, which would increase stream shading and improve LWD recruitment for eventual increases in instream shelter for juvenile steelhead. Practices to improve riparian condition include native riparian planting, development and enforcement of riparian buffers, and livestock exclusion fencing. Olema and San Geronimo Creek sub-basins are high priority areas.

Improve Water Quality in the Estuary

Tomales Bay is identified by the SFBRWQCB as impaired for sedimentation, nutrients, pathogens, and mercury. Current efforts to reduce pollution are focused on human pathogen sources from failing septic systems and inadequate facilities for recreational users, animal waste from agricultural operations, mercury-contaminated sediments from the Gambonini Mine, and sediment from erosion throughout the watershed. Ensuring water quality in Tomales Bay and tributary streams sufficient to support natural resources and sustain beneficial uses will require reductions in sediment, pathogen, mercury, and nutrient loading, restoring and maintaining adequate high quality freshwater flow, controlling invasive non-native species, and protecting habitats of native species in the Tomales Bay watershed.

Address Upslope and Riparian Road Sediment Sources

Many of the public roads have been surveyed, and recommendations have been partially implemented, though numerous private roads remain within the watershed and within the riparian corridor. Existing problem roads and active erosion sites should be prioritized and addressed as part of a comprehensive sediment reduction and transportation plan for the entire basin. Future road construction should utilize BMPs to prevent alteration of hydrologic processes, sediment transport, and fish passage, and avoid or minimize construction of roads within riparian zones.

Increase Instream Shelter Ratings and Pool Volume

MMWD, Tomales Bay Watershed Council, Point Reyes National Seashore, the Salmon Protection and Watershed Network (SPAWN), Trout Unlimited, and other partners within the watershed have embarked on many instream large wood placement projects, which have improved habitat complexity in some areas. However, complexity could be significantly improved where existing pool habitats are mainly comprised of undercut banks and aquatic vegetation by adding additional LWD at single log structure sites. Other stream reaches could utilize similar supplementation of multiple LWD placement, boulders and other channel forming features to encourage more desirable pool/riffle/flatwater ratios (including primary pools), sort coarse sediment, and increase pool shelter ratings. High priority sub-basins within the Lagunitas Creek watershed in need of LWD placement include: Devil's Gulch, San Geronimo Creek, upper reaches of Lagunitas Creek, Larsen Creek, Olema Creek and Woodacre Creek. Enhancing these streams will greatly improve the quality of available spawning and seasonal rearing habitat potential for steelhead.

Improve Baseflow Conditions

Residential development and associated diversions (riparian, groundwater, legal and illegal) contribute to reduced baseflows in summer. To address this, the NMFS recommends continued support for studies being conducted to quantify water demand and supply and identify water conservation projects and opportunities in cooperation with watershed landowners. In addition NMFS supports the evaluation of the environmental and socioeconomic costs and benefits of flow releases from Nicasio Reservoir that may lead toward improvements in summer flows. Exploring the benefits of simulated beaver dam structures (beavers are no longer present) in providing year round flow for rearing steelhead is also recommended. Maintaining sufficient freshwater flows in upstream rearing habitats will increase flows to the estuary, and moderate salinity, temperature and dissolved oxygen.

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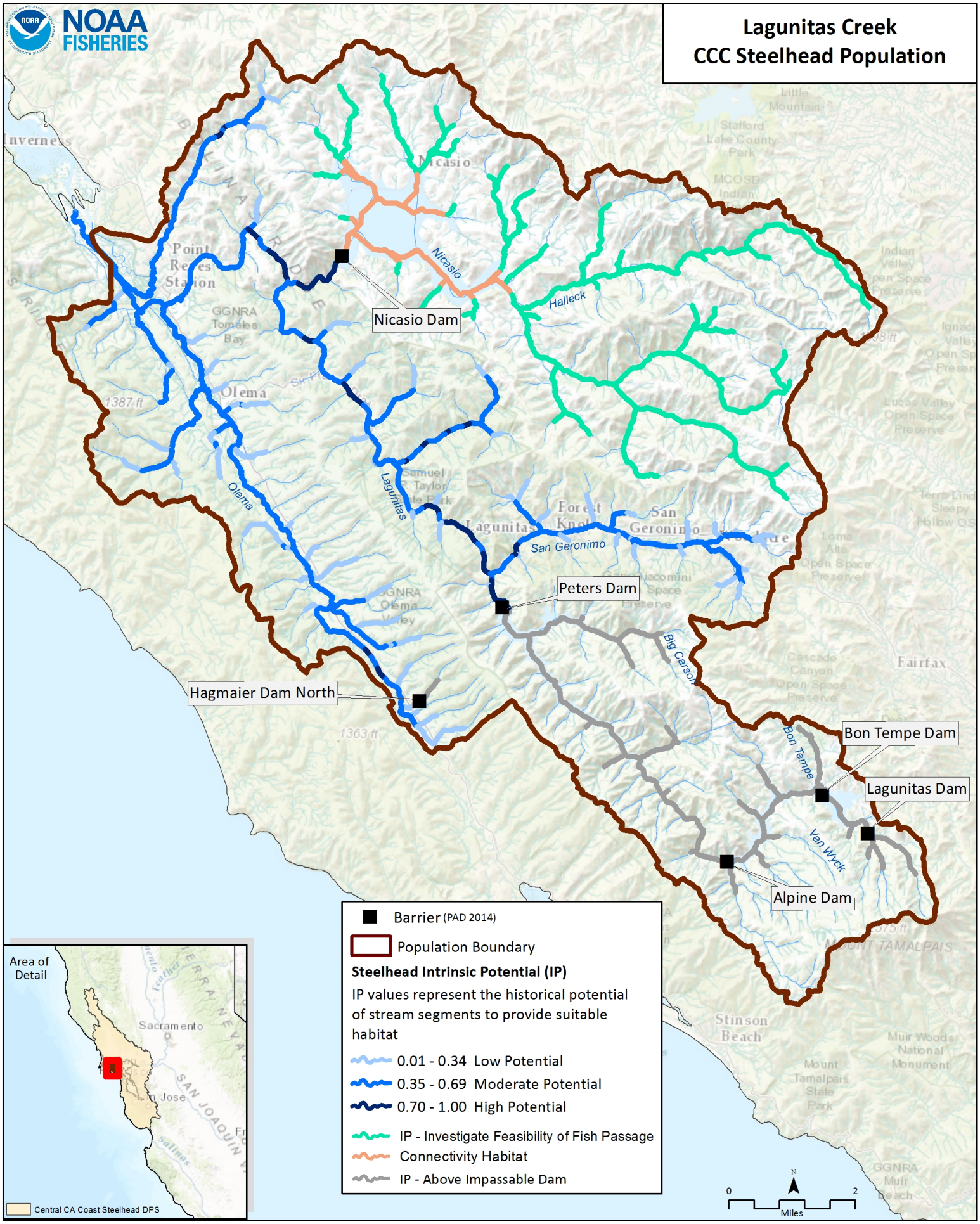
NOAA FISHERIES
Lagunitas Creek
CCC Steelhead Population
Nicasio Dam
Peters Dam
Hagmaier Dam North
Bon Tempe Dam
Lagunitas Dam
Alpine Dam
Nicasio
Halleck
Olema
Lagunitas
San Geronimo
Big Carson
Bon Tempe
Van Wyck
Barrier (PAD 2014)
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent 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 - Investigate Feasibility of Fish Passage
Connectivity Habitat
IP - Above Impassable Dam
Area of Detail
Sacramento
San Jose
Central CA Coast Steelhead DPS
0
2
Miles
N

CCC Steelhead Lagunitas Creek CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	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% to 74% of streams/ IP-km (>1.3 Key Pieces/100 meters)	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)	0% streams/ 0% IP-km (>80 stream average)	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	91.88% 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	0% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		

			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% 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 spawner per IP-km to < low risk spawner density per Spence (2008)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		Low risk spawner density per Spence (2008)	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 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 58	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)	50% streams/ 49% IP-km (>50% stream average scores of 1 & 2)	Fair
3	Summer Rearing Juveniles	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% to 74% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% of pools are primary pools)	50% to 74% of streams/ IP-Km (>49% of pools are primary pools)	75% to 89% of streams/ IP-Km (>49% of pools are primary pools)	>90% of streams/ IP-Km (>49% of pools are primary pools)	50% streams/ 75% IP-km (>49% of pools are primary pools)	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% 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)	0% streams/ 0% 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 67	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 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	1.3 Diversions/10 IP-km	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	91.88% of IP-km	Very Good

			Riparian Vegetation	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy)	50% to 74% of streams/ IP-Km (>70% average stream canopy)	75% to 90% of streams/ IP-Km (>70% average stream canopy)	>90% of streams/ IP-Km (>70% average stream canopy)	100% streams/ 100% IP-km (>70% average stream canopy)	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	0% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			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% streams/ 49% IP-km (>50% stream average scores of 1 & 2)	Fair
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT)	50 to 74% IP km (<20 C MWMT)	75 to 89% IP km (<20 C MWMT)	>90% IP km (<20 C MWMT)	50 to 74% IP-km (<20 C MWMT)	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	>90% of streams/ IP-Km maintains severity score of 3 or lower	Very Good
		Size	Viability	Density	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	0.2 - 0.6 Fish/m^2	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
4	Winter Rearing Juveniles	Condition	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	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)	0% streams/ 0% IP-km (>80 stream average)	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	91.88% 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	0% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			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% streams/ 49% 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	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

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% streams/ 0% IP-km (>80 stream average)	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	1.3 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	75% of IP-km to 90% of IP-km	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
			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 to produce low risk spawner density per Spence (2008)	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	0.432% 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	0.33% 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	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	9% of watershed >1 unit/20 acres	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	2.6 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	3.3 Miles/Square Mile	Poor

CCC Steelhead Lagunitas Creek CAP Threat Results

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

Lagunitas Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-1.1.1	Recovery Action	Estuary	Increase the extent of estuarine habitat				
LaC-CCCS-1.1.1.1	Action Step	Estuary	Prevent or minimize future encroachment of landuse (agricultural, residential and commercial) into floodplain areas of the estuary	3	50	CDFW, Marin County, NPS, RWQCB, USACE	
LaC-CCCS-1.1.1.2	Action Step	Estuary	Support a salmonid limiting factors assessment in Keys Estero and Tomales Bay (CDFG 2004).	3	10	MMWD, NPS, Tomales Bay Watershed Council	
LaC-CCCS-1.1.1.3	Action Step	Estuary	Per a completed limiting factors assessment, and utilizing adaptive management guidelines, develop restoration projects in areas which have high value physical and chemical properties for rearing salmonids	2	15	California Coastal Conservancy, CDFW, NMFS, NPS, Tomales Bay Watershed Council	
LaC-CCCS-1.1.2	Recovery Action	Estuary	Increase and enhance habitat complexity features				
LaC-CCCS-1.1.2.1	Action Step	Estuary	Restore estuarine wetlands and sloughs, develop floodplain and backwater habitat projects, and improve prey abundance by increasing shoreline perimeter and planting native emergent and riparian species to improve foraging and cover.	2	10	CA Coastal Commission, California Coastal Conservancy, CDFW, NPS, Private Landowners, SWRCB	
LaC-CCCS-1.2	**Objective**	**Estuary**	**Address the inadequacy of existing regulatory mechanisms**				
LaC-CCCS-1.2.1	Recovery Action	Estuary	Improve estuarine freshwater inflow				
LaC-CCCS-1.2.1.1	Action Step	Estuary	Improve estuarine water quality by identifying and remediating upstream pollution sources which contribute to poor water quality conditions in the estuary	2	10	NPS, RWQCB, SWRCB, Water Agencies	
LaC-CCCS-1.2.1.2	Action Step	Estuary	Increase freshwater inflow to improve water quality in the estuary.	2	12	CDFW, Marin County, NMFS, NPS, RWQCB, Tomales Bay Watershed Council, USACE	
LaC-CCCS-1.2.2	Recovery Action	Estuary	Reduce extent of estuarine shoreline development via the planning process or with the assistance of land conservation organizations.				
LaC-CCCS-1.2.2.1	Action Step	Estuary	Evaluate alterations to diking and leveeing which has reduced shoreline complexity and natural function	3	10	California Coastal Conservancy, CDFW, NPS, Marin County, NMFS, Tomales Bay Watershed Council, USACE	
LaC-CCCS-1.2.2.2	Action Step	Estuary	Evaluate the effect of nearby landuse practices and development structures which may impair or reduce the historical tidal prism and other estuarine functions and implement improvements	3	10	CA Coastal Commission, California Coastal Conservancy, CDFW, NPS	
LaC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
LaC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	1	5	Marin County, MMWD, NPS, State Parks, , SWRCB	
LaC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Identify the floodplain activation flow - the smallest flood pulse event that initiates substantial beneficial ecological processes when associated with floodplain inundation (Williams et al. 2009).	1	10	Marin County, MMWD, NPS, Private Landowners, SWRCB	
LaC-CCCS-2.1.1.3	Action Step	Floodplain Connectivity	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	60	CDFW, Marin County, MMWD, NMFS, NPS, State Parks, SWRCB	
LaC-CCCS-2.1.2	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
LaC-CCCS-2.1.2.1	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.	1	10	Marin County, Marin RCD, MMWD, NPS, State Parks, SWRCB	
LaC-CCCS-2.1.2.2	Action Step	Floodplain Connectivity	Target habitat restoration and enhancement projects that will function between winter base flow and flood stage.	1	60	Marin County, MMWD, NMFS, NPS, State Parks, SWRCB	

Lagunitas Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-2.1.2.3	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches (e.g. Olema Ranch Campground). Improve conditions to re-create, and restore alcove, backwater, or perennial pond habitats where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats.	1	50	Farm Bureau, Marin County, Marin RCD, MMWD, NMFS, NPS, Point Reyes National Seashore Association, USFWS, SWRCB	
LaC-CCCS-2.1.2.4	Action Step	Floodplain Connectivity	Support landowners and the RCD in developing projects to improve channel conditions and restore natural channel geomorphology, including side channels and dense contiguous riparian vegetation (CDFG 2004).	1	40	CDFW, Marin County, MMWD, NPS, Private Landowners, RCD	
LaC-CCCS-2.1.2.5	Action Step	Floodplain Connectivity	Encourage willing landowners to restore historical floodplains or offchannel habitats through conservation easements, etc.	2	10	Land Trusts, Marin County, MMWD, NPS, Private Landowners, RCD, SWRCB	
LaC-CCCS-2.1.2.6	Action Step	Floodplain Connectivity	Evaluate potential acquisition or easements to protect floodplain function on lower Lagunitas Creek.	2	5	MMWD, NPS, Private Landowners	
LaC-CCCS-2.1.2.7	Action Step	Floodplain Connectivity	Evaluate existing floodplain and historic floodplain property for potential function and acquisition using conservation easements.	2	3	MMWD, NPS, SPAWN, SWRCB	
LaC-CCCS-2.2	**Objective**	**Floodplain Connectivity**	**Address the inadequacy of existing regulatory mechanisms**				
LaC-CCCS-2.2.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
LaC-CCCS-2.2.1.1	Action Step	Floodplain Connectivity	Implement Marin County Flood Zone activities for the improvement of steelhead habitat	3	5	Marin County, MMWD, NPS	
LaC-CCCS-2.2.1.2	Action Step	Floodplain Connectivity	Implement SWRCB's Sediment TMDL	1			
LaC-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
LaC-CCCS-3.1.1.1	Action Step	Hydrology	Develop rearing habitat curves to identify optimal base flow conditions	3	10	CDFW, MMWD, NPS, SWRCB	
LaC-CCCS-3.1.1.2	Action Step	Hydrology	Continue to support efforts to model flows and water usage	3	5	CDFW, MMWD, NMFS, NPS, Private Landowners, RCD, UC Extension	
LaC-CCCS-3.1.1.3	Action Step	Hydrology	Develop cooperative projects with private landowners to conserve summer flows	2	5	CDFW, MMWD, NMFS, NPS, Private Landowners, RCD	
LaC-CCCS-3.1.1.4	Action Step	Hydrology	Evaluate current policy of allowing dams to fill and then spill once they are full versus an improved methodology of releasing water based on storm indicators and forecast models.	3	10	Marin County, MMWD, NPS, RWQCB, SWRCB	
LaC-CCCS-3.1.2	Recovery Action	Hydrology	Minimize redd scour				
LaC-CCCS-3.1.2.1	Action Step	Hydrology	Develop floodplain enhancement and LWD projects in modified and incised channel areas of major tributaries including San Geronimo Creek	2	10	California Conservation Corps, CDFW, Marin County, Marin RCD, MMWD, NOAA RC, NPS, Private Landowners, Trout Unlimited	
LaC-CCCS-3.1.2.2	Action Step	Hydrology	Improve spawning success and egg survival through improving channel configuration, sediment dynamics, and channel roughness and stability	2	20	CDFW, Marin County, MMWD, NMFS, NPS, RCD	
LaC-CCCS-3.2	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**				
LaC-CCCS-3.2.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
LaC-CCCS-3.2.1.1	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	2	60	CDFW, Marin County, Marin RCD, MMWD, NMFS, NPS	
LaC-CCCS-3.2.1.2	Action Step	Hydrology	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	10	DWR, Marin County, MMWD, NMFS, NPS, SWRCB	

Lagunitas Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-3.2.1.3	Action Step	Hydrology	Evaluate the feasibility of reintroducing beavers to improve summer baseflow conditions.	2	5	CDFW, MMWD, NMFS, NPS	
LaC-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
LaC-CCCS-5.1.1.1	Action Step	Passage	Restore fish passage at Roy's Pools to facilitate unimpeded passage for all life stages into the San Geronimo Creek	2	5	Marin County, NPS, SPAWN, Trout Unlimited	
LaC-CCCS-5.1.1.2	Action Step	Passage	Remove all barriers in the Woodacre, Arroyo, Larsen and Montezuma and San Geronimo subwatersheds	2	10	Marin County, NPS, SPAWN, Trout Unlimited	
LaC-CCCS-5.1.1.3	Action Step	Passage	Remove all remaining barriers in the Cheda, Devil's Gulch and Olema subwatersheds.	2	10	Marin County, MMWD, NPS, State Parks	
LaC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Improve shelter				
LaC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase shelters in 75% of streams across the watershed to improve conditions for adults, and winter/summer rearing juveniles	2	10	CDFW, Marin County, Marin RCD, NPS, SWRCB	
LaC-CCCS-6.1.1.2	Action Step	Habitat Complexity	Increase shelters to optimal conditions (>80 pool shelter value) by installing multiple log structures in select reaches of Larsen, San Geronimo, Woodacre, and Olema Creeks	2	10	CDFW, NOAA RC, NPS, Private Landowners, Trout Unlimited, SWRCB	
LaC-CCCS-6.1.1.3	Action Step	Habitat Complexity	Focus efforts to restore channel complexity in the Tocaloma reach of the Lagunitas mainstem to improve smolt survival.	2	10	MMWD, NPS, SWRCB	
LaC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools				
LaC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase pool frequency in 25% of streams within the watershed to improve conditions for adults, and summer/winter juveniles	2	10	CDFW, Marin County, NMFS, NOAA RC, NPS, SWRCB	
LaC-CCCS-6.1.2.2	Action Step	Habitat Complexity	Increase pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order streams; >3 feet in third order or larger streams)) in select reaches of Olema, Woodacre and San Geronimo Creeks	2	10	CDFW, NOAA RC, NPS, Private Landowners, Trout Unlimited, SWRCB	
LaC-CCCS-6.1.2.3	Action Step	Habitat Complexity	Hold restoration workshops to specifically focus on restoration techniques that promote winter rearing juvenile habitat complexity in the Tocaloma reach of the lower Lagunitas mainstem. In addition, focus on restoration techniques that specifically address declining pool frequency and shelters for summer rearing juveniles.	3	20	Marin County, Marin RCD, NOAA RC, NPS, SPAWN, SWRCB	
LaC-CCCS-6.1.2.4	Action Step	Habitat Complexity	Analyze whether summertime low-flow pools (perceived to be a limiting factor) are filling up with fine sediment from San Geronimo Creek between flow events that have enough power to scour the pools. This could be examined by surveying selected pools in detail several times a year (long enough to cover several potential scour and fill events), as was conducted in 1981.	3	10	MMWD, NPS, SPAWN, SWRCB	
LaC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve pool:riffle:flatwater ratio (hydraulic diversity)				
LaC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase riffle frequency in 25% of streams within the watershed to improve conditions for spawning adults	2	10	CDFW, Marin County, NMFS, NPS, RCD	
LaC-CCCS-6.1.3.2	Action Step	Habitat Complexity	Increase riffle frequency to achieve optimal conditions (20% riffles) by converting flatwater habitats (glides, runs, etc.) utilizing boulders and log structures in select reaches of San Geronimo Creek	2	10	CDFW, NOAA RC, NPS, Private Landowners, SWRCB	
LaC-CCCS-6.1.3.3	Action Step	Habitat Complexity	In the San Geronimo Creek sub-watershed, continue public outreach and education for private landowners, residents, commercial, public utility and county workers regarding best management practices to control erosion, protect riparian vegetation, retain LWD, and minimize disturbance to steelhead from domestic animals.	3	5	Marin County, MMWD, NPS, RCD, RWQCB, SPAWN, SWRCB	
LaC-CCCS-6.1.4	Recovery Action	Habitat Complexity	Increase large wood frequency				
LaC-CCCS-6.1.4.1	Action Step	Habitat Complexity	Increase large wood frequency throughout the watershed to improve conditions for adults, and winter/summer rearing juveniles	2	10	CDFW, NOAA RC, NPS, Private Landowners, SWRCB	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-6.1.4.2	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>2 key LWD pieces/100 meters) in select reaches of Olema Creek	2	10	CDFW, NOAA RC, NPS, Private Landowners, SWRCB	
LaC-CCCS-6.1.4.3	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in select reaches of Larsen, Woodacre, San Geronimo, and Devils Gulch Creeks	2	10	CDFW, NOAA RC, NPS, Private Landowners, Trout Unlimited, SWRCB	
LaC-CCCS-6.1.4.4	Action Step	Habitat Complexity	Expand on the efforts of the Regional Water Quality Control Board and Marin Municipal Water District to retain LWD.	2	10	MMWD, NPS, RCD, RWQCB, SPAWN, State Parks, Trout Unlimited, SWRCB	
LaC-CCCS-6.1.4.5	Action Step	Habitat Complexity	Install structures with multiple logs and root balls because they are more effective than structures with only one log.	3	10	CDFW, Marin County, Marin RCD, MMWD, NPS, SPAWN, SWRCB	
LaC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover				
LaC-CCCS-7.1.1.1	Action Step	Riparian	Continue riparian protection and sediment control projects with a focus on working with landowners to manage livestock to protect riparian areas, and to implement erosion control projects on State and Federal park and private lands (e.g., Devil's Gulch).	2	10	Marin County, Marin RCD, MMWD, NPS, SPAWN, State Parks	Livestock damage has severe effects in the Olema watershed. In addition, Cheda and lower Lagunitas creek have livestock damage issues .
LaC-CCCS-7.1.1.2	Action Step	Riparian	Plant native riparian species and native conifers/hardwoods in the riparian zone within the central portion of the watershed (Olema and lower Lagunitas Creek mainstem) to increase overall tree diameter	2	20	CDFW, MMWD, NOAA RC, NPS, Private Landowners, RCD	
LaC-CCCS-7.1.1.3	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (100 feet) throughout the watershed	3	50	Land Trusts, Marin County, MMWD, NPS, Sonoma County	
LaC-CCCS-7.1.1.4	Action Step	Riparian	Manage riparian areas for their site potential composition and structure.	3	60	Marin County, MMWD, NPS, Tomales Bay Watershed Council	
LaC-CCCS-7.1.2	Recovery Action	Riparian	Improve tree diameter				
LaC-CCCS-7.1.2.1	Action Step	Riparian	Implement the San Geronimo Valley Salmon Enhancement Plan to protect riparian integrity in San Geronimo Creek	2	20	Marin County, MMWD, NPS, Private Landowners	
LaC-CCCS-7.1.2.2	Action Step	Riparian	Conduct conifer release to promote growth of larger diameter trees where appropriate throughout the watershed.	3	10	Board of Forestry, MMWD, NPS, Private Landowners	
LaC-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-8.1.1	Recovery Action	Sediment	Improve gravel quantity and distribution for macro-invertebrate productivity (food)				
LaC-CCCS-8.1.1.1	Action Step	Sediment	Reduce embbeddness levels to the extent that 75% to 90% of streams within the watershed meet optimal criteria (>50% stream average scores of 1 & 2)	2	10	MMWD, NPS, Private Landowners, RCD, Tomales Bay Watershed Council, SWRCB	
LaC-CCCS-8.1.1.2	Action Step	Sediment	Conduct sediment source surveys in remaining portion of the watershed to identify existing sources of high sediment yield using accepted protocols and implement recommendations	3	10	NPS, Marin County, MMWD, Private Landowners, RCD, Tomales Bay Watershed Council, SWRCB	
LaC-CCCS-8.1.1.3	Action Step	Sediment	Implement recommendations of completed sediment source surveys (See ROADS for specific actions)	2	5	CDFW, Marin County, MMWD, NPS, Private Landowners, RCD, Tomales Bay Watershed Council, Trout Unlimited, SWRCB	
LaC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions				
LaC-CCCS-10.1.1.1	Action Step	Water Quality	Determine site-specific recommendations, including incentives, to remedy high temperatures and implement accordingly (CDFG 2004) .	2	5	Marin County, MMWD, NPS, State Parks	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-10.1.1.2	Action Step	Water Quality	Focus on restoration efforts that deal with riparian canopy, shelters and any other impaired key habitat attribute indicator that relates specifically to instream temperature.	2	5	Marin County, MMWD, NPS, State Parks	
LaC-CCCS-10.1.2	Recovery Action	Water Quality	Improve stream water quality conditions				
LaC-CCCS-10.1.2.1	Action Step	Water Quality	Fully implement practices consistent with the SFRWQCB pathogen and sediment TMDLs.	3	10	Marin County, MMWD, NPS, RWQCB, State Parks	
LaC-CCCS-11.1	**Objective**	**Viability**	**Address other natural or manmade factors affecting the species' continued existence**				
LaC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria				
LaC-CCCS-11.1.1.1	Action Step	Viability	Conduct habitat surveys to monitor change in key habitat variables.	1	100	CDFW, MMWD, NPS	
LaC-CCCS-11.1.1.2	Action Step	Viability	To better understand changes in sedimentation, monitoring in the basin should include: longitudinal profiles, cross-sections, V*, LWD volume and distribution, and embeddedness.	2	10	CDFW, MMWD, NMFS, NPS, SPAWN, Trout Unlimited, UC Extension	
LaC-CCCS-11.1.1.3	Action Step	Viability	Support operation of outmigrant traps.	1	10	CDFW, MMWD, NMFS, NPS, SPAWN, Trout Unlimited, UC Extension	
LaC-CCCS-11.1.1.4	Action Step	Viability	Use monitoring and trend information to adjust and adapt recovery actions/strategies.	3	50	MMWD, NMFS, NPS	
LaC-CCCS-11.1.1.5	Action Step	Viability	Adjust population targets and indicator ratings to reflect new habitat improvements and accessible habitat expansions.	3	5	MMWD, NMFS, NPS	
LaC-CCCS-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
LaC-CCCS-12.1.1.1	Action Step	Agriculture	Reduce or eliminate sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels (see Roads for specific actions/areas)	2	60	Marin County, NPS, Private Landowners, Public Works, Marin RCD, USACE	
LaC-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure				
LaC-CCCS-12.1.2.1	Action Step	Agriculture	Implement programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	30	Land Trusts, Marin County, Marin RCD, NPS	
LaC-CCCS-12.1.2.2	Action Step	Agriculture	Avoid or minimize agricultural activities within 100 feet of the edge of a stream	3	5	CDFW, Marin RCD, NMFS, NPS, NRCS, SWRCB, USACE	
LaC-CCCS-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
LaC-CCCS-12.1.3.1	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 recovery priorities.	3	10	CDFW, Farm Bureau, Marin RCD, NMFS, NRCS, NPS, Private Landowners	
LaC-CCCS-12.1.4	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
LaC-CCCS-12.1.4.1	Action Step	Agriculture	Complete Farm Conservation Plans to reduce sediment sources and restore riparian habitat and forest health	3	10	CDFW, Farm Bureau, MALT, Marin RCD, NMFS, NPS, NRCS, Private Landowners, UCE	
LaC-CCCS-12.1.5	Recovery Action	Agriculture	Prevent or minimize impairment to stream hydrology (impaired water flow)				
LaC-CCCS-12.1.5.1	Action Step	Agriculture	Work with the agricultural community to develop water conservation strategies protective of salmonids while allowing ongoing agricultural land uses (i.e., off-channel storage ponds).	3	10	CDFW, Farm Bureau, Marin RCD, NMFS, NRCS, NPS, Private Landowners, RCD, SWRCB	
LaC-CCCS-12.2	**Objective**	**Agriculture**	**Address the inadequacy of existing regulatory mechanisms**				
LaC-CCCS-12.2.1	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-12.2.1.1	Action Step	Agriculture	Assist in the development and support implementation of sediment TMDL to assure water quality conditions for steelhead are improved and fine sediment loads are decreased to baseline conditions.	3	5	Marin RCD, NPS, RWQCB, Water Agencies	
LaC-CCCS-12.2.2	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure				
LaC-CCCS-12.2.2.1	Action Step	Agriculture	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do.	2	50	Marin County, Marin RCD, NPS, RWQCB	
LaC-CCCS-12.2.2.2	Action Step	Agriculture	Enforce measures to avoid impacts within riparian setbacks/buffers.	1	50	Marin County, Marin RCD, NPS	
LaC-CCCS-12.2.2.3	Action Step	Agriculture	Streamline permit processing where landowners are conducting actions aligned with recovery priorities.	2	5	CDFW, Farm Bureau, Marin RCD, NMFS, NPS, Private Landowners	
LaC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
LaC-CCCS-13.1.1.1	Action Step	Channel Modification	Conduct rehabilitation activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows.(Evaluate the Tocaloma reach of the lower Lagunitas mainstem)	2	10	CDFW, Marin County, MMWD, NOAA RC, NPS, NRCS, Private Landowners, USACE	
LaC-CCCS-13.1.1.2	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. carefully evaluate feasibility where critical infrastructure is located) for bank hardening projects.	3	50	CDFW, MMWD, NMFS, NPS, USACE	
LaC-CCCS-13.1.1.3	Action Step	Channel Modification	Evaluate design alternatives to riprap bank repairs. Where riprap is necessary, evaluate integration of other habitat-forming features – including large woody debris to ensure improved habitat at the restoration site.	1	25	CDFW, MMWD, NMFS, NPS, USACE	
LaC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment of floodplain connectivity (impaired quality and extent)				
LaC-CCCS-13.1.2.1	Action Step	Channel Modification	Ensure that all future and existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	1	20	MMWD, NMFS, NPS, USACE	
LaC-CCCS-13.1.2.2	Action Step	Channel Modification	Any larger wood or rootwads should be stockpiled for future restoration projects where feasible.	2	10	CDFW, Marin County, Marin RCD, MMWD, NOAA RC, NPS	
LaC-CCCS-13.2	**Objective**	**Channel Modification**	**Address the inadequacy of existing regulatory mechanisms**				
LaC-CCCS-13.2.1	Recovery Action	Channel Modification	Prevent or minimize impairment of floodplain connectivity (impaired quality and extent)				
LaC-CCCS-13.2.1.1	Action Step	Channel Modification	Look for opportunities to locate new infrastructure outside of historic floodplains and find the means to compensate landowners in exchange for development rights or purchase of the land by a Land Trust. Look for opportunities for landowners to relocate existing infrastructure within the 100 year flood zone on a voluntary basis.	2	10	Marin County, MMWD, NPS, USACE	
LaC-CCCS-13.2.2	Recovery Action	Channel Modification	Prevent or minimize impairment to habitat complexity (reduce large wood and/or shelter)				
LaC-CCCS-13.2.2.1	Action Step	Channel Modification	Do not remove LWD, unless it is a emergency which threatens life and/or infrastructure.	2	10	Marin County, MMWD, NPS	
LaC-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
LaC-CCCS-18.1.1.1	Action Step	Livestock	Exclude livestock from riparian areas, specifically on State and Federal Park and private lands (e.g. Devils Gulch).	2	50	Marin RCD, NPS, NRCS, Private Landowners	
LaC-CCCS-18.1.1.2	Action Step	Livestock	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take first priority for riparian fencing programs over steer operations.	2	10	Marin RCD, NPS, NRCS	
LaC-CCCS-18.1.1.3	Action Step	Livestock	Encourage develop and fund riparian restoration projects to regain riparian corridors damaged from livestock and other causes.	2	20	Marin RCD, NPS, NRCS, Private Landowners	
LaC-CCCS-18.1.1.4	Action Step	Livestock	Manage rotational grazing to aid in the reduction of noxious weeds.	3	60	Marin RCD, NPS, NRCS, Private Landowners	

Lagunitas Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
LaC-CCCS-18.1.2.1	Action Step	Livestock	Substitute continuous season-long use of pastures in favor of rotational grazing strategies to reduce runoff. Short term, seasonal and long term rest from grazing in overgrazed areas would improve soil conditions for native revegetation and land values as well.	3	60	Marin RCD, NPS, NRCS	
LaC-CCCS-18.1.3	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
LaC-CCCS-18.1.3.1	Action Step	Livestock	To minimize gully initiation, grazing should be kept at relatively low intensities on steeper slopes	2	60	Marin RCD, NPS, NRCS, Private Landowners	
LaC-CCCS-18.1.3.2	Action Step	Livestock	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	60	Marin RCD, NPS, NRCS, Private Landowners	
LaC-CCCS-18.1.4	Recovery Action	Livestock	Prevent or minimize impairment to stream hydrology (impaired water flow)				
LaC-CCCS-18.1.4.1	Action Step	Livestock	Increase the use of water storage and catchment systems that collect rainwater in the winter for use during the dry summer and fall seasons.	2	10	Marin RCD, NPS, Private Landowners, State Parks	
LaC-CCCS-18.2	**Objective**	**Livestock**	**Address the inadequacy of existing regulatory mechanisms**				
LaC-CCCS-18.2.1	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
LaC-CCCS-18.2.1.1	Action Step	Livestock	Establish conservative residual dry matter (RDM) target per acre that ensures area is not overgrazed with 1000 lbs RDM (residual dry matter)/acre left at end of grazing season. Remove cattle from pasture before soils dry out.	3	50	Marin RCD, NPS, NRCS, Private Landowners	
LaC-CCCS-22.1	**Objective**	**Residential/Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-22.1.1	Recovery Action	Residential/Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
LaC-CCCS-22.1.1.1	Action Step	Residential/Commercial Development	Address failing septic systems in rural areas	3	10	County Planning, Marin County, NPS, RWQCB, Private Landowners	
LaC-CCCS-22.1.1.2	Action Step	Residential/Commercial Development	Improve water quality where necessary by addressing residential and commercial pollutant sources.	2	10	Marin County, NPS, Private Landowners, Public Works, RCD, RWQCB	
LaC-CCCS-22.1.2	Recovery Action	Residential/Commercial Development	Prevent or minimize impairment to stream hydrology (impaired water flow)				
LaC-CCCS-22.1.2.1	Action Step	Residential/Commercial Development	Encourage the use of rooftop water storage and other conservation devices	2	20	Marin County, NPS, Private Landowners	
LaC-CCCS-22.1.2.2	Action Step	Residential/Commercial Development	Disperse discharge from commercial and residential areas into a spatially distributed network rather than a few point discharges.	2	50	Marin County, NPS, Public Works, Water Agencies	
LaC-CCCS-22.1.3	Recovery Action	Residential/Commercial Development	Prevent or minimize adverse alterations to riparian species composition and structure				
LaC-CCCS-22.1.3.1	Action Step	Residential/Commercial Development	Enforce existing building permit programs to minimize unpermitted construction.	1	50	Marin County, NPS	
LaC-CCCS-22.1.3.2	Action Step	Residential/Commercial Development	Design new developments to minimize impacts to unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to watercourses.	1	20	Marin County, NPS, Private Landowners, RCD, USACE	
LaC-CCCS-22.1.3.3	Action Step	Residential/Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	2	60	Marin RCD, MMWD, NPS, Private Landowners, State Parks	
LaC-CCCS-22.1.3.4	Action Step	Residential/Commercial Development	Work with private landowners to 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	60	CDFW, Marin RCD, NPS, Private Landowners, State Parks	

Lagunitas Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-22.2	**Objective**	**Residential/Commercial Development**	**Address the inadequacy of existing regulatory mechanisms**				
LaC-CCCS-22.2.1	Recovery Action	Residential/Commercial Development	Prevent or minimize adverse alterations to riparian species composition and structure				
LaC-CCCS-22.2.1.1	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 CCC steelhead.	3	20	Marin County, MMWD, NPS, State Parks	
LaC-CCCS-22.2.1.2	Action Step	Residential/Commercial Development	Support the Marin County Streamside Conservation Area Ordinance. Evaluate current moratorium in San Geronimo Valley for pertinent action items.	3	10	CDFW, Marin County, NPS, SPAWN, State Parks	
LaC-CCCS-22.2.2	Recovery Action	Residential/Commercial Development	Prevent or minimize impairment to stream hydrology (impaired water flow)				
LaC-CCCS-22.2.2.1	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	25	Marin County, NPS, RWQCB, Water Agencies	
LaC-CCCS-22.2.2.2	Action Step	Residential/Commercial Development	Develop legislation that will fund county planning for environmentally sound water supply development and work in coordination with California Dept. of Housing, Association of Bay Area Governments and other government associations (CDFG 2004).	1	10	Marin County, NPS	
LaC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
LaC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	3	10	CalTrans, Marin County, NPS	
LaC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips.	2	20	NPS, Private Landowners, Public Works, RCD, State Parks	
LaC-CCCS-23.1.1.3	Action Step	Roads/Railroads	In the Olema Creek watershed, implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources.	2	20	NPS, Private Landowners, Public Works, RCD	
LaC-CCCS-23.1.1.4	Action Step	Roads/Railroads	In the Lagunitas Creek watershed, implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources. Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	2	30	NPS, Private Landowners, Public Works, RCD, State Parks	
LaC-CCCS-23.1.1.5	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	3	20	NPS, Private Landowners, Public Works	
LaC-CCCS-23.1.1.6	Action Step	Roads/Railroads	Decommission or treat the road sites on the priority list of 20 road sites within the San Geronimo subwatershed based on amount of sediment discharge.	2	20	Marin County, Marin RCD, NPS, SPAWN	
LaC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to watershed hydrology				
LaC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Utilize best management practices for road construction (e.g. Fishnet 4C, 2004; Weaver and Hagans, 1994; Sommarstrom et al., 2002; Oregon Department of Transportation, 1999).	3	100	Caltrans, Marin County, NPS, Private Landowners	
LaC-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize adverse alterations to riparian species composition and structure				
LaC-CCCS-23.1.3.1	Action Step	Roads/Railroads	Evaluate the potential of road widening projects (e.g. Sir Francis Drake Rd) on riparian corridors, and discourage encroachment into riparian zone.	3	50	Caltrans, CDFW, Marin County, NPS	
LaC-CCCS-23.1.3.2	Action Step	Roads/Railroads	Discourage or eliminate unwanted vegetation types and species and promote desirable (native) vegetation.	3	10	Marin County, NPS, RCD, State Parks, Water Agencies	
LaC-CCCS-23.1.4	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				

Lagunitas Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-23.1.4.1	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.	2	5	CDFW, NPS, RCD	
LaC-CCCS-23.1.4.2	Action Step	Roads/Railroads	Monitor and maintain the Coastal Conservancy database of barriers to fish passage (CDFG 2004).	3	10	California Coastal Conservancy, CDFW, NMFS, NPS	
LaC-CCCS-23.1.5	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
LaC-CCCS-23.1.5.1	Action Step	Roads/Railroads	Utilize BMP's to develop new and upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	2	50	Marin County, NPS, Private Landowners, State Parks	
LaC-CCCS-23.1.5.2	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. Bridge construction should not reduce streamside vegetation.	3	60	Board of Forestry, CalTrans, CDFW, City, NPS, Planning, Private Landowners, Public Works, RCD	
LaC-CCCS-23.1.5.3	Action Step	Roads/Railroads	Prevent future barriers on newly constructed roads utilizing NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	2	25	Marin County, NPS, RCD, State Parks, Water Agencies	
LaC-CCCS-23.1.5.4	Action Step	Roads/Railroads	Assess private road stream crossings for barrier potential and implement recommendations.	2	5	CDFW, NPS, Private Landowners, RCD, Trout Unlimited	
LaC-CCCS-23.1.5.5	Action Step	Roads/Railroads	Implement public road barrier survey recommendations in high then medium value areas as a priority (See Passage).	2	5	CDFW, NPS, Private Landowners, Public Works, State Parks	
LaC-CCCS-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanism**				
LaC-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
LaC-CCCS-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.	3	20	Marin County, NPS, USACE	
LaC-CCCS-23.2.1.2	Action Step	Roads/Railroads	Support the MMWD in their efforts to reduce sedimentation from lands in the Lagunitas Creek watershed. MMWD will also coordinate with the Marin County Stormwater Pollution Prevention Program (MCSTOPPP) to make sure that educational materials about non-point source pollution are available to homeowners in the San Geronimo Valley.	3	10	Marin RCD, MMWD, NPS, RWQCB	
LaC-CCCS-23.2.1.3	Action Step	Roads/Railroads	Support and Implement the MOU for Maintenance and Management of Unpaved Roads in the Lagunitas Watershed.	2	10	Marin County, NPS	
LaC-CCCS-24.1	**Objective**	**Severe Weather Patterns**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
LaC-CCCS-24.1.1.1	Action Step	Severe Weather Patterns	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.	3	10	CDFW, Marin County, NMFS, NPS	
LaC-CCCS-24.1.1.2	Action Step	Severe Weather Patterns	Evaluate and implement rainfall capture from impervious surfaces for irrigation use to protect water quality and reduce water demand in summer.	3	10	CDFW, Marin County, Marin RCD, MMWD, NPS, SPAWN, State Parks	
LaC-CCCS-24.1.1.3	Action Step	Severe Weather Patterns	In event of ongoing drought, SWRCB should not allow instream flow releases to result in less than 6 cfs in mainstem Lagunitas Creek.	2	10	MMWD, NPS, SWRCB	
LaC-CCCS-24.2	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
LaC-CCCS-24.2.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				

Lagunitas Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-24.2.1.1	Action Step	Severe Weather Patterns	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC steelhead recovery needs.	3	20	CDFW, County, NPS, SWRCB	
LaC-CCCS-25.1	**Objective**	**Water Diversion/Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
LaC-CCCS-25.1.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
LaC-CCCS-25.1.1.1	Action Step	Water Diversion/Impoundment	Minimize reductions of flow <8 cfs below major dams in the summer	2	50	Marin County, MMWD, NMFS, NPS, SWRCB	
LaC-CCCS-25.1.1.2	Action Step	Water Diversion/Impoundment	Ensure consistent fishery flows below Peter's Dam by improving gauging at SP Taylor Park	2	5	MMWD, NMFS, NPS, State Parks	
LaC-CCCS-25.1.1.3	Action Step	Water Diversion/Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	2	20	CDFW, Farm Bureau, MMWD, NPS, NRCS, Water Agencies	
LaC-CCCS-25.1.1.4	Action Step	Water Diversion/Impoundment	Promote the use of reclaimed water for agricultural or other uses.	3	60	CDFW, Marin County, NPS, RCD, Water Agencies	
LaC-CCCS-25.1.1.5	Action Step	Water Diversion/Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	3	20	CDFW, Marin County, Marin RCD, MMWD, NMFS, NPS, Private Landowners, RWQCB, SWRCB	
LaC-CCCS-25.1.1.6	Action Step	Water Diversion/Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	3	30	MMWD, NMFS, NPS, RCD, RWQCB, Water Agencies	
LaC-CCCS-25.1.1.7	Action Step	Water Diversion/Impoundment	Promote conjunctive use of water with water projects whenever possible.	3	60	CDFW, Marin County, MMWD, NPS, RCD, RWQCB, Water Agencies	
LaC-CCCS-25.1.1.8	Action Step	Water Diversion/Impoundment	Evaluate and assess impacts of local groundwater withdrawals in San Geronimo Creek watershed.	3	20	Marin RCD, MMWD, NPS, Private Landowners, RWQCB, SWRCB, SPAWN	
LaC-CCCS-25.1.1.9	Action Step	Water Diversion/Impoundment	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	20	CDFW, Marin County, MMWD, NMFS, NPS, Private Landowners, SPAWN	
LaC-CCCS-25.1.1.10	Action Step	Water Diversion/Impoundment	Support hydrology studies to evaluate instream flows in San Geronimo and its tributaries and determine effect of diversions, groundwater pumping, and altered groundwater recharge due to impervious surfaces on summer baseflow	2	10	DWR, MMWD, NPS, RWQCB	
LaC-CCCS-25.1.2	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to water quality (impaired stream temperature)				
LaC-CCCS-25.1.2.1	Action Step	Water Diversion/Impoundment	Encourage enforcement of SWRCB Order 95-17 (specifically in the warm summer months)	2	50	MMWD, NMFS, NPS, SWRCB	
LaC-CCCS-25.1.2.2	Action Step	Water Diversion/Impoundment	Discourage the transfer of water from Nicasio Reservoir to Kent Lake which could degrade water quality releases into Lagunitas Creek	2	50	CDFW, MMWD, NMFS, NPS, SWRCB	
LaC-CCCS-25.1.3	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to instream habitat complexity (altered pool complexity and/or pool riffle ratio)				
LaC-CCCS-25.1.3.1	Action Step	Water Diversion/Impoundment	Develop riffles and/or spawning channels below Kent Dam to increase spawner distribution and success	2	5	CDFW, MMWD, NMFS, NPS, Trout Unlimited	
LaC-CCCS-25.1.4	Recovery Action	Water Diversion/Impoundment	Prevent or minimize alterations to sediment transport (road conditions/density, dams etc.)				

Lagunitas Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
LaC-CCCS-25.1.4.1	Action Step	Water Diversion/Impoundment	Develop and Evaluate opportunities to expand spawning distribution through gravel augmentation below major dams.	2	10	CDFW, MMWD, NMFS, NPS, Trout Unlimited	
LaC-CCCS-25.1.5	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
LaC-CCCS-25.1.5.1	Action Step	Water Diversion/Impoundment	Develop and implement a plan to improve shelter value and rearing habitat through LWD augmentation below major dams.	2	5	CDFW, MMWD, NMFS, NPS, Trout Unlimited	
LaC-CCCS-25.1.6	Recovery Action	Water Diversion/Impoundment	Prevent or minimize reduced density, abundance, and diversity				
LaC-CCCS-25.1.6.1	Action Step	Water Diversion/Impoundment	Adequately screen water diversions to prevent juvenile salmonid mortalities.	2	100	CDFW, Marin County, MMWD, NMFS, NPS, Private Landowners, SPAWN	
LaC-CCCS-25.1.6.2	Action Step	Water Diversion/Impoundment	Allow all "fisheries flows" (baseflows, and passage, attractant, and channel maintenance flows) to bypass or flow through diversion facilities (see other actions steps below).	1	20	Marin County, MMWD, NPS, SWRCB	
LaC-CCCS-25.2	**Objective**	**Water Diversion/Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
LaC-CCCS-25.2.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
LaC-CCCS-25.2.1.1	Action Step	Water Diversion/Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of salmonids and their habitats, and avoidance of adverse impacts caused by water diversion (CDFG 2004).	2	60	CDFW, MMWD, NMFS, NPS, RCD, Water Agencies	
LaC-CCCS-25.2.1.2	Action Step	Water Diversion/Impoundment	Minimize take attributable to diversion of stream flow through alternatives such as: the operation of off-stream reservoirs, development of infrastructure necessary for conjunctive use of stream flow, and use of reclaimed water.	2	30	CDFW, Marin RCD, MMWD, NPS, Private Landowners	
LaC-CCCS-25.2.1.3	Action Step	Water Diversion/Impoundment	Identify and 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.	2	10	CDFW Law Enforcement, County, MMWD, NMFS OLE, NPS, SWRCB	
LaC-CCCS-25.2.1.4	Action Step	Water Diversion/Impoundment	Encourage the SWRCB to adjudicate watersheds to resolve over-allocation of water resources and provide adequate funding to water masters to enforce allocations.	2	5	CDFW, Marin County, NPS, RCD, RWQCB, Water Agencies	
LaC-CCCS-25.2.1.5	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	5	CDFW, Marin County, MMWD, NPS, RCD, RWQCB, Water Agencies	
LaC-CCCS-25.2.1.6	Action Step	Water Diversion/Impoundment	Encourage SWRCB to conduct interagency consultation with the California Department of Fish and Wildlife, and seek technical assistance from NMFS on the issuance of water rights permits.	2	15	CDFW, MMWD, NMFS, NPS, SWRCB	
LaC-CCCS-25.2.1.7	Action Step	Water Diversion/Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	15	MMWD, NMFS, NPS, RWQCB	
LaC-CCCS-25.2.1.8	Action Step	Water Diversion/Impoundment	Enforce SWRCB Order 95-17 (specifically in the warm summer months).	1	10	MMWD, NMFS, NPS, SWRCB	

Salmon Creek Population

CCC Steelhead Winter-Run

- Role within DPS: Potentially Independent Population
- Diversity Stratum: North Coastal
- Spawner Target: 1,300 adults
- Current Intrinsic Potential: 33.6 IP-km

For information regarding CCC coho salmon for this watershed, please see the CCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

Few historical surveys dating back to the 1950s exist for Salmon Creek, although angling reports from California Department of Fish and Game/Wildlife (CDFG/CDFW) wardens indicate that angling pressure (and presumably steelhead numbers) decreased from 1950s to the 1970s (Prunuske Chatham Inc. 2006). Sporadic historical surveys indicate that coho salmon were once abundant and steelhead were documented commonly. CDFG fish field surveys were conducted in the 1960s. Although the majority of fish were silver salmon, steelhead density ranged from 50-100 fish/100 feet (CDFG 1964) to 100 fish /100 feet (CDFG 1965). In 1977, after a "very dry" winter and several years of drought, local residents reported that the number of steelhead and coho declined significantly after that period, with the fall run of steelhead never returning to "normal" (Prunuske Chatham Inc. 2006).

In 2002, CDFG/CDFW conducted a systematic habitat survey of the entire watershed, which also included biological inventories to describe summer juvenile and adult general abundance and distribution in all the tributaries. Steelhead were documented in good numbers and were found present in all age classes. From 2004 to 2006, Prunuske Chatham Inc. (2006) conducted a study in the Salmon Creek estuary routinely encountering steelhead in the estuary. From 2008 to recently, summer juvenile, adult fish, and redd monitoring was conducted by Goldridge RCD in coordination with CDFG/CDFW and Trout Unlimited (TU) as a result of adult coho salmon releases to Salmon Creek from the Russian River Captive Broodstock Program. While the focus of this program was on coho salmon, juvenile steelhead have been incidentally captured and enumerated, though adult counts can only be considered anecdotal as the trapping timeline has only covered a portion of the steelhead adult migration period.

History of Land Use

Coast Miwok people were managing the Salmon Creek watershed when Russians first established farms in Bodega and Freestone in 1812 (Prunuske Chatham Inc. 2006). European settlers began to arrive in the 1840s and immediately began logging for their own needs as well as for the developing city of San Francisco. In the mid-1800s, an era of large-scale farming, ranching and timber-cutting began in Salmon Creek watershed with farms producing dairy products, potatoes and grain for California's growing population. In the early 1890s, timber cutting had a major impact on the watershed, with mills built and moved, sometimes to several locations within upland and lowland areas of each tributary. Douglas fir was harvested for lumber, oak for firewood, and tanoak for charcoal production and tanning. Felled logs were dragged by long teams of oxen through creek beds and over rough roads on slopes, then trucked out, or later exported by the narrow gauge railroad (GRRCD and Prunuske Chatham Inc. 2007).

Through the early part of the century, logging roads were used by automobiles to transport the increasing number of vacationers from the Bay Area to see the coast. This influx of vacationers led to the improvement of myriad failing roads that crisscrossed the watershed to meet engineering standards of the time in Sonoma County. In the 1960s, two significant wildfires occurred in the northern portion of the watershed: the Robertson Fire in 1961, which burned ~2000 acres in Fay Tannery and Coleman Valley Creeks; and the 1965 Coleman Valley Fire, which burned 1,840 acres on the ridge between Fay and Coleman Creeks and went almost to Salmon Creek. This fire took out most of the trees and the understory (Prunuske Chatham Inc. 2006).

Current Resources and Land Management

Today, the land cover of the Salmon Creek Watershed is still mostly forest (50% of land cover), grassland (37%) and shrub communities although the distribution and composition are significantly changed from what was present prior to European settlement. There are 424 acres of vineyards; 110 acres of paved surfaces; and 90 acres of orchards in the watershed. Nearly the entire Salmon Creek watershed is in private ownership, with only 98 acres in the lower estuary managed by the California Department of Parks and Recreation as Sonoma Coast State Beach. The dominant land uses are agriculture, livestock, and dairy production in the western portion of the watershed, along with viticulture and timber harvest occurring in the rest of the watershed. Residential development is fairly low, and commercial development is confined to the small unincorporated communities of Occidental, Freestone, Bodega, and Salmon Creek (Prunuske Chatham Inc. 2006).

Resource management on private lands is largely carried out by private landowners with assistance from various Federal and state agencies (e.g., CDFW, NMFS, and Goldridge Resource

Conservation District (RCD) with the assistance of National Resource Conservation Service). Recently, Goldridge RCD with the assistance of the Salmon Creek Watershed Council, CDFW and Trout Unlimited has conducted some salmonid population monitoring throughout the watershed where access is available.

Salmonid Viability and Watershed Conditions

Salmon Creek drains about 35 square miles in western Sonoma County, including the tributaries of Finley, Coleman Valley, Thurston, Nolan, and Tannery Creeks and enters the ocean just north of Bodega Bay. Its estuary extends approximately 1.3 miles inland from the coast. The mouth of the estuary is closed by a sandbar in spring or summer every year and remains closed until after the first significant storms. Under conditions of adequate summer streamflow, the closed estuary converts to a largely freshwater lagoon (Prunuske Chatham Inc. 2006). Habitat surveys conducted by CDFW (CDFG 2004) found the highest quality habitat conditions in upper Salmon Creek, and Tannery and Fay Creeks, although access for surveys was not granted basin-wide. Frequency of pools, shelter values, canopy levels, and stream temperatures were noted as limiting factors for salmonids in many reaches of the watershed. The following indicators were rated "Poor" through the CAP process for steelhead: Riparian Vegetation, Estuary/Lagoon, Habitat Complexity, Sediment Transport, and Landscape Disturbance. 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 were rated Fair or Poor as a result of our CAP viability analysis. The Salmon Creek CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Riparian Vegetation: Composition, Cover & Tree Diameter

Stream canopy, which is required for good summer rearing, buffers water temperatures. Only 57% (4 of 7) of streams meet optimal criteria (>70% canopy averaged for the stream) for stream canopy. Specifically Salmon, Coleman Valley, and Nolan creeks were rated Fair (50-69% canopy), and the native structure of the riparian zone has been highly altered on the Salmon Creek mainstem. Only 30% of the riparian zone is made up of larger conifer and hardwood species which provide for bank stabilization and the future recruitment of LWD. Loss of woody plants on channel banks of most of the tributaries is a major problem contributing to the destabilization of the stream bank (California State Coastal Conservancy and Circuit Rider Productions Inc. 1987). Much of the surrounding forest which was historically present has been cleared for grazing purposes with the largest classes in annual grasses (42%), redwood (28%) and hardwoods (12%).

Sediment Transport: Road Density

Sediment transport was altered by historic logging roads, which crisscross the watershed of Salmon Creek. These roads in the lower floodplain were converted to rural residential without appropriate upgrading for handling year round traffic and sizing of culverts to handle increased drainage areas and ditches. County and private roads parallel and occur in the riparian zone, limiting natural meandering of the stream. Though passage improvements have been conducted by the County and private organizations to assist adult migration, the retro-fits have not improved sediment transport through culverts.

Estuary: Quality & Extent

Increased water consumption in the upper watershed from groundwater and direct stream withdrawals has reduced base streamflows during critical periods (Prunuske Chatham Inc. 2006). These lower spring and summer flows increase pool stratification in the estuary to create bottom saline layers too hot and low in oxygen to sustain salmonids; thus, fish are confined to the upper freshwater layer and to the well-mixed area near the sandbar where they are vulnerable to predation by birds. Significant amounts of course sediment have dramatically decreased the areal extent and depth of the estuary since the mid-1800s (Prunuske Chatham Inc. 2006). These conditions when combined with low spring and summer flows also reduce lagoon elevations and can delay the breaching of the sandbar, delaying adult salmonid river entry. Additionally, erosion of fine sediments from the upper watershed creates high turbidity levels that impair salmonid physiological functioning and behavior.

Velocity Refuge: Floodplain Connectivity

Even though channelization has occurred in the mainstem of lower Salmon Creek, flooding frequently occurs; however, the riparian zone is thin, and agriculture encroaches upon the historic floodplain. Road building, culverts, and grazing development have led to severe channel incision in lower Salmon Creek and Finley Creek. The lack of large woody debris or access to refugia in the near stream floodplain impacts the winter survival of juveniles throughout the Salmon Creek watershed. Channel modification and incision have removed the stream channel from its natural floodplain except at extreme flood flows when salmonids can be flushed out to agricultural and grazing lands where they may become trapped on the declining limb of the hydrograph. High density streamside roads limit floodplain enhancement in some portions of the watershed.

Hydrology: Redd Scour

In the incised or channelized reaches, winter storms are confined within the channel due to the lack of near stream floodplain, which may scour eggs out of redds due to high velocities. During the winter months, incubation of eggs is further stressed due to high embeddedness levels as a result of high flows that accelerate erosion sites.

Hydrology: Baseflow & Passage Flows

Though the number of diversions in the Salmon Creek watershed wa rated as Fair, many of them are direct domestic diversions and many more unreported riparian diversions exist; thus, low summer flows reduce viable salmonid rearing habitat in the main channel and tributaries. Low spring and summer flows also increase pool stratification in the estuary to create bottom saline layers too hot and low in oxygen to sustain salmonids (Prunuske Chatham Inc. 2006).

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

Only Salmon Creek meets frequency criteria for diversity of habitat types, although all streams except Finley Creek meet pool depth criteria. No streams within the watershed meet optimal criteria for shelter complexity for any lifestage. Adequate numbers of pools with adequate shelter are specifically lacking and are of particular concern in most of Salmon Creek and its tributaries. Summer juvenile production is highly affected by the lack of or poor condition of these habitat elements.

Habitat Complexity: Large Wood & Shelter

CDFW habitat surveys conducted in 2008 indicated that mainstem Salmon creek lacked pool shelter and habitat complexity. Habitat complexity was lost in many streams due to poor abundance of channel forming features (e.g., LWD, boulders, etc.), channel simplification, and sediment aggradation, which reduced both summer and winter survival. In addition, thin buffer width of riparian zones severely limited the natural recruitment of LWD and the quality of juvenile rearing habitat in many areas of the watershed.

Water Quality: Temperature

Temperatures in Salmon Creek and Coleman Valley Creek exceeded optimal conditions. Chileno and Frink Canyon Creeks hovered slightly below optimal conditions at 16 and 14 degrees, respectively. Temperatures in Lower Salmon Creek and within the estuary also exceed optimal conditions for smolting.

Water Quality: Turbidity or Toxicity

High siltation affects incubating eggs, and high nutrient loading can affect summer rearing conditions by affecting temperature and levels of oxygen. Turbidity is also considered a problem

for winter rearing smolts because it affects their ability to forage for food and avoid predators. Prunuske Chatham Inc. (2006) shows turbidity levels remaining above the detrimental level for salmonids for an extended period of time during storm monitoring. Storm-related turbidity monitoring shows turbidity events as the creeks quickly rise and fall during flashy flood events.

Threats

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

Agriculture

Historic farming practices and current intensive grazing have reduced riparian vegetation, causing stream and bank erosion. Livestock in streams generally inhibit the growth of new trees, exacerbate erosion, and reduce summertime survival of juvenile fish by defecating in the water (CDFG 2004) . Erosion leads to increased sedimentation and water temperatures, degrading the quality of marshes and open water area in the estuary (GRRCD and Prunuske Chatham Inc. 2007). Although GIS spatial analysis shows vegetation occurring as only 4% in agricultural production, 61% of the watershed is in grasslands habitats consisting of rangeland, dairy land and pasture. Grazing in the riparian zone is common, and much of the native forest habitat has been converted to perennial grasslands. Water diversions supporting viticulture in these areas likely lower summer baseflows, causing disconnected aquatic habitat and elevated instream temperatures. Also, agriculture operations can encroach into adjacent riparian areas, possibly increasing sediment delivery to the stream as well as impacting shading and wood recruitment.

Channel Modification

Channel modification has had an historic impact to salmonid resources in Salmon Creek and its tributaries through the removal and transport of timber from the floodplain, riparian, and forest resources. Less than 80% of stream channels are estimated to be connected to their floodplain, leaving winter rearing juveniles without refugia from high velocities. Juvenile steelhead can be flushed from headwater areas which have higher rearing potential to lower reaches which have documented poorer habitat conditions. Channel modification has led to channel incision, over-steepened banks, high erosional forces and gravel embeddedness, and ultimately loss of riparian trees and width in some reaches. Channelization has occurred in the mainstem of Salmon Creek, and agriculture, road building, culverts and grazing land development encroach upon the historic floodplain resulting in a narrow riparian zone and to severe channel incision in upper Salmon Creek, Thurston and Nolan Creeks, and Freestone Valley subwatersheds.

Livestock Farming and Ranching

The GIS spatial analysis shows vegetation occurring as only 3 percent in agricultural production, and 4 percent of lands are classified as "Timber Production" by GRRCD and Prunuske Chatham Inc. (2007), although 47 percent of the watershed is in grasslands habitats consisting of rangeland, dairy land and pasture. Grazing in the riparian zone is common, and much of the native forest habitat has been converted to perennial grasslands; however, the irreversibility of these land use impacts is low. Cattle and other livestock browsing have decreased understory riparian species that provide habitat for terrestrial invertebrates that are food for rearing juvenile salmonids. Grazing and loafing within riparian corridors has led to bank erosion and high gravel embeddedness impacting spawning success and egg incubation. Bank erosion on tributary streams that are freely accessed by livestock is common (GRRCD and Prunuske Chatham Inc. 2007). Land use in the lower Salmon Creek and Finely Creek subwatersheds predominantly consists of pastureland, at 95 percent and 89 percent, respectively (Prunuske Chatham Inc. 2006).

Logging and Wood Harvesting

The general lack of wood within Salmon Creek stream channels is likely a cause of historic harvest and the highly flashy nature of the system, which transports out smaller woody debris during storm events. Although close to 50 percent of the forested land in the watershed is comprised of redwood forests (GRRCD and Prunuske Chatham Inc. 2007), GIS analysis of the riparian forest indicates only 30% of the forest riparian canopy is made up of large tree classes. Although much of the larger trees were removed during the previous century, forest tracts that could be of marketable size in the next decades exist. Thus, timber harvest remains a threat mainly from smaller fractured ownerships, which if harvested could cumulatively contribute to erosion and reduced canopy and large wood recruitment.

Residential and Commercial Development

Although Salmon Creek is a relatively small watershed, residential and commercial development pressures exist, with an impervious surfaces measurement of 23 percent, resulting in a rating of Poor at the watershed scale. The potential future demand for residential and commercial development in Sonoma County is very high. Although Salmon Creek currently has a low percentage of development, conversion of ranches, farms, and dairy lands to home tracts could greatly offset the benefits of the current land uses which remain in open space and have left the hydrologic regime relatively undisturbed. Residential pressures can result in increased road building and water development, encroachment in riparian areas, and reduced water quality. The irreversibility of land use impacts associated with residential and commercial development is high. The upper Salmon Creek, Thurston, and Nolan creeks, and Freestone Valley subwatersheds are the most heavily developed with a mix of land uses (GRRCD and Prunuske Chatham Inc. 2007).

Roads and Railroads

While road density was rated Fair within the Salmon Creek watershed, streamside road density is high. Road development has altered the natural flow of water and interrupted sediment transport, often causing channel degradation below undersized culverts. Currently many existing roads are not maintained adequately, and this lack of maintenance contributes sediment from surface erosion. Most culverts are undersized, reducing the availability of spawning gravel and increasing channel incision. Increased road building would accompany further development of the basin. No watershed-wide road assessment or transportation plan exists for this basin. Most other watersheds in Marin and adjacent Sonoma County have road/culvert assessments completed and erosion correction/prevention plan recommendations in progress or completed.

Severe Weather Patterns

The watershed experiences a Coastal type climate and year-round flows are normal conditions in the Salmon Creek watershed. Severe drought conditions were present in the summer of 2004. Spring rainfall totals were 35% of normal. Streamflows declined rapidly throughout the watershed. Continuous monitoring of the water table elevation captured the decline over a 3 month period. By mid-August, the riffles were dry, disconnecting the pools. Given that summer streamflows are already pressured by agricultural and some residential development, long-lasting drought patterns could pose a significant threat to maintaining adequate streamflows and aquatic habitat. Flooding can contribute positive as well as negative changes to streams through the initiation or acceleration of natural processes, respectively. For Salmon Creek, severe flooding could accelerate erosion road and historic mining sites, increasing the already sediment riffles and pool habitats in tributaries.

Water Diversion and Impoundments

Although few earthen dams occur in the upper watershed, and the number of reported diversions is low, the chief water demand occurs in the summer from creek side residential and agricultural development. Increased water diversion resulting from residential development within Salmon Creek could offset the current benefits of the relatively undisturbed hydraulic regime. Water diversion in the tributaries could impact rearing juveniles. Flows in the mainstem are already compromised due to the operation of the PUD water supply well, which is low in the system, and reduces water supply to lower Salmon Creek and the estuary (Prunuske Chatham Inc. 2006).

Limiting Conditions, Lifestages, and Habitats

Threat and conditions analysis within the CAP workbook suggests summer rearing juveniles and watershed processes are the targets most at risk in Salmon Creek watershed, though eggs are at high risk if current and future threats are not addressed. The smolts lifestage may be the most

limiting steelhead production in Salmon Creek, as all smolts must out-migrate through an estuary that has poor quality conditions. Alteration of estuarine, riparian, and floodplain habitats and water quality is a result of landscape disturbance from historic adjacent land uses, including logging, agriculture, livestock grazing, and the effects of residential development.

General Recovery Strategy

The watershed has high potential for habitat restoration, and many BMPs are available for the primary existing land uses (i.e., Livestock, Roads, Residential and Agriculture) in the watershed. Summer rearing conditions can be improved through pool and shelter development throughout the watershed; however, the enhancement of winter rearing conditions is somewhat hampered by the encroachment of roads or urban development to the stream. Decreasing sediment sources and improving water quality would decrease turbidity and improve food foraging and growth of winter rearing salmonids, while expanding riparian corridors for LWD and decreasing erosion would improve conditions for all lifestages.

Improve Estuary Conditions

Recommendations include: enhancing habitat diversity in the estuary through woody debris structures, restoring side channels and pond connectivity, maintaining beneficial freshwater flows through water conservation/management of diversions, expanding erosion control and riparian protections, implementing storm water management practices in the upper watershed, and enhancing upstream rearing habitat to provide alternatives to poor quality estuarine habitat. The recommendations also include continuing the biological and water quality monitoring in the estuary for at least 5 more years, installing a USGS stream gage at the upper end of the estuary and several additional flow monitors higher in the watershed, and implementing community education programs on a variety of topics including water conservation and erosion control BMPs.

Improve/Conserve Water Resources

Continuing and supporting studies being conducted to quantify water demand and supply and identify water conservation projects and opportunities in cooperation with watershed landowners is recommended. Exploring the benefits of simulated beaver dam structures (beavers are no longer present) in providing year-round flow for rearing steelhead is also recommended. Maintaining sufficient freshwater flows in upstream rearing habitats will increase flows to the estuary, keep the sandbar open longer, and moderate salinity, temperature and dissolved oxygen.

Address Upslope/Instream Sediment Sources

Maintenance of existing private roads should be improved per the recommendations of *Forest and Ranch Roads* (MCRCD 1994). Maintenance on public roads should be increased and should follow

the standards of the *Fishnet 4c Road Manual*. Problem roads and active erosion sites should be prioritized and addressed as part of a comprehensive sediment reduction plan for the entire Salmon Creek basin. GRRCD and Prunuske Chatham Inc. (2007) notes that instream sediment sources are likely as large or a larger source of sediment yield as non-point sources from roads, primarily due to impacts associated with cattle and dairy grazing, or as a result of incised channel conditions from channel modification. An erosion control technique utilizing bio-engineering methods to implement The Salmon Creek Watershed Assessment and Restoration Plan is recommended.

Improve LWD Volume

Shelter ratings are low within all surveyed stream reaches of Salmon Creek. Due largely to an absence of LWD, quality pool habitat is absent, and shelter components are comprised mainly of undercut banks and overhanging vegetation. Where applicable, restoration efforts should incorporate instream wood/boulder structures into degraded reaches along with bank erosion measures to improve habitat complexity and shelter availability. Salmon Creek would benefit from improved forest management practices, which would provide eventual LWD recruitment and riparian composition and structure. Protection of riparian zones from timber harvest would be most beneficial in providing a long term source of instream LWD, which provides shelter for adult and juvenile fish.

Improve Habitat Complexity

Throughout the mainstem Salmon creek and its tributaries, the instream and floodplain habitat needs to be improved through supplementation of LWD, boulders, and other channel forming features to encourage more desirable pool/riffle ratios and develop primary pools. Expanding opportunities for spawning and rearing habitat, such as structures for pool development and enhancement and trapping of spawning gravels, is specifically recommended in Fay, Finley, Tannery, and Thurston creeks.

Improve Water Quality/Water Temperature

An inventory of erosion sites was completed on 26 properties within the Salmon Creek watershed in the spring of 2004. The properties assessed included large agricultural parcels, small rural-residential acreages, and urban stream-side lots. The focus of the project was to document sediment sources that have the potential to deliver material directly to the stream network and provide a prioritized repair list for future funding and implementation projects. The recommendations of this study should be implemented.

Protect Riparian Corridors and Refugia Areas

Existing riparian corridors should be protected, and where opportunity exists, riparian buffers should be widened and/or floodplain areas enhanced to benefit wintertime rearing. Rural residential expansion should be discouraged except where General Plan elements are protective enough to offset impacts to this largely undeveloped watershed. Additionally, planting the riparian zone with native overstory and understory reaches specifically on Coleman Valley, Nolan and Salmon Creek mainstem is recommended. Conservation easements to protect riparian resources should be evaluated and implemented where refugia areas have been identified. Restoration of riparian corridors with the establishment of conservation easements from willing landowners would allow expansion of corridors through natural meandering and active re-vegetation with native species appropriate to the area.

Improve Livestock Management

Improving distribution of livestock to reduce prolonged concentrated utilization of grassland and riparian areas and to provide periods of rest for improved grassland is recommended. Confining livestock out of riparian corridors in Salmon Creek and its tributaries is the highest priority for the basin and would have the single largest voluntary impact. Where landowners have fenced livestock, the practice has eliminated concerns for temperature and/or poor water quality from livestock browsing and loafing if fences are maintained. Projects to limit access by livestock in any areas where livestock currently have access should be implemented, either independently or as part of cooperative restoration projects.

Improve Water Quality

The Regional Water Quality Control Board (RWQCB) has identified channel protection and increased riparian zones along Salmon Creek as targeted nonpoint source (NPS) pollution control projects. Through a cooperative effort between several agencies, the goal of the RWQCB's effort has been to promote the implementation of needed NPS pollution controls and to assist landowners with BMPs that will restore water quality. The main goal of this project is to improve and protect water quality by helping landowners achieve Tier 1 voluntary compliance with current and future NPS regulations (GRRCD and Prunuske Chatham Inc. 2007).

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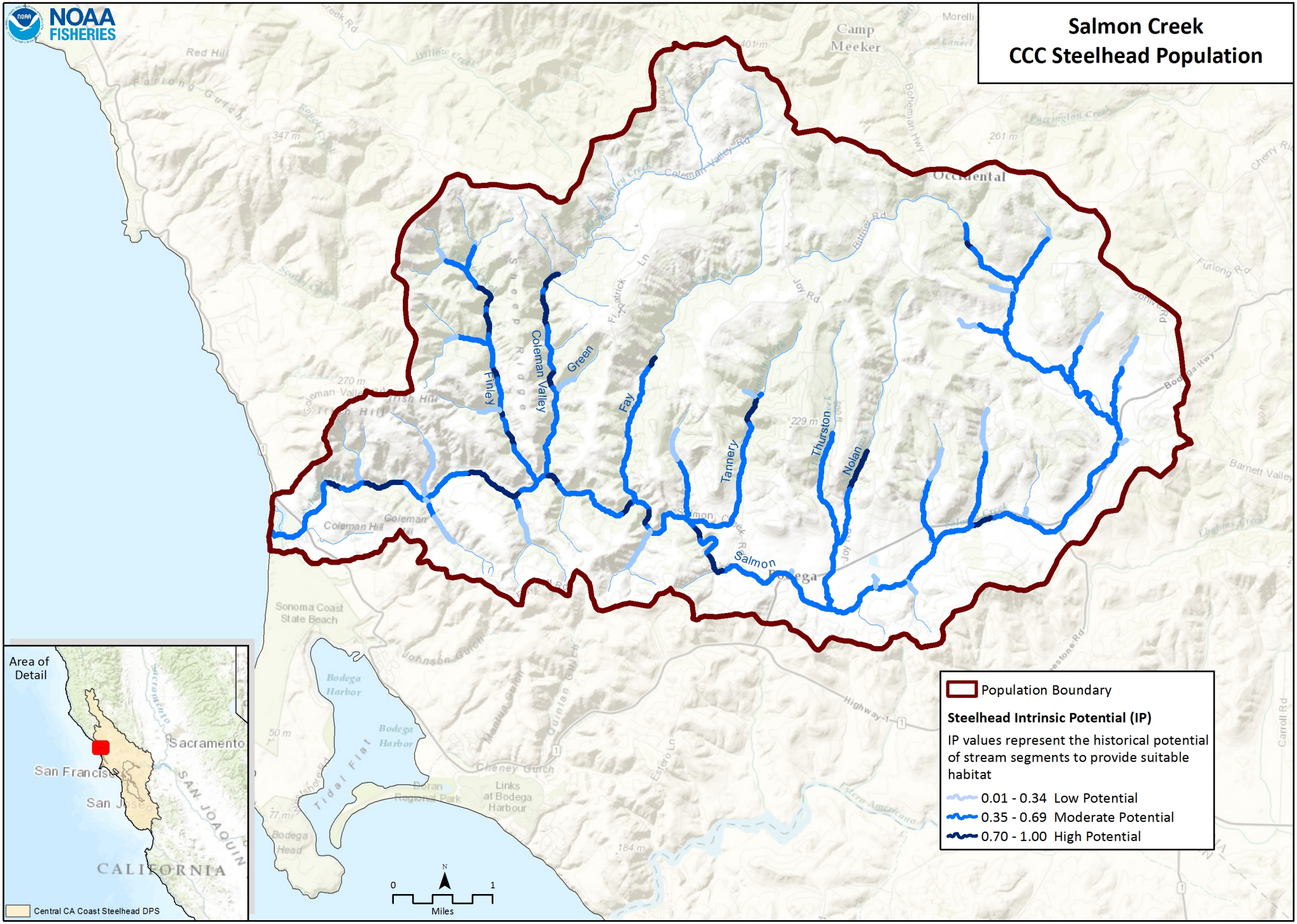
Salmon Creek
CCC Steelhead Population
NOAA FISHERIES
Coleman Valley
Green
Finley
Fay
Tannery
Thurston
Nolan
Salmon
Occidental
Camp Meeker
Bodega
Sonoma Coast State Beach
Bodega Harbor
Bodega Head
Tidal Flat
Links at Bodega Harbour
Coleman Hill
Area of Detail
Sacramento
San Francisco
San Jose
SAN JOAQUIN
CALIFORNIA
Central CA Coast Steelhead DPS
Population Boundary
Steelhead 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
1
Miles
N

CCC Steelhead Salmon Creek CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	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	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)	52% of streams/ 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)	0% of streams/ IP-km (>80 stream average)	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 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	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	30% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		

			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	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
		Size	Viability	Density	<1 spawner per IP-km to < low risk spawner density per Spence (2008)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		>1 spawner per IP-km to < low risk spawner density per Spence (2008)	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 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 58	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)	87% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
3	Summer Rearing Juveniles	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% 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 Primary Pools	<50% of streams/ IP-Km (>40% average primary pool frequency)	50% 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)	90% of streams/ IP-km (>40% average primary pool frequency)	Good
			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)	52% of streams/ 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)	0% 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 67	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 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	1.58 Diversions/10 IP-km	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	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy)	50% to 74% of streams/ IP-Km (>70% average stream canopy)	75% to 90% of streams/ IP-Km (>70% average stream canopy)	>90% of streams/ IP-Km (>70% average stream canopy)	75% to 90% of streams/ IP-km (>70% average stream canopy)	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	30% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			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)	87% of streams/ IP-km (>50% stream average scores of 1 & 2)	Good
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT)	50 to 74% IP km (<20 C MWMT)	75 to 89% IP km (<20 C MWMT)	>90% IP km (<20 C MWMT)	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	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	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	0.2 - 0.6 Fish/m^2	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
4	Winter Rearing Juveniles	Condition	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	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)	52% of streams/ 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)	0% of streams/ IP-km (>80 stream average)	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
			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	30% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			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)	87% 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	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

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	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	1.58 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	75% of IP-km to 90% of IP-km	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
			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 75% 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	0.248% 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	2.75% 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	25-15% 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	23% 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	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	2.9 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	4.0 Miles/Square Mile	Poor

CCC Steelhead Salmon Creek CAP Threat Results

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

Salmon Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-1.1.1	Recovery Action	Estuary	Increase the quality and extent of estuarine habitat				
SIC-CCCS-1.1.1.1	Action Step	Estuary	Implement the SCC Salmon Creek Enhancement Plan by regaining as much of the historical capacity and area of the Salmon Creek Estuary as possible.	2	30	California Coastal Conservancy, CDFW, NMFS, Private Landowners, RWQCB, Sonoma County, State Parks, USFWS	
SIC-CCCS-1.1.1.2	Action Step	Estuary	Restore estuarine wetlands and sloughs, and improve prey abundance by increasing shoreline perimeter and planting native emergent and riparian species to improve foraging and cover.	2	10	CA Coastal Commission, California Coastal Conservancy, CDFW, Private Landowners	
SIC-CCCS-1.1.1.3	Action Step	Estuary	Assess the need to dredge Salmon Creek Estuary to increase capacity of estuarine habitat.	3	10	California Coastal Conservancy, CDFW, NMFS, USACE	
SIC-CCCS-1.1.2	Recovery Action	Estuary	Increase rate of lagoon formation and/or freshwater conversion				
SIC-CCCS-1.1.2.1	Action Step	Estuary	Restore estuary function by increasing in-stream flow in Salmon Creek and tributaries that will provide greater freshwater input into the estuary.	2	30	CDFW, Gold Ridge RCD, NMFS, Private Landowners	
SIC-CCCS-1.1.2.2	Action Step	Estuary	Improve estuarine water quality by identifying and remediating upstream pollution sources which contribute to poor water quality conditions in the estuary	2	20	California Coastal Conservancy, RWQCB, Sonoma County, SWRCB	
SIC-CCCS-1.1.2.3	Action Step	Estuary	Evaluate alterations to river mouth dynamics and implement changes to restore natural function	2	10	California Coastal Conservancy, CDFW, NMFS, Sonoma County, State Parks, USACE	
SIC-CCCS-1.1.3	Recovery Action	Estuary	Improve the quality of each estuarine habitat zone				
SIC-CCCS-1.1.3.1	Action Step	Estuary	Restore estuary function by reducing fine sediment input from the upper watershed.	2	30	CDFW, Gold Ridge RCD, NMFS, Private Landowners	
SIC-CCCS-1.1.3.2	Action Step	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (CDFG 2004).	2	60	Gold Ridge RCD, Sonoma County	
SIC-CCCS-1.1.3.3	Action Step	Estuary	Monitor the habitat use of various life stages of steelhead in the Salmon Creek estuary and associated wetlands.	3	10	CDFW, Gold Ridge RCD, NMFS	
SIC-CCCS-1.1.4	Recovery Action	Estuary	Increase and enhance habitat complexity features				
SIC-CCCS-1.1.4.1	Action Step	Estuary	Restore estuary function in Salmon Creek Estuary by improving complex habitat features and restoring historical flooding patterns where possible.	2	30	California Coastal Conservancy, CDFW, NMFS, NOAA RC, Sonoma County, USACE, USFWS	
SIC-CCCS-1.1.4.2	Action Step	Estuary	Develop Estuary Enhancement Projects to improve rearing habitat for juveniles and smolts (e.g. habitat features such as LWD, vegetative cover, deeper habitat, etc.)	2	15	California Coastal Conservancy, CDFW, County Planning, NOAA RC, Private Landowners, RCD	
SIC-CCCS-1.1.4.3	Action Step	Estuary	Monitor the effectiveness of LWD structures and other restoration projects in the estuary	3	30	CDFW, Gold Ridge RCD	
SIC-CCCS-1.2	**Objective**	**Estuary**	**Address the inadequacy of existing regulatory mechanisms**				
SIC-CCCS-1.2.1	Recovery Action	Estuary	Improve the quality and extent of freshwater lagoon habitat (see WQ parameters)				
SIC-CCCS-1.2.1.1	Action Step	Estuary	Evaluate the effect of nearby landuse practices and development structures which may impair or reduce the historical tidal prism and other estuarine functions and implement improvements	3	10	CA Coastal Commission, California Coastal Conservancy, CDFW	
SIC-CCCS-1.2.1.2	Action Step	Estuary	Minimize future encroachment of landuse (agricultural, residential and commercial) into floodplain areas of the estuary	3	5	CDFW, RWQCB, Sonoma County, USACE	
SIC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				

Salmon Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches	2	10	Farm Bureau, NMFS, Public Works, RCD	
SIC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Identify the floodplain activation flow - the smallest flood pulse event that initiates substantial beneficial ecological processes when associated with floodplain inundation (Williams et al. 2009).	3	10	CDFW, NMFS	
SIC-CCCS-2.1.1.3	Action Step	Floodplain Connectivity	Improve conditions to re-create, and restore alcove, backwater, or perennial pond habitats where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity. Develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats in lower Salmon Creek.	2	10	California Coastal Conservancy, NMFS, RCD	
SIC-CCCS-2.1.1.4	Action Step	Floodplain Connectivity	Support landowners and the Gold Ridge RCD in developing projects to improve channel conditions and restore natural channel geomorphology, including side channels and dense contiguous riparian vegetation (CDFG 2004).	2	60	Gold Ridge RCD, Private Landowners	
SIC-CCCS-2.2	**Objective**	**Floodplain Connectivity**	**Address the inadequacy of existing regulatory mechanisms**				
SIC-CCCS-2.2.1	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
SIC-CCCS-2.2.1.1	Action Step	Floodplain Connectivity	Design new development to allow streams to meander in historical patterns, Protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	3	5	CDFW, Gold Ridge RCD, NOAA RC	
SIC-CCCS-2.2.1.2	Action Step	Floodplain Connectivity	Minimize new development within riparian zones and the 100 year floodprone zones.	3	30	CDFW, NMFS, Sonoma County	
SIC-CCCS-2.2.1.3	Action Step	Floodplain Connectivity	Encourage willing landowners to restore historical floodplains or offchannel habitats through conservation easements, etc.	3	10	County Planning, Land Trusts, Private Landowners, RCD	
SIC-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
SIC-CCCS-3.1.1.1	Action Step	Hydrology	Develop cooperative projects with private landowners to conserve summer flows	1	5	CDFW, NFWF, NMFS, Private Landowners, RCD	
SIC-CCCS-3.1.1.2	Action Step	Hydrology	Support the water conservation training conducted by the Occidental Arts and Ecology Center Water Institute, Gold Ridge RCD, and Salmon Creek Watershed Council.	3	20	Gold Ridge RCD, Private Landowners, Sonoma County	
SIC-CCCS-3.1.1.3	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	2	60	Gold Ridge RCD, Private Landowners	
SIC-CCCS-3.1.1.4	Action Step	Hydrology	Low in-stream flow should be addressed by increasing summer baseflows during the low rainfall seasons especially in reaches impacted by water diversions and by increasing riparian protection and restoration, erosion control, and employing best management practices that encourage permeability and infiltration. (Gold Ridge Resource Conservation District & Prunuske Chatham, Inc., 2007; CDFG 2004).	2	10	Gold Ridge RCD, Private Landowners, Sonoma County	
SIC-CCCS-3.1.2	Recovery Action	Hydrology	Improve flow conditions (instantaneous conditions)				
SIC-CCCS-3.1.2.1	Action Step	Hydrology	Avoid and/or minimize the adverse effects of water diversion on steelhead by establishing: a more natural hydrograph, by-pass flows, season of diversion, and off-stream storage (BM-HU-04 in CDFG 2004).	3	20	Gold Ridge RCD, Private Landowners, Sonoma County	
SIC-CCCS-3.1.3	Recovery Action	Hydrology	Minimize redd scour				
SIC-CCCS-3.1.3.1	Action Step	Hydrology	Improve spawning success and egg survival through improving channel configuration, sediment dynamics, and channel roughness and stability	2	20	Private Landowners, Public Works, RCD	
SIC-CCCS-3.1.3.2	Action Step	Hydrology	Develop floodplain enhancement and LWD projects in modified and incised channel areas of major tributaries	2	10	California Conservation Corps, CDFW, NOAA RC, Private Landowners, Trout Unlimited	
SIC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				

Salmon Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase frequency of primary or staging pools				
SIC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase pool frequency across 60% of watershed to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order streams; >3 feet in third order or larger streams)) in select reaches of Nolan, Tannery, Fay, and Thurston Creeks	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
SIC-CCCS-6.1.1.2	Action Step	Habitat Complexity	Where feasible, design and engineer pool enhancement structures to increase the number of pools (Gold Ridge Resource Conservation District and Prunuske Chatham, Inc., 2007; CDFG 2004).	2	60	CDFW, Gold Ridge RCD, NOAA RC	
SIC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase large wood frequency (BFW 0-10 meters)				
SIC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in select reaches of Fay, Tannery, Finley, and Thurston Creeks	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
SIC-CCCS-6.1.2.2	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>2 key LWD pieces/100 meters) in Salmon Creek	2	5	CDFW, NOAA RC, Private Landowners	
SIC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter				
SIC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase shelters in 75% of watershed to optimal conditions (>80 pool shelter value) in select reaches of Fay, Tannery, Finley, Thurston and Salmon Creeks	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
SIC-CCCS-6.1.3.2	Action Step	Habitat Complexity	Promote growth of larger diameter trees where appropriate.	3	20	CalFire, CDFW, NMFS	
SIC-CCCS-6.1.3.3	Action Step	Habitat Complexity	Protect existing riparian areas to maintain LWD supply and canopy.	2	20	CDFW, Gold Ridge RCD	
SIC-CCCS-6.1.4	Recovery Action	Habitat Complexity	Improve pool/riffle/flatwater ratio				
SIC-CCCS-6.1.4.1	Action Step	Habitat Complexity	Increase riffle frequency in 50% of watershed to achieve optimal conditions (20% riffles) by converting flatwater habitats (glides, runs, etc.) utilizing boulders and log structures in select reaches of Coleman Valley, Fay and Finley Creeks	2	5	CDFW, NOAA RC, Private Landowners	
SIC-CCCS-6.1.5	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD, and shelters				
SIC-CCCS-6.1.5.1	Action Step	Habitat Complexity	Investigate the feasibility of beaver re-location and re-introductions to promote channel complexity, improve baseflows and provide rearing habitat	3	10	CDFW, NMFS, Private Landowners, Sonoma Ecology Center	
SIC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-7.1.1	Recovery Action	Riparian	Increase tree diameter				
SIC-CCCS-7.1.1.1	Action Step	Riparian	Increase tree diameter within 25% of watershed to achieve optimal riparian forest conditions (55 - 69% Class 5 & 6 tree)	3	20	CDFW, NOAA RC, Private Landowners, RCD	
SIC-CCCS-7.1.1.2	Action Step	Riparian	Plant native riparian species and native conifers/hardwoods in the riparian zone within the southern portion of the watershed (Salmon Creek mainstem) to increase overall tree diameter	3	20	CDFW, NOAA RC, Private Landowners, RCD	
SIC-CCCS-7.1.1.3	Action Step	Riparian	Conduct conifer release to promote growth of larger diameter trees where appropriate throughout the watershed.	3	20	Board of Forestry, Private Landowners	
SIC-CCCS-7.1.1.4	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers throughout the watershed (CDFG 2004).	3	50	City Planning, Land Trusts, Sonoma County	
SIC-CCCS-7.1.2	Recovery Action	Riparian	Improve canopy cover				
SIC-CCCS-7.1.2.1	Action Step	Riparian	Improve canopy cover in 25% of streams within the watershed	2	5	CDFW, NOAA RC, Private Landowners, RCD	
SIC-CCCS-7.1.2.2	Action Step	Riparian	Increase the average stream canopy to a minimum of 80% within select reaches of Salmon, Nolan and Coleman Valley Creeks.	2	5	CDFW, NOAA RC, Private Landowners, RCD	
SIC-CCCS-7.1.2.3	Action Step	Riparian	Encourage the cultivation and availability of locally indigenous riparian plants for use in restoration and bank stabilization (CDFG 2004)	3	60	CDFW, Gold Ridge RCD, NRCS, Private Landowners	
SIC-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream substrate/food productivity (impaired gravel quality and quantity)				

Salmon Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-8.1.1.1	Action Step	Sediment	Continue to implement erosion control projects that were assessed and inventoried in sediment assessment plans (CDFG 2004).	2	60	Gold Ridge RCD, Private Landowners, Sonoma County	
SIC-CCCS-8.1.1.2	Action Step	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.	3	60	Gold Ridge RCD, NRCS, Private Landowners, Sonoma County	
SIC-CCCS-8.1.1.3	Action Step	Sediment	Address sources from slides and gullies that deliver sediment and runoff to stream channels.	2	10	Gold Ridge RCD, NRCS, Private Landowners, Sonoma County	
SIC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions				
SIC-CCCS-10.1.1.1	Action Step	Water Quality	Increase the canopy by planting native species where shade canopy is not at acceptable levels within middle Salmon Creek, Nolan, and Coleman Valley Creeks.	2	10	CDFW, NMFS, NRCS, Private Landowners, RCD	
SIC-CCCS-10.1.1.2	Action Step	Water Quality	Monitor instream water temperatures to determine baseline conditions and judge the efficacy of restoration actions. High priority streams include tributary and mainstem reaches within Salmon and Walker Creeks (CDFG stream survey reports).	3	20	CDFW, NMFS, NRCS, Private Landowners, RCD	
SIC-CCCS-10.1.2	Recovery Action	Water Quality	Improve stream water quality conditions				
SIC-CCCS-10.1.2.1	Action Step	Water Quality	Install continuous water quality monitoring stations in lower Salmon Creek	3	5	NMFS, Private Landowners, RWQCB	
SIC-CCCS-10.1.2.2	Action Step	Water Quality	Work with livestock and ranch owners to implement BMP's to control sediment and nitrates	3	30	NRCS, Private Landowners, RCD	
SIC-CCCS-10.1.3	Recovery Action	Water Quality	Reduce turbidity and suspended sediment				
SIC-CCCS-10.1.3.1	Action Step	Water Quality	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.	3	100	City Planning, County Planning, RWQCB	
SIC-CCCS-10.1.3.2	Action Step	Water Quality	Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody debris.	3	10	City Planning, County Planning, RWQCB	
SIC-CCCS-10.1.3.3	Action Step	Water Quality	Implement Best Management Practices such as those in the Fish Friendly Farming program (California Land Stewardship Institute), or other cooperative conservation programs.	3	3	Private Landowners, RCD, RWQCB	
SIC-CCCS-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria				
SIC-CCCS-11.1.1.1	Action Step	Viability	Adjust population targets and indicator ratings to reflect new habitat improvements and accessible habitat expansions	3	10	NMFS	
SIC-CCCS-11.1.1.2	Action Step	Viability	Conduct habitat surveys to monitor change in key habitat variables	3	10	CDFW, NMFS	
SIC-CCCS-11.1.1.3	Action Step	Viability	To better understand changes in sedimentation, monitoring in the basin should include: longitudinal profiles, cross-sections, V*, LWD volume and distribution, and embeddedness.	3	60	RCD	
SIC-CCCS-11.1.1.4	Action Step	Viability	Develop smolt abundance estimates	1	10	CDFW, NMFS, RCD	
SIC-CCCS-11.1.1.5	Action Step	Viability	Support operation of outmigrant traps	1	10	CDFW, NMFS, Trout Unlimited, UC Extension	
SIC-CCCS-11.1.1.6	Action Step	Viability	Use monitoring and trend information to adjust and adapt recovery actions/strategies. Specific locations to be monitored will be determined through implementation of he Coastal Salmonid Monitoring Plan.	2	TBD	CDFW, NMFS	
SIC-CCCS-11.1.1.7	Action Step	Viability	Evaluate and conduct nutrient enrichment projects to improve freshwater growth and increase smolt escapement utilizing available carcasses from hatcheries and other methods (e.g. salmon analogs).	2	5	CDFW, NMFS, Private Landowners, RCD	
SIC-CCCS-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				

Salmon Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
SIC-CCCS-12.1.1.1	Action Step	Agriculture	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	
SIC-CCCS-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	
SIC-CCCS-12.1.1.3	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 salmon recovery priorities.	3	10	CDFW, Farm Bureau, NMFS, NRCS, Private Landowners, RCD	
SIC-CCCS-12.1.1.4	Action Step	Agriculture	Conduct outreach and education on agriculture programs that benefit salmonids.	3	10	CDFW, Farm Bureau, NMFS, NRCS, Private Landowners, RCD	
SIC-CCCS-12.1.1.5	Action Step	Agriculture	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.	3	10	CDFW, Farm Bureau, NMFS, NRCS, Private Landowners, RCD	
SIC-CCCS-12.1.1.6	Action Step	Agriculture	Incentive programs and incentive-based approaches should be explored for landowners who conduct operations in a manner compatible with steelhead and Chinook salmon recovery requirements.	3	10	CDFW, Farm Bureau, NMFS, NRCS, Private Landowners, RCD	
SIC-CCCS-12.1.1.7	Action Step	Agriculture	Encourage landowners to implement restoration projects as part of their ongoing practices in priority stream reaches and where habitat is in poor or fair condition.	3	10	CDFW, Farm Bureau, NMFS, NRCS, Private Landowners, RCD	
SIC-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure				
SIC-CCCS-12.1.2.1	Action Step	Agriculture	Improve water temperature conditions for migrating smolts and summer rearing juvenile salmonids throughout 35% of watershed by increasing the canopy by planting native species where shade canopy is not at acceptable levels within middle Salmon Creek, Nolan, and Coleman Valley Creeks.	2	20	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD	
SIC-CCCS-12.1.2.2	Action Step	Agriculture	Monitor instream water temperatures to determine baseline conditions and judge the efficacy of restoration actions. High priority streams include tributary and mainstem reaches within Salmon and Walker Creeks (CDFG stream survey reports).	2	5	CDFW, NMFS, NRCS, Private Landowners, RCD	
SIC-CCCS-12.2	**Objective**	**Agriculture**	**Address the inadequacy of existing regulatory mechanisms**				
SIC-CCCS-12.2.1	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure				
SIC-CCCS-12.2.1.1	Action Step	Agriculture	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do.	3	5	City Planning, RWQCB, Sonoma County	
SIC-CCCS-12.2.1.2	Action Step	Agriculture	Enforce requirements of local regulations and riparian/setbacks.	3	5	City Planning, Sonoma County	
SIC-CCCS-12.2.1.3	Action Step	Agriculture	Implement programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	5	Land Trusts, Sonoma County	
SIC-CCCS-12.2.2	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
SIC-CCCS-12.2.2.1	Action Step	Agriculture	Design new developments to avoid or minimize impacts to unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to watercourses.	3	100	Private Landowners, RCD, Sonoma County, USACE	
SIC-CCCS-12.2.2.2	Action Step	Agriculture	Develop legislation that will fund county planning for environmentally sound agricultural growth and water supply.	2	10	Farm Bureau, NRCS, Sonoma County, UC Extension	
SIC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality and extent)				
SIC-CCCS-13.1.1.1	Action Step	Channel Modification	Where feasible, remove obsolete bank stabilization structures from the channel which contribute to channel incision and reduced habitat complexity.	3	10	CalTrans, Farm Bureau, FEMA, Gold Ridge RCD, NRCS, Private Landowners, Public, Sonoma County	
SIC-CCCS-13.1.1.2	Action Step	Channel Modification	Evaluate undeveloped and developed floodplain property for potential function and conservation easement and/or acquisition potential.	3	10	RCD, Sonoma County	

Salmon Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-13.1.1.3	Action Step	Channel Modification	Conduct rehabilitation activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows, (see FLOODPLAIN for specific actions).	2	30	CDFW, NOAA RC, NRCS, Private Landowners, Sonoma County, USACE	
SIC-CCCS-13.1.1.4	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. carefully evaluate feasibility where critical infrastructure is located) for bank hardening projects.	3	50	CDFW, NMFS, USACE	
SIC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to habitat complexity (reduce large wood and/or shelter)				
SIC-CCCS-13.1.2.1	Action Step	Channel Modification	Evaluate design alternatives to riprap bank repairs. Where riprap is necessary, evaluate integration of other habitat-forming features – including large woody debris to ensure improved habitat at the restoration site.	3	20	CDFW, NMFS, USACE	
SIC-CCCS-13.1.2.2	Action Step	Channel Modification	Local agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	3	25	City Planning, Sonoma County	
SIC-CCCS-13.2	**Objective**	**Channel Modification**	**Address inadequacies of regulatory mechanisms**				
SIC-CCCS-13.2.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality and extent)				
SIC-CCCS-13.2.1.1	Action Step	Channel Modification	All proposed flood control projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.	3	30	NMFS, Sonoma County, USACE	
SIC-CCCS-13.2.1.2	Action Step	Channel Modification	Channel modifying projects should be designed to ensure potential effects to salmonid habitat are fully minimized or mitigated, and where possible, existing poor conditions should be remediated.	3	50	NMFS, USACE	
SIC-CCCS-13.2.1.3	Action Step	Channel Modification	Ensure that all future and existing channel designed for flood conveyance incorporate features that enhance salmonid migration under high and low flow conditions.	3	60	NMFS, USACE	
SIC-CCCS-13.2.1.4	Action Step	Channel Modification	Minimize new construction that will adversely affect watershed processes, particularly within the 100-year flood prone zones.	3	50	City Planning, Sonoma County, USACE	
SIC-CCCS-13.2.1.5	Action Step	Channel Modification	Develop a mitigation policy that requires In-Kind replacement of removed large woody debris at a 3:1 ratio.	3	10	CalTrans, Farm Bureau, FEMA, Gold Ridge RCD, NRCS, Private Landowners, Public, Sonoma County	
SIC-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
SIC-CCCS-18.1.1.1	Action Step	Livestock	Encourage riparian restoration to regain riparian corridors damaged from livestock and other causes.	2	30	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners	
SIC-CCCS-18.1.1.2	Action Step	Livestock	To minimize gully initiation, grazing should be kept at relatively low intensities on steeper slopes	2	60	NRCS, RCD, Private Landowners	
SIC-CCCS-18.1.1.3	Action Step	Livestock	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	60	NRCS, RCD, Private Landowners	
SIC-CCCS-18.1.1.4	Action Step	Livestock	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	20	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners	
SIC-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize impairment to stream hydrology (impaired water flow)				
SIC-CCCS-18.1.2.1	Action Step	Livestock	Aid landowners willing to fence off riparian areas with development of offstream alternative water sources	2	5	NRCS, RCD	
SIC-CCCS-18.1.2.2	Action Step	Livestock	Increase the use of water storage and catchment systems that collect rainwater in the winter for use during the dry summer and fall seasons.	1	30	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners	
SIC-CCCS-18.1.3	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
SIC-CCCS-18.1.3.1	Action Step	Livestock	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take first priority for riparian fencing programs over steer operations.	2	60	NRCS, RCD	
SIC-CCCS-18.1.3.2	Action Step	Livestock	Encourage, develop and fund riparian restoration projects to regain riparian corridors damaged from livestock and other causes.	2	10	NRCS, RCD	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-18.1.3.3	Action Step	Livestock	Manage rotational grazing to aid in the reduction of noxious weeds.	3	60	NRCS, RCD, Private Landowners	
SIC-CCCS-18.1.3.4	Action Step	Livestock	Substitute continuous season-long use of pastures in favor of rotational grazing strategies to reduce runoff. Short term, seasonal and long term rest from grazing in overgrazed areas would improve soil conditions for native revegetation and land values as well.	3	60	NRCS, RCD, Private Landowners	
SIC-CCCS-18.2	**Objective**	**Livestock**	**Address the inadequacy of existing regulatory mechanisms**				
SIC-CCCS-18.2.1	Recovery Action	Livestock	Prevent or minimize increased landscape disturbance				
SIC-CCCS-18.2.1.1	Action Step	Livestock	Establish conservative residual dry matter (RDM) target per acre that ensures area is not overgrazed with 1000 lbs RDM (residual dry matter)/acre left at end of grazing season. Remove cattle from pasture before soils dry out.	3	5	NRCS, RCD, Private Landowners	
SIC-CCCS-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
SIC-CCCS-19.1.1.1	Action Step	Logging	Develop a Road Sediment Reduction Plan that prioritizes problem sites and outlines implementation and a timeline of necessary actions.	3	5	Board of Forestry, CalFire, CDFW, Private Landowners, RCD	
SIC-CCCS-19.1.1.2	Action Step	Logging	Utilize BMP's to properly construct roads for stormproofing and Minimize the construction of roads in the riparian zone	3	5	Board of Forestry, CalFire, CDFW, Private Landowners, RCD	
SIC-CCCS-19.1.1.3	Action Step	Logging	Prevent or minimize future sediment and runoff sources from logging by utilizing BMP's that prevent or minimize delivery of sediment and runoff to stream channels.	3	5	Board of Forestry, CalFire, CDFW, Private Landowners, RCD	
SIC-CCCS-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
SIC-CCCS-19.2.1	Recovery Action	Logging	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
SIC-CCCS-19.2.1.1	Action Step	Logging	Acquire key large tracts of forestlands identified as a priority by Federal, State, local government, and non-governmental organizations	3	60	CDFW, NMFS, RCD, Sonoma County, State Parks	
SIC-CCCS-19.2.1.2	Action Step	Logging	Encourage forest management which allows for optimal levels of natural LWD recruitment of larger older trees into stream channels	3	60	Board of Forestry, NMFS, Private Landowners, Sonoma County, State Parks, US EPA	
SIC-CCCS-19.2.1.3	Action Step	Logging	Conserve and manage forestlands for older forest stages.	3	60	Board of Forestry, CDFW, NMFS, Sonoma County, State Parks, USEPA	
SIC-CCCS-19.2.2	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
SIC-CCCS-19.2.2.1	Action Step	Logging	Minimize future conversion of forestlands to agriculture or other land uses.	3	25	CalFire, County Planning	
SIC-CCCS-19.2.2.2	Action Step	Logging	Provide information to BOF regarding CCC steelhead priorities and recommend upgrading relevant forest practices.	3	2	CalFire, CDFW, NMFS	
SIC-CCCS-19.2.2.3	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	100	CalFire, NMFS, Private Landowners	
SIC-CCCS-22.1	**Objective**	**Residential /Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-22.1.1	Recovery Action	Residential /Commercial Development	Prevent or minimize adverse alterations to riparian species composition and structure				
SIC-CCCS-22.1.1.1	Action Step	Residential /Commercial Development	Identify areas at high risk of conversion, and develop incentives and alternatives for landowners that discourage conversion.	3	10	Private Landowners, Sonoma County	
SIC-CCCS-22.1.1.2	Action Step	Residential /Commercial Development	Explore the use of conservation easements to provide incentives for private landowners to preserve riparian corridors	3	10	CDFW, Land Trusts, Private Landowners	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-22.1.1.3	Action Step	Residential /Commercial Development	Reduce impacts of existing development in floodplains/riparian zones by encouraging willing landowners to restore these areas.	3	15	CDFW, RWQCB	
SIC-CCCS-22.1.1.4	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.	3	25	City Planning, Sonoma County	
SIC-CCCS-22.1.2	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to watershed hydrology				
SIC-CCCS-22.1.2.1	Action Step	Residential /Commercial Development	Encourage the use and provide incentives for rooftop water storage and other conservation devices	2	10	Private Landowners, Sonoma County	
SIC-CCCS-22.1.2.2	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	25	RWQCB, Sonoma County	
SIC-CCCS-22.1.3	Recovery Action	Residential /Commercial Development	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
SIC-CCCS-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.	3	20	City Planning, RWQCB, Sonoma County	
SIC-CCCS-22.2	**Objective**	**Residential /Commercial Development**	**Address the inadequacy of existing regulatory mechanisms**				
SIC-CCCS-22.2.1	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
SIC-CCCS-22.2.1.1	Action Step	Residential /Commercial Development	Implement performance standards in Stormwater Management Plans.	3	20	RWQCB, Sonoma County	
SIC-CCCS-22.2.1.2	Action Step	Residential /Commercial Development	Improve water quality where necessary by addressing residential and commercial pollutant sources.	2	10	Private Landowners, Public Works, RCD, RWQCB	
SIC-CCCS-22.2.2	Recovery Action	Residential /Commercial Development	Prevent or minimize adverse alterations to riparian species composition and structure				
SIC-CCCS-22.2.2.1	Action Step	Residential /Commercial Development	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do	3	20	City Planning, Sonoma County	
SIC-CCCS-22.2.2.2	Action Step	Residential /Commercial Development	Enforce requirements of local regulations and riparian/setbacks	3	20	City Planning, Sonoma County	
SIC-CCCS-22.2.2.3	Action Step	Residential /Commercial Development	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	3	30	Board of Forestry, CalFire, CDFW, City Planning, Sonoma County	
SIC-CCCS-22.2.2.4	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.	3	5	Sonoma County	
SIC-CCCS-22.2.3	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to watershed hydrology				
SIC-CCCS-22.2.3.1	Action Step	Residential /Commercial Development	Develop legislation that will fund county planning for environmentally sound growth water supply development and work in coordination with California Dept. of Housing, Association of Bay Area Governments and other government associations (CDFG 2004).	2	10	City Planning, Sonoma County	
SIC-CCCS-22.2.3.2	Action Step	Residential /Commercial Development	New development in all historic CCC steelhead and CC Chinook salmon watersheds should minimize storm-water runoff, changes in duration, or magnitude of peak flow.	3	20	RWQCB, Sonoma County, SWRCB	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-22.2.3.3	Action Step	Residential /Commercial Development	Minimize new construction in undeveloped areas within the 100-year flood prone zone in all historical CCC steelhead watersheds.	3	100	California Department of Mines and Geology, CalTrans, Mendocino County, NMFS, Private Landowners, Public, Sonoma County	
SIC-CCCS-22.2.4	Recovery Action	Residential /Commercial Development	Prevent or minimize increased landscape disturbance				
SIC-CCCS-22.2.4.1	Action Step	Residential /Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential in undeveloped areas.	3	100	City Planning, Mendocino County, Sonoma County	
SIC-CCCS-22.2.4.2	Action Step	Residential /Commercial Development	Work with counties to develop and implement ordinances to restrict subdivisions by requiring a minimum acreage limit for parcelization in concert with limits on water supply and groundwater recharge areas.	3	15	RCD, Sonoma County	
SIC-CCCS-22.2.4.3	Action Step	Residential /Commercial Development	Design new developments to avoid or minimize impacts to unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to watercourses	3	100	Private Landowners, Santa Cruz County, USACE	
SIC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
SIC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
SIC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	3	10	CalTrans, Sonoma County	
SIC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Assess roads in Nolan and Thurston Creeks to identify high priority and high sediment yield sources.	2	5	Private Landowners, Public Works, RCD	
SIC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources.	2	5	Private Landowners, Public Works, RCD	
SIC-CCCS-23.1.1.4	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	2	10	Private Landowners, Public Works	
SIC-CCCS-23.1.1.5	Action Step	Roads/Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or steelhead watersheds.	2	20	Private Landowners, Sonoma County	
SIC-CCCS-23.1.1.6	Action Step	Roads/Railroads	Utilize best management practices for road construction (e.g. Fishnet 4C, 2004; Weaver and Hagans, 1994; Sommarstrom et al., 2002; Oregon Department of Transportation, 1999).	3	20	Private Landowners, Public Works	
SIC-CCCS-23.1.1.7	Action Step	Roads/Railroads	Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	3	10	Private Landowners, Public Works	
SIC-CCCS-23.1.1.8	Action Step	Roads/Railroads	Prevent sediment sources on newly constructed roads.	3	20	Private Landowners, Public Works	
SIC-CCCS-23.1.1.9	Action Step	Roads/Railroads	Decommission riparian roads and skid trails on forestlands that deliver sediment into adjacent watercourses. High priority streams identified by CDFW habitat reports include Verde Canyon, Frink Canyon, and Salmon Creek (CDFG 2009).	3	10	Private Landowners, Public Works	
SIC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
SIC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips.	3	30	Private Landowners, Public Works, RCD, State Parks	
SIC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Utilize BMP's to upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	3	20	Private Landowners, Public Works, State Parks	
SIC-CCCS-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	Public Works	
SIC-CCCS-23.1.2.4	Action Step	Roads/Railroads	Assess private and public road stream crossings for barrier potential and implement recommendations.	2	5	CDFW, Private Landowners, RCD, Trout Unlimited	

Salmon Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-23.1.2.5	Action Step	Roads/Railroads	Prevent future barriers on newly constructed roads utilizing NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	2	5	CDFW, Private Landowners, RCD, Trout Unlimited	
SIC-CCCS-23.1.2.6	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	60	Board of Forestry, CalTrans, CDFW, City Planning, Private Landowners, Public Works, RCD	
SIC-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
SIC-CCCS-23.1.3.1	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	5	CDFW, RCD	
SIC-CCCS-23.1.4	Recovery Action	Roads/Railroads	Prevent or minimize adverse alterations to riparian species composition and structure				
SIC-CCCS-23.1.4.1	Action Step	Roads/Railroads	Discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	3	10	Public Works, RCD, Water Agencies	
SIC-CCCS-23.1.4.2	Action Step	Roads/Railroads	Utilize the Fishnet 4c or similar manual in training and operations.	3	10	City Planning, County Planning, Public Works	
SIC-CCCS-24.1	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
SIC-CCCS-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to watershed hydrology				
SIC-CCCS-24.1.1.1	Action Step	Severe Weather Patterns	Work with CDFW, County of Sonoma, State Parks, municipalities, and knowledgeable biologists to develop severe weather emergency rules (i.e. floods, droughts) and adopt implementation agreements.	3	20	Cities, Sonoma County, State Parks	
SIC-CCCS-24.1.1.2	Action Step	Severe Weather Patterns	Work with local governments to incorporate protection of CCC steelhead in any flood management activity (CDFG 2004).	3	10	CDFW, Cities, FEMA, Gold Ridge RCD, NMFS, Sonoma County, USACE	
SIC-CCCS-24.1.1.3	Action Step	Severe Weather Patterns	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts and floods while also providing for salmonid recovery needs.	3	10	Board of Forestry, CA Coastal Commission, California Coastal Conservancy, California Department of Mines and Geology, CDFW, CDFW Law Enforcement, City Planning, Farm Bureau, FEMA, NMFS, NRCS, Public Works, RWQCB, State Parks, SWRCB, USACE, USEPA, USGS, Water Agencies	
SIC-CCCS-24.1.1.4	Action Step	Severe Weather Patterns	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	3	20	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE	
SIC-CCCS-24.2	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species continued existence**				
SIC-CCCS-24.2.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to watershed hydrology				
SIC-CCCS-24.2.1.1	Action Step	Severe Weather Patterns	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.	3	20	Gold Ridge RCD, Private Landowners, Sonoma County	
SIC-CCCS-25.1	**Objective**	**Water Diversion/ Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				

Salmon Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
SIC-CCCS-25.1.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
SIC-CCCS-25.1.1.1	Action Step	Water Diversion/ Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	2	5	CDFW, Gold Ridge RCD, Private Landowners, RWQCB, Sonoma County	
SIC-CCCS-25.1.1.2	Action Step	Water Diversion/ Impoundment	Promote the use of reclaimed water for agricultural or other uses.	3	10	Gold Ridge RCD, Private Landowners, RWQCB, Sonoma County	
SIC-CCCS-25.1.1.3	Action Step	Water Diversion/ Impoundment	Promote water conservation by the public, water agencies, agriculture, private industry, and the citizenry.	3	20	CDFW, Farm Bureau, NRCS, Water Agencies	
SIC-CCCS-25.1.1.4	Action Step	Water Diversion/ Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	3	20	CDFW, Farm Bureau, NRCS, Water Agencies	
SIC-CCCS-25.1.1.5	Action Step	Water Diversion/ Impoundment	Allow all "fisheries flows" (baseflows, and passage, attractant, and channel maintenance flows) to bypass diversion facilities (see action steps below).	3	10	SWRCB	
SIC-CCCS-25.1.1.6	Action Step	Water Diversion/ Impoundment	Evaluate requests for on-stream dams above migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (CDFG 2004).	3	5	CDFW, USACE	
SIC-CCCS-25.1.2	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize reduced density, abundance, and diversity				
SIC-CCCS-25.1.2.1	Action Step	Water Diversion/ Impoundment	Adequately screen water diversions to prevent juvenile salmonid mortalities.	2	5	CDFW, NMFS, Private Landowners, RCD, SWRCB	
SIC-CCCS-25.1.2.2	Action Step	Water Diversion/ Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	3	30	NMFS, RCD, RWQCB, Water Agencies	
SIC-CCCS-25.1.2.3	Action Step	Water Diversion/ Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of salmonids and their habitats, and avoidance of adverse impacts caused by water diversion (CDFG 2004).	3	60	CDFW, RCD, Water Agencies	
SIC-CCCS-25.2	**Objective**	**Water Diversion/ Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
SIC-CCCS-25.2.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to watershed hydrology				
SIC-CCCS-25.2.1.1	Action Step	Water Diversion/ Impoundment	Identify and 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.	3	5	CDFW Law Enforcement, NMFS OLE, SWRCB	
SIC-CCCS-25.2.1.2	Action Step	Water Diversion/ Impoundment	Encourage the SWRCB to adjudicate watersheds to resolve over-allocation of water resources and provide adequate funding to water masters to enforce allocations.	2	5	CDFW, County Planning, RCD, RWQCB, Water Agencies	
SIC-CCCS-25.2.1.3	Action Step	Water Diversion/ Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	15	NMFS, RWQCB. SWRCB	

Walker Creek Population

CCC Steelhead Winter-Run

- Role within DPS: Potentially Independent Population
- Diversity Stratum: North Coastal
- Spawner Target: 1,900 adults
- Current Intrinsic Potential: 54.2 IP-km

For information regarding CCC coho salmon for this watershed, please see the CCC coho salmon recovery plan (http://www.westcoast.fisheries.noaa.gov/).

Abundance and Distribution

Few historical surveys dating back to the 1950s exist for Walker Creek, although angling reports from California Department of Fish and Game/Wildlife (CDFG/CDFW) wardens indicate that angling pressure (and presumably steelhead numbers) decreased from 1950s to the 1970s (Kelley 1976; Emig 1984; Rich 1989). Kelley (1978) noted that for Walker Creek, the size of the salmon and steelhead runs were limited by the amount and quality of available rearing area for juvenile fish during their first summer and fall when the stream flows were low (Kelley 1976; Kelley 1978). The Marin Municipal Water District (MMWD) through its completion of the Soulajule Reservoir on Arroyo Sausal Creek entered into agreement with CDFW to operate the Soulajule Reservoir in a way that was expected to restore the salmon and steelhead runs in Walker Creek. In 1976, MMWD estimated that the streamflow releases scheduled with the Soulajule Project would produce an average spawning run of about 1200 adult salmon and steelhead, although this estimate was based on a very rough model and an assumption that significant stream improvement would occur (Kelley and Reineck 1978). In 1984, CDFG conducted a study that showed steelhead abundance increased compared with populations sampled prior to flow releases from the reservoir (Emig 1984). However, the success of the flow augmentation program in restoring salmonid populations was questioned (Rich 1989; UCCE 1995).

More recently, steelhead have been documented in fair numbers and are noted as "very abundant" (MMWD and GANDA 2010) and occurring in all age classes through monitoring conducted by MMWD as a result of adult coho salmon releases to Walker Creek from the Russian River Captive Broodstock Program. While the focus of this program has been coho, juvenile steelhead have been incidentally captured and enumerated, although adult counts can only be considered anecdotal because the trapping timeline has only covered a portion of the steelhead adult migration period (B. Coey, NMFS, personal communication, 2011).

History of Land Use

Since European settlement, the land use has been almost exclusively agricultural, with beef and dairy products produced, and potatoes, barley, and other grains grown in the watershed. From the 1850s into the early 1870s, potatoes were loaded onto shallow barges in Keyes Creek immediately downstream of the present Highway 1 Bridge (UCCE 1995). Historic sedimentation has been linked to the disturbance of the native grassland through cultivation, change in species composition as introduced annual grasses gained dominance, and concentrated livestock use (Zumwalt 1972). The current small size of the channel at this location, more suitable for a canoe than a barge, is dramatic evidence of significant watershed change over the past 150 years (Prunuske Chatham Inc. 2004). Mercury was mined at three sites in the Walker Creek watershed after World War II. The largest mine, at the Gambonini Ranch near the confluence of Salmon Creek and mainstem Walker Creek, closed in 1970. The severe storm of January 1982 destabilized the mine site and sent massive amounts of mercury-laden sediment into Walker Creek. The U.S. Environmental Protection Agency (EPA), working with the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB), completed remediation of the site in 2000.

Current Resources and Land Management

The watershed contains a 220-acre shallow natural lake, Laguna Lake, which is officially classified as a vernal pool. Laguna Lake is located at the top of Chileno Valley. The lake is used extensively for migrating and breeding waterfowl like the wetlands at the mouth of Walker Creek. The watershed has one major reservoir, Soulajule Reservoir that is managed by MMWD. Soulajule Reservoir is located at the top of Arroyo Sausal, and was constructed in 1968 and then enlarged in 1980 (current capacity is 10,570 acre-feet). The reservoir was enlarged to restore salmonid runs with summer releases ranging from 0.5 cfs to 5 cfs and winter releases up to 25 cfs depending upon the availability of stored water (Kelley and Reineck 1978). From 2007-2016 stream flow ranged from 2 cfs in the summer to 2,500 cfs in the winter.

Today cattle, dairy and sheep ranching are the predominant industry although some minor vineyard development has spread into the eastern edge of the watershed. The only concentrated development in the watershed occurs in the small town of Tomales. Resource management on private lands is largely carried out by private landowners with assistance from various Federal and state agencies (*e.g.*, CDFW, NMFS, Marin Agricultural Land Trust, and Marin Resource Conservation District with the assistance of USDA Natural Resource Conservation Service). A large component of resource management within the watershed is done under the guise of Marin RCD's Conserving Our Watershed Program (COW) which has actively provided technical and financial assistance to private landowners from various federal and state partners. The work of these, and many agencies and organizations, are explained in detail in a Half Century of

Stewardship: programmatic review of conservation by Marin RCD & partner organizations (http://cemarin.ucanr.edu/files/138471.pdf). Since 2009, following the most recent CDFW habitat survey (discussed below), over a $1 million have been directed toward restoration action on private lands. Ultimately, the government-private partnership formed by COW has resulted in fencing of 10 miles of stream in the watershed, implementation of 1,000 BMPs across 110,000 acres, preventing an estimated 266,365 CY of sediment from entering waterways and the development of many alternative drinking water sources for cattle.

Since 2003, MMWD with the assistance of CDFW and Trout Unlimited has conducted some salmonid population monitoring throughout the watershed where access is available. A summary of these monitoring efforts is described in Ruiz *et al.* (2016). A systematic habitat assessment of the entire watershed was conducted by the CDFW Watershed Restoration Program in 2008.

Salmonid Viability and Watershed Conditions

Habitat surveys conducted by CDFG/CDFW (CDFG 2008) found the highest quality habitat conditions in portions of Walker Creek mainstem, and upper Salmon Creek, although access for surveys was not granted basin-wide. Shelter values, canopy levels, large woody debris, and gravel embeddedness were noted as limiting factors for salmonids in most reaches of the watershed. The following key attributes were rated "Poor" through the CAP process for steelhead: Sediment, Sediment Transport, and Habitat Complexity. 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 were rated Fair or Poor as a result of our CAP viability analysis. The Walker Creek Profile CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Riparian Vegetation: Composition, Cover & Tree Diameter

Sixty seven percent (3 of 5) of streams met optimal criteria (>70 percent canopy averaged for the stream). Specifically, Verde Canyon, Salmon and Chileno Creek were rated Fair (50-69 percent canopy), although the native structure of the riparian zone has been highly altered. Only 16 percent of the riparian zone is made up of small trees in the class of hardwood forest and hardwood woodland species. In addition, large trees that provide bank stabilization and are the source for future recruitment of LWD were found to be lacking in this watershed. In riparian areas where landowners have worked with local partners to fence off cattle and plant woody

vegetation, the riparian corridor is vast and well vegetated with a bank of future LWD that can be recruited.

Estuary: Quality & Extent

Walker Creek estuary has been highly altered from its natural state due to high sediment load from erosive channel conditions due to grazing development, and the channelized and filled conditions of the delta and estuary for agriculture. Toxins from mercury may alter water quality. Conditions for rearing of juvenile steelhead to smolts are further complicated by warming temperatures into the summer months.

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

No streams met optimal criteria habitat complexity for pool depths, or shelter complexity for any lifestage, within the watershed. Summer juvenile production is highly affected by the lack of these habitat elements. Riffle habitats for spawning are specifically lacking and are of particular concern in most of Walker Creek and its tributaries.

Water Quality: Temperature

Temperatures in Lower and Upper Walker Creek mainstem and Salmon Creek exceeded optimal conditions. Chileno and Frink Canyon Creeks hovered slightly below optimal conditions at 16 and 14 degrees, respectively. Temperatures in Lower and Upper Walker Creek mainstem, Salmon Creek, and Chileno Creek and within the estuary may exceed optimal conditions for smolting (MMWD unpublished data).

Water Quality: Turbidity or Toxicity

Walker Creek was listed by the RWQCB Clean Water Act section 303(d) listing for siltation and nutrients in 2007. High siltation affects incubating eggs, and high nutrient loading can affect summer rearing conditions through affecting temperature and levels of oxygen. Turbidity is also considered to be a problem for winter rearing smolts affecting foraging ability for food and predator avoidance.

Threats

The following discussion focuses on those threats that were rated as High or Very High. Recovery strategies will likely focus on ameliorating 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 Walker Creek CAP results.

Channel Modification

Channel modification has been the second largest impact to salmonid resources in Walker Creek and its tributaries through the removal of floodplain and riparian resources. Less than 50 percent of stream channels are estimated to be connected to their floodplain; thus, winter rearing is compromised when resident steelhead cannot find refugia from high velocities and are flushed from headwater areas which have higher rearing potential to lower reaches which have documented poor habitat conditions. Channel modification has led to channel incision, over-steepened banks, high erosional forces and gravel embeddedness, and ultimately loss of riparian trees and width. While channelization has occurred in the mainstem of Walker Creek, flooding frequently occurs; however, the riparian zone is thin and agriculture encroaches upon the historic floodplain. Road building, culverts, and grazing land development have led to severe channel incision in lower middle and lower Walker Creek and lower portions of Chileno Creek.

Livestock Farming and Ranching

Cattle and other livestock browsing have decreased under story riparian species which provide habitat for terrestrial invertebrates which are food for rearing juvenile salmonids. Grazing and loafing within riparian corridors have led to bank erosion and high gravel embeddedness, impacting spawning success and resulting egg incubation. Historic management converted forestlands to grasslands, and current erosion from livestock grazing has taken its toll on the adjacent riparian zone. 61 percent of the watershed is in grasslands habitats consisting of rangeland, dairy land, and pasture. Grazing in the riparian zone is common and much of the native forest habitat has been converted to perennial grasslands.

Roads and Railroads

While road density is low within the Walker Creek watershed, streamside road density is high. Road development has altered the natural flow of water and interrupted sediment transport, often causing channel degradation below undersized culverts. Currently many existing roads are not maintained adequately and this inadequate road maintenance contributes sediment from surface erosion. Most culverts are undersized and this reduces the availability of spawning gravel; and this increases channel incision, resulting in the risk of failing or causing flow diversion down roads. Increased road building would accompany further development of the basin. No watershed-wide road assessment or transportation plan exists for this basin. Most other watersheds in Marin and adjacent Sonoma County have road/culvert assessments completed and erosion correction/prevention plan recommendations.

Severe Weather Patterns

The watershed experiences a Mediterranean-type climate and year-round flows are provided to Arroyo Sausal and Walker Creek mainstem from Soulajule Reservoir operated by MMWD. Given that summer streamflows are already pressured by agricultural and some residential development, long-lasting drought patterns could pose a significant threat to maintaining adequate streamflows and aquatic habitat. Flooding can contribute positive as well as negative changes to streams through the initiation or acceleration of natural processes, respectively. For Walker Creek, severe flooding could accelerate erosion from road and historic mining sites, increasing sediment in riffles and pool habitats.

Water Diversion and Impoundments

Although several earthen dams occur in the upper watershed, and the number of reported diversions is low, the chief water demand occurs in the summer from creek-side residential and livestock use. Increased water diversion resulting from residential development and livestock use within Walker Creek could offset the current benefits of the relatively undisturbed hydraulic regime. Water diversion in the tributaries could impact rearing juveniles.

Limiting Conditions, Lifestages, and Habitats

Threat and condition analysis within the CAP workbook suggests eggs, winter rearing juveniles, and watershed processes are the factors most at risk in Walker Creek watershed, while summer rearing habitat conditions could be most easily improved. Increased sediment load, alteration of sediment transport processes, and reduced large wood quantity and recruitment are a result of landscape disturbance from historic and current adjacent land uses, including livestock grazing, and the effects of roads associated with these land uses. Increased residential development and severe weather are future threats to existing habitat conditions.

General Recovery Strategy

In general, recovery strategies will 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. Restoration actions should target addressing these issues within high potential stream reaches.

Re-Assessing habitat conditions in the Watershed

As mentioned earlier, a substantial level of effort has been put forth to address the highest threat in Walker Creek (*i.e.,* livestock grazing in riparian areas). Over the past decade, together Marin Resource Conservation District (MRCD) and the Marin Agricultural Land Trust (MALT) have

secured cattle fencing and conservation easements over major swaths of the watershed. Much of their restoration effort had not matured by the time CDFW had conducted their habitat inventory in 2008. In 2016, NMFS staff visited many of the restoration sites completed over the past ten years. These sites have mature riparian vegetation, dynamic gravel bars, and overall provide good habitat for steelhead—a stark contrast from what was documented in CDFW (2008) which is what this analysis largely relies on. Since the habitat may have improved greatly since the last assessment, as a result of MRCD's and MALT's efforts; Walker Creek should be reassessed to identify the specific factors limiting steelhead production within the watershed.

Implementing Beaver Dam Analog Projects and Beaver Introduction Studies

Prior to European settlement, it is thought that woodland vegetation types had a more extensive distribution in Walker Creek, including evergreen trees and redwoods in the high valleys and north facing slopes (Zumwalt, 1972). However, there is some dispute whether redwoods were present in the watershed other than the uppermost portions of Arroyo Sausal. Whether redwood forests were abundant or not within the watershed is almost irrelevant to addressing the immediate need that is to change the trajectory of the population toward recovery.

The current riparian forests along Walker Creek is composed of large alders (16 inches plus in dbh) and willow thickets, both of which are known to function as effective as conventional LWD made of redwood or some other conifer (Opperman 2005). Working with the existing plant species is essential for addressing the immediate need. These plant species have successfully been used in restoration efforts (*i.e.*, beaver dam analogues) to address many of the same poor conditions that Walker Creek has (i.e., habitat complexity, flood plain connectivity, channel incision). Implementing projects similar to what is described in Pollock (Pollock *et al.* 2012) (https://www.nwfsc.noaa.gov/research/divisions/fe/wpg/beaver-assist-stld.cfm) would be the most effective strategy in improving many of the poorly rated Key Attributes.

Assess flow releases from Soulajule Reservoir and Assess the Cost/Benefit of Soulajule Dam Removal.

Other than for flow releases made into Walker Creek, the water stored in Soulajule Reservoir was not relied on by MMWD to meet demand during California's most recent and unprecedented drought from 2012 to 2016. Further studies should be conducted on Soulajule Reservoir regarding its role in serving water to Marin County customers. Based on that analysis, two studies should subsequently be implemented 1) the CDFW flow study should be re-evaluated based on the amount of water in the reservoir that could be used for the fishery; and 2) evaluate the environmental and socio-economic costs and benefits of removing Soulajule Reservoir.

Protect, Improve, and Expand Riparian Corridors and Refugia Areas

Existing riparian corridors should be protected, and where opportunity exists, riparian buffers should be widened and/or floodplain areas enhanced to benefit wintertime rearing. Conservation easements with willing landowners to protect riparian resources should be evaluated and implemented where refugia areas have been identified. Rural residential expansion should be discouraged except where General Plan elements are protective enough to offset impacts to this largely undeveloped watershed.

Improving distribution of livestock to reduce prolonged concentrated utilization of grassland and riparian areas and to provide periods of rest for improved grassland is recommended. Fencing livestock out of riparian corridors in Walker Creek and its tributaries is the highest priority for the basin and would have the single largest voluntary impact. Where landowners have fenced livestock, the practice has eliminated concerns for temperature and/or poor water quality from livestock browsing and loafing if fences are maintained. Riparian restoration projects that limit livestock access to riparian areas and restore native plant species] should be implemented either independently or as part of a programmatic approach together with Regional Conservation Districts (RCDs) or National Resources Conservation Service (NRCS). Priority subwatersheds include Chileno Creek, middle reach Walker Creek, Laguna Lake, and Keyes Creek.

Decrease Erosion

Maintenance on existing private roads should be improved per the recommendations of *Forest and Ranch Roads* (Weaver and Hagans 1994). Maintenance on public roads should be increased and follow the standards of the *Fishnet 4c Road Manual*. Problem roads and active erosion sites should be prioritized and addressed as part of a comprehensive sediment reduction plan for the entire Walker Creek basin. Instream sediment sources are likely as large or a larger source of sediment yield as non-point sources from roads, primarily due to impacts associated with cattle and dairy grazing, or as a result of incised channel conditions from channel modification. Erosion control utilizing bio-engineering methods is recommended in association with livestock management as discussed above.

Improve Shelter Ratings

Shelter ratings are Low within all surveyed stream reaches of Walker Creek. Due largely to an absence of LWD, quality pool habitat is absent and shelter components are comprised mainly of undercut banks and overhanging vegetation. Where applicable, restoration efforts should incorporate instream wood/boulder structures into degraded reaches along with bank erosion protection measures to improve habitat complexity and shelter availability.

Improve Habitat Complexity

Expanding opportunities for spawning and rearing habitat, such as adding structures for pool development and enhancement, and trapping of spawning gravels, is specifically recommended throughout all stream reaches.

Improve Estuary Conditions

Estuarine residency has been shown to be highly tied to successful smoltification of juveniles and improved return rate for adult salmonids. Implementation of positive changes for rearing salmonids should be identified through an assessment of physical conditions and water quality conditions of the estuary.

Improve Water Quality/Water Temperature

High mercury levels were found in fish collected from Tomales Bay (Whyte and Kirchner 2000); thus, more investigation is needed to directly relate the mercury concentrations in Tomales Bay sediments to the mercury in the fish tissue (MMWD and GANDA 2010). Nonetheless, managing the mercury-contaminated sediment within the Walker Creek system for the least possible impact on downstream resources and human health is a critical issue for the Walker Creek watershed. Planting trees to improve over story conditions and stream temperatures is recommended for Walker Creek and its tributaries.

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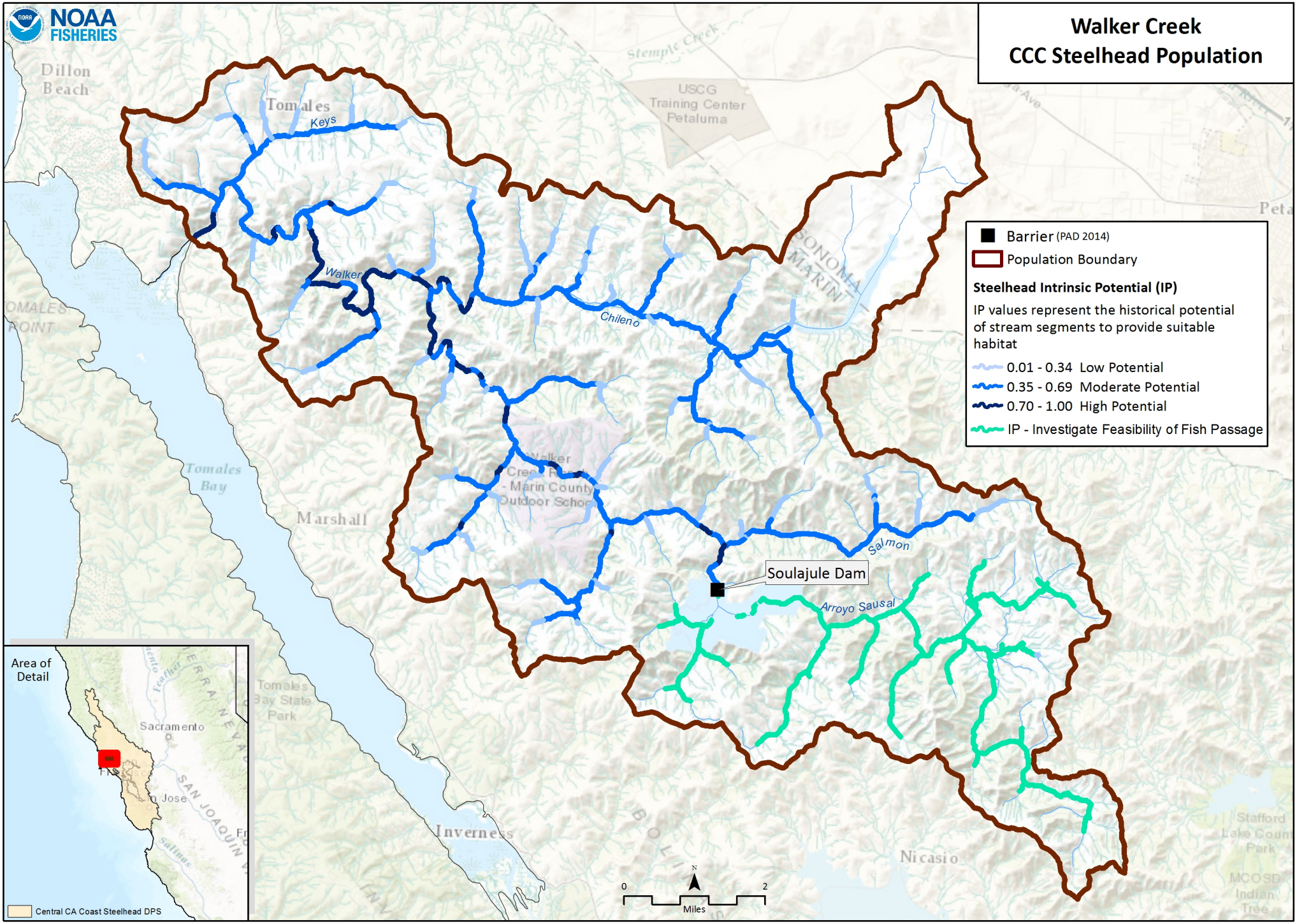
Walker Creek
CCC Steelhead Population
NOAA FISHERIES
Barrier (PAD 2014)
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
IP - Investigate Feasibility of Fish Passage
Soulajule Dam
Walker
Keys
Chileno
Salmon
Arroyo Sausal
Tomales
Dillon Beach
Tomales Bay
Marshall
Inverness
Nicasio
USCG Training Center Petaluma
Stemple Creek
SONOMA
MARIN
Walker Creek Ranch - Marin County Outdoor School
Tomales Bay State Park
Stafford Lake County Park
MCOSD Indian Tree
Area of Detail
Sacramento
San Jose
Central CA Coast Steelhead DPS
0
2
Miles

CCC Steelhead Walker Creek CAP Viability Results

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	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)	0.2% 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	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)	0% of streams/ 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)	0% streams/ 0% IP-km (>80 stream average)	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 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	94% 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	94% 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	55 - 69% Class 5 & 6 across IP-km	Good
			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	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 spawner per IP-km to < low risk spawner density per Spence (2008)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		>1 spawner per IP-km to < low risk spawner density per Spence (2008)	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 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)	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)	0% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
3	Summer Rearing Juveniles	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)	0.2% 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 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)	<30% of streams/ IP-km (>40% average primary pool frequency)	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% streams/ 0% 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 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	0.34 Diversions/10 IP-km	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	94% of IP-km	Good
			Riparian Vegetation	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy)	50% to 74% of streams/ IP-Km (>70% average stream canopy)	75% to 90% of streams/ IP-Km (>70% average stream canopy)	>90% of streams/ IP-Km (>70% average stream canopy)	67% of streams/ IP-km (>70% average stream canopy)	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	55 - 69% Class 5 & 6 across 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)	0% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT)	50 to 74% IP km (<20 C MWMT)	75 to 89% IP km (<20 C MWMT)	>90% IP km (<20 C MWMT)	40% IP-km (<20 C MWMT)	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	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	Good
		Size	Viability	Density	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	0.7 - 1.5 Fish/m^2	Good
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	72% of Historical Range	Fair
4	Winter Rearing Juveniles	Condition	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)	0.2% 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	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)	0% of streams/ IP-km (>40% Pools; >20% Riffles)	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	94% 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	55 - 69% Class 5 & 6 across 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)	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	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
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% streams/ 0% IP-km (>80 stream average)	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 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	94% of IP-km	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)	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	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 to produce low risk spawner density per Spence (2008)	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	1% 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	<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	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	1.5 Miles/Square Mile	Very 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	3.6 Miles/Square Mile	Poor

CCC Steelhead Walker Creek CAP Threat Results

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

Walker Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-1.1.1	Recovery Action	Estuary	Increase the quality and extent of estuarine habitat				
WkC-CCCS-1.1.1.1	Action Step	Estuary	Develop Estuary Enhancement Projects to improve rearing habitat for juveniles and smolts (eg. habitat features such as LWD, vegetative cover, deeper habitat, etc.)	2	5	MMWD, Tomales Bay Watershed Council	
WkC-CCCS-1.1.1.2	Action Step	Estuary	Maintain and improve estuarine biological, chemical, and physical parameters necessary for high quality rearing habitat for summer juveniles and smolts.	2	5	MMWD, Tomales Bay Watershed Council	
WkC-CCCS-1.1.1.3	Action Step	Estuary	Support a salmonid limiting factors assessment in Walker Creek, Keys Estero and Tomales Bay.	1	5	MMWD, Tomales Bay Watershed Council	
WkC-CCCS-1.1.1.4	Action Step	Estuary	Evaluate alterations to river mouth dynamics and implement changes to restore natural function.	2	10	California Coastal Conservancy, CDFW, Marin County, MMWD, NMFS, State Parks, USACE	
WkC-CCCS-1.1.2	Recovery Action	Estuary	Improve the quality of the estuarine habitat zones				
WkC-CCCS-1.1.2.1	Action Step	Estuary	Restore estuarine wetlands and sloughs, and improve prey abundance by increasing shoreline perimeter and planting native emergent and riparian species to improve foraging and cover.	2	10	CA Coastal Commission, California Coastal Conservancy, CDFW, Private Landowners	
WkC-CCCS-1.1.2.2	Action Step	Estuary	Improve estuarine water quality by identifying and remediating upstream pollution sources which contribute to poor water quality conditions in the estuary	2	10	Marin County, MMWD, SWRCB, RWQCB	
WkC-CCCS-1.1.2.3	Action Step	Estuary	Modify alterations to freshwater inflow and water quality (temperature, dissolved oxygen) and the practice of artificial breaching.	2	12	CDFW, MMWD, NMFS, USACE	
WkC-CCCS-1.2	**Objective**	**Estuary**	**Address the inadequacy of existing regulatory mechanisms**				
WkC-CCCS-1.2.1	Recovery Action	Estuary	Reduce extent of estuarine shoreline development				
WkC-CCCS-1.2.1.1	Action Step	Estuary	Minimize future encroachment of landuse (agricultural, residential and commercial) into floodplain areas of the estuary.	3	50	CDFW, Marin County, RWQCB, USACE	
WkC-CCCS-1.2.1.2	Action Step	Estuary	Evaluate the effect of nearby landuse practices and work to remove development structures which may impair or reduce the historical tidal prism and other estuarine functions and implement improvements.	3	10	CA Coastal Commission, California Coastal Conservancy, CDFW	
WkC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
WkC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Encourage willing landowners to restore historical floodplains or offchannel habitats through conservation easements, etc.	2	10	Marin RCD, MMWD	
WkC-CCCS-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	Marin County, MMWD, Tomales Bay Watershed Council	
WkC-CCCS-2.1.2	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
WkC-CCCS-2.1.2.1	Action Step	Floodplain Connectivity	Identify the floodplain activation flow - the smallest flood pulse event that initiates substantial beneficial ecological processes when associated with floodplain inundation (Williams et al. 2009).	3	10	CDFW, Marin County, NMFS	
WkC-CCCS-2.1.2.2	Action Step	Floodplain Connectivity	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	10	Marin RCD, MMWD	
WkC-CCCS-2.1.2.3	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches of Walker Creek. Develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats.	2	20	Farm Bureau, NMFS, Public Works, RCD	
WkC-CCCS-2.1.2.4	Action Step	Floodplain Connectivity	Support landowners and the Marin RCD in developing projects to improve channel conditions and restore natural channel geomorphology, including side channels and dense contiguous riparian vegetation (CDFG 2004).	2	40	Marin County, MMWD, Tomales Bay Watershed Council	
WkC-CCCS-2.2	**Objective**	**Floodplain Connectivity**	**Address the inadequacy of existing regulatory mechanisms**				

Walker Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-2.2.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
WkC-CCCS-2.2.1.1	Action Step	Floodplain Connectivity	Set-back existing levees in strategic areas to increase flood-flow detention and promote flood-tolerant land uses.	3	10	MMWD	
WkC-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
WkC-CCCS-3.1.1.1	Action Step	Hydrology	Assess the environmental and socio-economic costs and benefits of removing Soulajule Reservoir.	2	10	MMWD, CDFW, NMFS	
WkC-CCCS-3.1.1.2	Action Step	Hydrology	Evaluate flow releases from Soulajule Reservoir based on fishery needs and the amount of water available in Soulajule	2	10	MMWD, CDFW, NMFS	
WkC-CCCS-3.1.1.3	Action Step	Hydrology	Monitor, identify problems, and prioritize needed changes to water diversion on current or potential steelhead streams that go dry in some years (CDFG 2004).	2	60	MMWD	
WkC-CCCS-3.1.1.4	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	2	30	Marin County, Marin RCD, MMWD	
WkC-CCCS-3.1.1.5	Action Step	Hydrology	To improve connectivity of surface flows with groundwater reduce aggradation and overall sediment load at the watershed scale by treating roads and sources of mass wasting.	3	10	Marin RCD	
WkC-CCCS-3.1.1.6	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	30	Marin County, Marin RCD, MMWD	
WkC-CCCS-3.1.1.7	Action Step	Hydrology	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).	3	10	DWR, NMFS, SWRCB	
WkC-CCCS-3.1.2	Recovery Action	Hydrology	Improve passage flows				
WkC-CCCS-3.1.2.1	Action Step	Hydrology	Continue to assess the release of water from Soulejule Reservoir to develop the optimum flow release for steelhead (CDFG 2004).	2	60	CDFW, MMWD, NMFS	
WkC-CCCS-3.1.2.2	Action Step	Hydrology	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	60	CDFW, MMWD, NMFS	
WkC-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
WkC-CCCS-5.1.1.1	Action Step	Passage	Evaluate the feasibility of bypassing large dams (CDFG 2004) in the watershed.	3	20	MMWD, NMFS	
WkC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pool, LWD, and shelters				
WkC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Enhance habitat complexity by implementing beaver dam analog projects and beaver introductions to the watershed	2	5	CDFW, Marin RCD, Private Landowners, MALT, TU	
WkC-CCCS-6.1.1.2	Action Step	Habitat Complexity	Conduct habitat assessment in Keys Creek, according to CDFW's protocols.	2	5	CDFW, Marin RCD, Private Landowners	
WkC-CCCS-6.1.1.3	Action Step	Habitat Complexity	Utilize recommendations to prioritize reaches for habitat improvement.	2	5	CDFW, Marin RCD, Private Landowners	
WkC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Improve pool/riffle/flatwater ratio				
WkC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase the frequencies of riffles in 55% of the streams within the watershed.	2	10	CDFW, Marin RCD, NOAA RC, Private Landowners, RCD	
WkC-CCCS-6.1.2.2	Action Step	Habitat Complexity	Increase riffle frequency to 20% by converting flatwater habitats (glides, runs, etc.) utilizing boulders and log structures in select reaches of Chilen, Salmon and Walker Creek.	2	5	CDFW, Marin RCD, NOAA RC, Private Landowners, RCD	
WkC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve large wood frequency				

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase large wood frequency in 75% of streams within the watershed to improve conditions for adults, and winter/summer rearing juveniles.	2	10	CDFW, Marin RCD, MMWD, NOAA RC, Private Landowners	
WkC-CCCS-6.1.3.2	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>2 key LWD pieces/100 meters) in middle and upper reaches of Walker Creek.	2	10	CDFW, Marin RCD, MMWD, NOAA RC, Private Landowners	
WkC-CCCS-6.1.3.3	Action Step	Habitat Complexity	Modify MMWD's multi-agency MOU for Large Woody Debris to include Walker Creek.	2	1	CDFW, Marin RCD, MMWD, NMFS	
WkC-CCCS-6.1.3.4	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in all reaches of Chileno, Salmon and Verde Canyon.	2	10	CDFW, Marin RCD, MMWD, NOAA RC, Private Landowners, RCD	
WkC-CCCS-6.1.4	Recovery Action	Habitat Complexity	Improve frequency of primary pools				
WkC-CCCS-6.1.4.1	Action Step	Habitat Complexity	Increase primary pool frequency in 75% of streams within the watershed to improve conditions for adults, and summer/winter juveniles.	2	10	CDFW, Marin RCD, NOAA RC, Private Landowners	
WkC-CCCS-6.1.4.2	Action Step	Habitat Complexity	Increase primary pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order streams; >3 feet in third order or larger streams)) in all reaches of Chileno, Verde Canyon, and Walker Creek.	2	10	CDFW, Marin RCD, NOAA RC, Private Landowners	
WkC-CCCS-6.1.5	Recovery Action	Habitat Complexity	Improve shelter				
WkC-CCCS-6.1.5.1	Action Step	Habitat Complexity	Increase shelters in 75% of streams across the watershed to improve conditions for adults, and winter/summer rearing juveniles.	2	20	CDFW, Marin RCD, NOAA RC, Private Landowners	
WkC-CCCS-6.1.5.2	Action Step	Habitat Complexity	Increase shelters to optimal conditions (>80 pool shelter value) in all reaches of Chileno, Salmon, Verde Canyon and Walker Creeks.	2	10	CDFW, Marin RCD, NOAA RC, Private Landowners	
WkC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover				
WkC-CCCS-7.1.1.1	Action Step	Riparian	Assess riparian canopy, extent of exotic vegetation (e.g., Arundo donax, etc.), and prioritize, develop and implement riparian habitat projects using native vegetation.	2	20	Marin RCD	
WkC-CCCS-7.1.1.2	Action Step	Riparian	Support grazing practices that minimize impacts to riparian and instream habitat: livestock exclusion, rotational grazing, etc.	2	60	Marin RCD, RWQCB	
WkC-CCCS-7.1.1.3	Action Step	Riparian	Increase the width of riparian corridors to 100' to allow multi-age stands of native trees and shrubs, and eventual recruitment of LWD.	3	50	Land Trusts, Marin County	
WkC-CCCS-7.1.1.4	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers throughout the watershed (CDFG 2004).	2	30	Land Trusts, Marin County	
WkC-CCCS-7.1.2	Recovery Action	Riparian	Improve tree diameter				
WkC-CCCS-7.1.2.1	Action Step	Riparian	Increase tree diameter within 55% of watershed to achieve optimal riparian forest conditions (55 - 69% Class 5 & 6 tree).	3	30	CDFW, NOAA RC, Private Landowners, RCD	
WkC-CCCS-7.1.2.2	Action Step	Riparian	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other steelhead needs.	2	20	CDFW, NOAA RC, Private Landowners, RCD	
WkC-CCCS-7.1.2.3	Action Step	Riparian	Plant native riparian species and native conifers/hardwoods throughout riparian zones within the northern (Chileno and Keys Creek) and eastern (Walker and Salmon Creek) portions of the watershed to increase overall tree diameter.	2	20	CDFW, NOAA RC, Private Landowners, RCD	
WkC-CCCS-7.1.2.4	Action Step	Riparian	Encourage programs to purchase land/conservation easements to re-establish and enhance natural riparian communities.	3	10	Marin RCD, MMWD	
WkC-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality and distribution for macro-invertebrate production (food)				
WkC-CCCS-8.1.1.1	Action Step	Sediment	Reduce embeddedness levels to the extent that 75% to 90% of streams within the watershed meet optimal criteria (>50% stream average scores of 1 & 2).	2	20	Marin County, Marin RCD, Private Landowners, RCD	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-8.1.1.2	Action Step	Sediment	Conduct instream and upslope sediment source surveys in upper Walker Creek and sub-watersheds (Salmon and Key Creeks) to identify existing sources of high sediment yield using accepted protocols and implement recommendations.	2	10	Marin County, Marin RCD, Private Landowners, RCD	
WkC-CCCS-8.1.1.3	Action Step	Sediment	Implement recommendations of completed sediment source surveys in the watershed (See ROADS for specific actions).	2	5	CDFW, Marin County, Marin RCD, Private Landowners, RCD	
WkC-CCCS-8.1.1.4	Action Step	Sediment	Fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream).	2	20	CDFW, Marin RCD, NOAA RC, NRCS	
WkC-CCCS-8.1.1.5	Action Step	Sediment	Solicit cooperation from NRCS, RCDs, Farm Bureau, and others to devise incentive programs and incentive-based approaches to encourage and support landowners who conduct operations in a manner compatible with steelhead recovery priorities.	2	60	Marin RCD, NMFS, NRCS	
WkC-CCCS-8.1.2	Recovery Action	Sediment	Improve instream gravel quantity				
WkC-CCCS-8.1.2.1	Action Step	Sediment	Increase the quantity and distribution of spawning gravels in 50% of streams within the watershed.	2	20	Marin RCD, MMWD, RWQCB	
WkC-CCCS-8.1.2.2	Action Step	Sediment	Implement high priority steelhead enhancement projects for the reduction of sediment delivery and the restoration of riparian corridors as listed in the Walker Creek Enhancement Plan (Prunuske Chatham Inc. 2001, CDFG 2004).	2	20	Marin RCD, MMWD, RWQCB	
WkC-CCCS-8.1.2.3	Action Step	Sediment	Develop habitat enhancement projects to establish additional riffle habitat and import spawning gravel from mining operations in the Russian River basin to select reaches of Chileno, Salmon, Verde Canyon, Frink Canyon and Walker Creeks.	2	5	CDFW, NMFS, NOAA RC, Private Landowners, RCD, Trout Unlimited	
WkC-CCCS-8.1.2.4	Action Step	Sediment	Place instream structures to improve gravel retention and habitat complexity.	2	10	Marin RCD, MMWD, RWQCB	
WkC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions				
WkC-CCCS-10.1.1.1	Action Step	Water Quality	Monitor instream water temperatures to determine baseline conditions and judge the efficacy of restoration actions. High priority streams include tributary and mainstem reaches within Salmon and Walker Creeks (CDFG stream survey reports).	2	10	CDFW, NMFS, NRCS, Private Landowners, RCD	
WkC-CCCS-10.1.1.2	Action Step	Water Quality	Improve water temperature conditions for migrating smolts and summer rearing juvenile salmonids throughout 35% of watershed.	1	10	CDFW, NMFS, NRCS, Private Landowners, RCD	
WkC-CCCS-10.1.1.3	Action Step	Water Quality	Reduce temperature levels within lower and upper Salmon and Walker Creeks.	1	25	CDFW, NMFS, NRCS, Private Landowners, RCD	
WkC-CCCS-10.1.1.4	Action Step	Water Quality	Reduce water temperatures in Chileno and Frink Canyon Creek by identifying potential summer rearing areas that need enhancement.	1	15	CDFW, NMFS, NRCS, Private Landowners, RCD	
WkC-CCCS-10.1.1.5	Action Step	Water Quality	Rehabilitate or restore riparian corridor conditions within all current and potential high value habitat summer rearing areas.	2	20	CDFW, NMFS, NRCS, Private Landowners, RCD	
WkC-CCCS-10.1.1.6	Action Step	Water Quality	Develop site-specific recommendations, including incentives, to remedy high temperatures (CDFG 2004).	2	3	CDFW, NMFS, NRCS, Private Landowners, RCD	
WkC-CCCS-10.1.1.7	Action Step	Water Quality	Investigate the potential to reduce water temperature within Walker Creek by releasing water from Walker Creek Dam.	2	10	CDFW, MMWD, NMFS	
WkC-CCCS-10.1.1.8	Action Step	Water Quality	Plant native vegetation to promote streamside shade: increase the canopy by planting native species where shade canopy is not at acceptable levels.	2	20	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD	
WkC-CCCS-10.1.2	Recovery Action	Water Quality	Improve stream water quality conditions				
WkC-CCCS-10.1.2.1	Action Step	Water Quality	Identify and provide solutions for point and non-point sources contributing to toxicity and turbidity.	2	10	NMFS, Private Landowners, RWQCB	
WkC-CCCS-10.1.2.2	Action Step	Water Quality	Install continuous water quality monitoring stations in lower Walker and within Salmon Creeks	3	5	NMFS, Private Landowners, RWQCB	
WkC-CCCS-10.1.2.3	Action Step	Water Quality	Restore the Gambioni Mine	2	5	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, RWQCB, USEPA	
WkC-CCCS-10.1.2.4	Action Step	Water Quality	Work with livestock and ranch owners to implement BMP's to control sediment and nitrates	3	20	NRCS, Private Landowners, RCD	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-10.1.3	Recovery Action	Water Quality	Reduce turbidity and suspended sediment				
WkC-CCCS-10.1.3.1	Action Step	Water Quality	Conduct sediment source surveys to identify existing sources of high sediment yield using accepted protocols and develop and implement recommendations to address sources of detrimental sediment input.	3	10	CDFW, Marin County, Marin RCD, MMWD, NMFS	
WkC-CCCS-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria				
WkC-CCCS-11.1.1.1	Action Step	Viability	Conduct salmonid life stage monitoring to determine factors that limit steelhead production within Walker Creek	1	10	CDFW, Marin RCD,	
WkC-CCCS-11.1.1.2	Action Step	Viability	Adjust population targets and indicator ratings to reflect new habitat improvements and accessible habitat expansions	3	10	NMFS	
WkC-CCCS-11.1.1.3	Action Step	Viability	Conduct habitat surveys to monitor change in key habitat variables	3	10	CDFW, NMFS	
WkC-CCCS-11.1.1.4	Action Step	Viability	To better understand changes in sedimentation, monitoring in the basin should include: longitudinal profiles, cross-sections, V*, LWD volume and distribution, and embeddedness.	2	60	Marin RCD, MMWD	
WkC-CCCS-11.1.1.5	Action Step	Viability	Develop smolt abundance estimates	1	10	CDFW, MMWD, NMFS	
WkC-CCCS-11.1.1.6	Action Step	Viability	Support MMWD in operation of outmigrant traps	1	10	CDFW, MMWD, NMFS, Trout Unlimited, UC Extension	
WkC-CCCS-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)				
WkC-CCCS-12.1.1.1	Action Step	Agriculture	Minimize agricultural activities from within 100 feet of the edge of the stream.	2	50	Farm Bureau, NRCS, Private Landowners, RCD	
WkC-CCCS-12.1.1.2	Action Step	Agriculture	Promote off-channel storage to reduce impacts of water diversion during the spring and summer (e.g. diversion during winter high flow).	2	10	NRCS, Private Landowners, RCD, UC Extension	
WkC-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize impairment to watershed hydrology				
WkC-CCCS-12.1.2.1	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	60	NRCS, Private Landowners, RCD	
WkC-CCCS-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
WkC-CCCS-12.1.3.1	Action Step	Agriculture	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels (see Roads for specific actions/areas).	2	60	CDFW, Private Landowners, RCD	
WkC-CCCS-12.1.3.2	Action Step	Agriculture	Assess the effectiveness of erosion control measures throughout the winter period.	2	20	CDFW, NMFS, NRCS, Private Landowners, RCD	
WkC-CCCS-12.1.3.3	Action Step	Agriculture	Encourage the NRCS, RCDs, and other appropriate organizations to increase the number of landowners participating in sediment reduction planning and implementation.	2	10	CDFW, NMFS, NRCS, Private Landowners, RCD	
WkC-CCCS-12.1.4	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure				
WkC-CCCS-12.1.4.1	Action Step	Agriculture	Complete Farm Conservation Plans (through the NRCS, RCDs, or other cooperative conservation programs) to address sediment source reduction, riparian habitat, forest health, and restoration.	2	10	CDFW, Farm Bureau, NMFS, NRCS, Private Landowners, RCD	
WkC-CCCS-12.1.4.2	Action Step	Agriculture	Re-establish native plant communities in riparian zones to increase stream canopy to 80%.	2	20	CDFW, Private Landowners, RCD, UC Extension	
WkC-CCCS-12.1.4.3	Action Step	Agriculture	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to provide future recruitment of large wood and other shelter components.	2	50	NRCS, Private Landowners, RCD	
WkC-CCCS-12.2	**Objective**	**Agriculture**	**Address the inadequacy of existing regulatory mechanisms**				
WkC-CCCS-12.2.1	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure				

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-12.2.1.1	Action Step	Agriculture	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do. Setback/buffers should be 100 feet wide.	3	10	Marin County, RWQCB	
WkC-CCCS-12.2.1.2	Action Step	Agriculture	Coordinate with the agencies that authorize forest land conversions to discourage conversions to agriculture.	3	50	Board of Forestry, CDFW, Marin County	
WkC-CCCS-12.2.2	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
WkC-CCCS-12.2.2.1	Action Step	Agriculture	Design new developments to avoid or minimize impacts to unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to watercourses.	3	60	Marin County, Private Landowners, RCD, USACE	
WkC-CCCS-12.2.2.2	Action Step	Agriculture	Develop legislation that will fund county planning for environmentally sound agricultural growth and water supply.	3	10	Farm Bureau, Marin County, NRCS, Sonoma County, UC Extension	
WkC-CCCS-12.2.3	Recovery Action	Agriculture	Prevent or minimize impairment to watershed hydrology				
WkC-CCCS-12.2.3.1	Action Step	Agriculture	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for steelhead and Chinook salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of steelhead and Chinook salmon (Water Code § 1707).	2	10	CDFW, MCRRFCD, MMWD, RWQCB	
WkC-CCCS-12.2.3.2	Action Step	Agriculture	Streamline permit processing where landowners are conducting actions aligned with recovery priorities.	3	5	CDFW, NMFS, NRCS, RCD, SWRCB, USACE	
WkC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)				
WkC-CCCS-13.1.1.1	Action Step	Channel Modification	Evaluate undeveloped and developed floodplain property for potential function and conservation easement and/or acquisition potential.	2	10	Marin County, RCD	
WkC-CCCS-13.1.1.2	Action Step	Channel Modification	Improve conditions to re-create, and restore alcove, backwater, or perennial pond habitats in lower Walker Creek or other areas where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, (See FLOODPLAIN for specific actions/criteria).	2	20	CDFW, NOAA RC, Private Landowners, USACE	
WkC-CCCS-13.1.1.3	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. carefully evaluate feasibility where critical infrastructure is located) for bank hardening projects.	3	50	CDFW, NMFS, USACE	
WkC-CCCS-13.1.1.4	Action Step	Channel Modification	Evaluate undeveloped and developed floodplain property for potential function and conservation easement and/or acquisition potential.	3	5	Marin County, RCD	
WkC-CCCS-13.1.1.5	Action Step	Channel Modification	Conduct rehabilitation activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows.	2	20	CDFW, Marin County, NOAA RC, NRCS, Private Landowners, USACE	
WkC-CCCS-13.1.1.6	Action Step	Channel Modification	Ensure that all future and existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	3	20	NMFS, USACE	
WkC-CCCS-13.2	**Objective**	**Channel Modification**	**Address the inadequacy of existing regulatory mechanisms**				
WkC-CCCS-13.2.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)				
WkC-CCCS-13.2.1.1	Action Step	Channel Modification	All proposed flood control projects should include habitat protection, and/or alternatives that minimize impacts to salmonid habitat.	3	60	Marin County, NMFS, USACE	
WkC-CCCS-13.2.1.2	Action Step	Channel Modification	Minimize additional channel modification or utilize BMP's described in Diversity Stratum level actions to address flood control or bank stabilization issue.	3	60	Marin County, NMFS, USACE	
WkC-CCCS-13.2.1.3	Action Step	Channel Modification	Evaluate design alternatives to riprap bank repairs. Where riprap is necessary, evaluate integration of other habitat-forming features – including large woody debris to ensure improved habitat at the restoration site.	3	30	CDFW, NMFS, USACE	
WkC-CCCS-13.2.1.4	Action Step	Channel Modification	Modify city and county regulatory and planning processes to minimize new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historical CCC steelhead watersheds.	3	10	Marin County, USACE	
WkC-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-18.1.1.1	Action Step	Livestock	Support grazing practices that minimize impacts to riparian and instream habitat: livestock exclusion, rotational grazing, etc.	2	60	Marin RCD, RWQCB	
WkC-CCCS-18.1.1.2	Action Step	Livestock	Increase the width of riparian corridors to 100' to allow multi-age stands of native trees and shrubs, and eventual recruitment of LWD.	2	50	Cities, County Planning, Private Landowners, RCD	
WkC-CCCS-18.1.1.3	Action Step	Livestock	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers throughout the watershed (CDFG 2004).	3	60	Land Trusts, Marin County, Sonoma County	
WkC-CCCS-18.1.1.4	Action Step	Livestock	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC steelhead needs.	3	30	Private Landowners, RCD	
WkC-CCCS-18.1.1.5	Action Step	Livestock	Encourage programs to purchase land/conservation easements to re-establish and enhance natural riparian communities.	3	10	Marin RCD, MMWD	
WkC-CCCS-18.1.1.6	Action Step	Livestock	Develop a watershed wide program with Marin RCD to identify riparian corridors subject to livestock grazing, and develop and implement livestock exclusion measures to protect and improve riparian resources.	1	30	Marin RCD, NMFS, NRCS	
WkC-CCCS-18.1.1.7	Action Step	Livestock	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take first priority for riparian fencing programs over steer operations.	2	5	Marin RCD, NRCS	
WkC-CCCS-18.1.1.8	Action Step	Livestock	Aid landowners willing to fence off riparian areas with development of offstream alternative water sources.	2	30	Marin RCD, NRCS	
WkC-CCCS-18.1.1.9	Action Step	Livestock	Develop and fund riparian restoration and bank stabilization projects to regain riparian corridors damaged from livestock and other causes.	2	30	Marin RCD, NRCS	
WkC-CCCS-18.1.1.10	Action Step	Livestock	Manage rotational grazing to aid in the reduction of noxious weeds.	3	60	Marin RCD, NRCS, Private Landowners	
WkC-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
WkC-CCCS-18.1.2.1	Action Step	Livestock	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	60	Marin RCD, NRCS, Private Landowners	
WkC-CCCS-18.1.2.2	Action Step	Livestock	Substitute continuous season-long use of pastures in favor of rotational grazing strategies to reduce runoff. Short term, seasonal and long term rest from grazing in overgrazed areas would improve soil conditions for native revegetation and land values as well.	3	60	Marin RCD, NRCS, Private Landowners	
WkC-CCCS-18.1.2.3	Action Step	Livestock	To minimize gully initiation, grazing should be kept at relatively low intensities on steeper slopes.	3	60	Marin RCD, NRCS, Private Landowners	
WkC-CCCS-18.1.2.4	Action Step	Livestock	Establish conservative residual dry matter (RDM) target per acre that ensures area is not overgrazed with 1000 lbs RDM (residual dry matter)/acre left at end of grazing season. Remove cattle from pasture before soils dry out.	3	25	Marin RCD, NRCS, Private Landowners	
WkC-CCCS-18.1.3	Recovery Action	Livestock	Prevent or minimize impairment to stream hydrology (impaired water flow)				
WkC-CCCS-18.1.3.1	Action Step	Livestock	Increase the use of water storage and catchment systems that collect rainwater in the winter for use during the dry summer and fall seasons.	2	60	Marin RCD, NRCS, Private Landowners	
WkC-CCCS-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification or curtailment of the species habitat or range**				
WkC-CCCS-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
WkC-CCCS-19.1.1.1	Action Step	Logging	Encourage forest management which allows for optimal levels of natural LWD recruitment of larger older trees into stream channels.	3	60	Board of Forestry, Marin County, NMFS, Private Landowners, US EPA	
WkC-CCCS-19.1.2	Recovery Action	Logging	Prevent or minimize adverse alterations to riparian species composition and structure				
WkC-CCCS-19.1.2.1	Action Step	Logging	Conserve and manage forestlands for older forest stages.	3	60	Board of Forestry, CDFW, Marin County, NMFS, USEPA	
WkC-CCCS-22.1	**Objective**	**Residential/ Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-22.1.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize adverse alterations to riparian species composition and structure				

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-22.1.1.1	Action Step	Residential/ Commercial Development	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do.	3	30	County Planning	
WkC-CCCS-22.1.1.2	Action Step	Residential/ Commercial Development	Reduce impacts of existing development in floodplains/riparian zones by encouraging willing landowners to restore these areas.	3	15	CDFW, RWQCB	
WkC-CCCS-22.1.1.3	Action Step	Residential/ Commercial Development	Explore the use of conservation easements to provide incentives for private landowners to preserve riparian corridors.	3	10	Land Trusts, Private Landowners, RCD	
WkC-CCCS-22.1.1.4	Action Step	Residential/ Commercial Development	Utilize native plants when landscaping and discourage the use of exotic invasive.	3	50	Private Landowners, UC Extension	
WkC-CCCS-22.1.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to watershed hydrology				
WkC-CCCS-22.1.2.1	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 salmonids.	3	50	County Planning, MMWD	
WkC-CCCS-22.1.2.2	Action Step	Residential/ Commercial Development	New development in all historic CCC steelhead watersheds should minimize increase in storm-water runoff, changes in duration, or magnitude of peak flow.	3	50	County Planning, RWQCB, SWRCB	
WkC-CCCS-22.1.2.3	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	25	County Planning, RWQCB, Water Agencies	
WkC-CCCS-22.1.2.4	Action Step	Residential/ Commercial Development	Encourage the use and provide incentives for rooftop water storage and other conservation devices.	2	20	County Planning, Private Landowners, Water Agencies	
WkC-CCCS-22.1.3	Recovery Action	Residential/ Commercial Development	Prevent or minimize increased landscape disturbance				
WkC-CCCS-22.1.3.1	Action Step	Residential/ Commercial Development	Identify areas at high risk of conversion from forest to rural residential, etc. and develop incentives and alternatives for landowners that discourage conversion.	3	20	County Planning, Private Landowners	
WkC-CCCS-22.1.3.2	Action Step	Residential/ Commercial Development	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	3	25	Board of Forestry, CalFire, CDFW, County Planning	
WkC-CCCS-22.2	**Objective**	**Residential/ Commercial Development**	**Address the inadequacy of existing regulatory mechanisms**				
WkC-CCCS-22.2.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to watershed hydrology				
WkC-CCCS-22.2.1.1	Action Step	Residential/ Commercial Development	Develop legislation that will fund county planning for environmentally sound growth water supply development and work in coordination with California Dept. of Housing, Association of Bay Area Governments and other government associations (CDFG 2004).	3	20	County Planning, SWRCB	
WkC-CCCS-22.2.1.2	Action Step	Residential/ Commercial Development	Implement performance standards in Stormwater Management Plans.	3	20	County Planning, RWQCB	
WkC-CCCS-22.2.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize increased landscape disturbance				
WkC-CCCS-22.2.2.1	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.	3	25	County Planning	
WkC-CCCS-22.2.2.2	Action Step	Residential/ Commercial Development	Modify Federal, State, local processes, and County General Plans, to minimize new construction in undeveloped areas within the 100-year flood prone zone.	3	60	California Department of Mines and Geology, CalTrans, County Planning, NMFS, Private Landowners, Public, Federal	

Walker Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-22.2.2.3	Action Step	Residential/ Commercial Development	Work with counties to develop and implement ordinances to restrict subdivisions by requiring a minimum acreage limit for parcelization in concert with limits on water supply and groundwater recharge areas.	3	15	County Planning, RCD	
WkC-CCCS-22.2.2.4	Action Step	Residential/ Commercial Development	Design new developments to avoid or minimize impacts to unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to watercourses.	3	60	County Planning, Private Landowners, USACE	
WkC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)				
WkC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Assess roads in Salmon Creek, Walker Creek and Keys Creek to identify high priority and high sediment yield sources.	2	10	Private Landowners, Public Works, RCD	
WkC-CCCS-23.1.1.2	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	CDFW, Marin County, NMFS, NRCS	
WkC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Reduce the hydrologic connectivity of roads and trails to adjacent crossings across watercourses.	3	60	Marin County, Marin RCD, MMWD, Private Landowners	
WkC-CCCS-23.1.1.4	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	60	CDFW, NMFS, RWQCB, WCB	
WkC-CCCS-23.1.1.5	Action Step	Roads/Railroads	Decommission riparian roads and skid trails on forestlands that deliver sediment into adjacent watercourses. High priority streams identified by CDFG habitat reports include Verde Canyon, Frink Canyon, and Salmon Creek (http://coastalwatersheds.ca.gov/).	2	10	NRCS, Private Landowners, Public Works	
WkC-CCCS-23.1.1.6	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	3	20	Private Landowners, Public Works	
WkC-CCCS-23.1.1.7	Action Step	Roads/Railroads	Utilize best management practices for road maintenance, management (e.g. Fishnet 4C, 2004; Weaver and Hagans, 1994; Sommarstrom et al., 2002; Oregon Department of Transportation, 1999).	3	50	Private Landowners, Public Works	
WkC-CCCS-23.1.1.8	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips.	3	50	Private Landowners, Public Works, RCD, State Parks	
WkC-CCCS-23.1.1.9	Action Step	Roads/Railroads	Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	2	10	Private Landowners, Public Works, RCD	
WkC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
WkC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Assess private and public road stream crossings for barrier potential and implement recommendations.	2	5	CDFW, Private Landowners, RCD, Trout Unlimited	
WkC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Utilize BMP's to upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	2	10	Private Landowners, Public Works, State Parks	
WkC-CCCS-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	50	Public Works	
WkC-CCCS-23.1.2.4	Action Step	Roads/Railroads	Prevent future barriers on newly constructed roads utilizing NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	3	25	County Planning, Private Landowners	
WkC-CCCS-23.1.2.5	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. Bridge construction should not reduce streamside vegetation.	3	60	Board of Forestry, CalTrans, CDFW, Private Landowners, Public Works, RCD	
WkC-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
WkC-CCCS-23.1.3.1	Action Step	Roads/Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.	2	5	CDFW, RCD	

Walker Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-23.1.3.2	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.	2	5	CDFW, RCD	
WkC-CCCS-24.1	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species continued existence**				
WkC-CCCS-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to water quality (impaired stream temperature)				
WkC-CCCS-24.1.1.1	Action Step	Severe Weather Patterns	Maintain canopy levels at desirable levels in all streams and restore canopy levels to desirable levels in high value habitat areas (See WATER QUALITY for specific actions/areas.	2	25	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
WkC-CCCS-24.1.2	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
WkC-CCCS-24.1.2.1	Action Step	Severe Weather Patterns	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts and floods while also providing for salmonid recovery needs.	1	20	Board of Forestry, CA Coastal Commission, California Coastal Conservancy, California Department of Mines and Geology, CalTrans, CDFW, CDFW Law Enforcement, Farm Bureau, FEMA, NMFS, NRCS, Public Works, RWQCB, State Parks, SWRCB, USACE, USEPA, USGS, Water Agencies	
WkC-CCCS-24.1.3	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to the estuary (impaired quality and extent)				
WkC-CCCS-24.1.3.1	Action Step	Severe Weather Patterns	Evaluate and prepare contingency plans to breach estuary sandbars to facilitate adult upmigration when instream flows are adequate for passage and spawning if sandbar remains closed by mid-January.	2	15	CDFW, NMFS, USACE	
WkC-CCCS-24.1.3.2	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, which will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.	2	60	CDFW, MMWD, SWRCB	
WkC-CCCS-24.1.3.3	Action Step	Severe Weather Patterns	Manage reservoirs and dam releases to maintain suitable rearing temperatures and migratory flows in downstream habitats and the estuary (e.g., pulse flow programs for adult upstream migration and smolt outmigration).	2	60	CDFW, MMWD, SWRCB	
WkC-CCCS-24.2	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
WkC-CCCS-24.2.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
WkC-CCCS-24.2.1.1	Action Step	Severe Weather Patterns	Work with CDFW, County and knowledgeable biologists to develop and implement severe weather emergency rules (i.e. fire, flood, drought) that consider the lifehistory requirements of salmonids.	2	15	CDFW, County, NMFS, USACE, Water Agencies	
WkC-CCCS-24.2.1.2	Action Step	Severe Weather Patterns	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.	3	10	CDFW, RWQCB, Water Agencies	
WkC-CCCS-25.1	**Objective**	**Water Diversion /Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WkC-CCCS-25.1.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				

Walker Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WkC-CCCS-25.1.1.1	Action Step	Water Diversion /Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	2	20	CDFW, Marin County, MMWD, Private Landowners, RCD, RWQCB	
WkC-CCCS-25.1.1.2	Action Step	Water Diversion /Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	3	20	CDFW, Farm Bureau, NRCS, Water Agencies	
WkC-CCCS-25.1.1.3	Action Step	Water Diversion /Impoundment	Promote the use of reclaimed water for agricultural or other uses.	3	60	CDFW, RCD, Water Agencies	
WkC-CCCS-25.1.1.4	Action Step	Water Diversion /Impoundment	Promote conjunctive use of water with water projects whenever possible.	3	60	CDFW, County Planning, RCD, RWQCB, Water Agencies	
WkC-CCCS-25.1.1.5	Action Step	Water Diversion /Impoundment	Evaluate requests for on-stream dams above migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (CDFG 2004).	3	5	CDFW, USACE	
WkC-CCCS-25.1.2	Recovery Action	Water Diversion /Impoundment	Prevent or minimize reduced density, abundance, and diversity				
WkC-CCCS-25.1.2.1	Action Step	Water Diversion /Impoundment	Adequately screen water diversions to prevent juvenile salmonid mortalities.	2	10	CDFW, NMFS	
WkC-CCCS-25.1.2.2	Action Step	Water Diversion /Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	3	30	NMFS, RCD, RWQCB, Water Agencies	
WkC-CCCS-25.1.2.3	Action Step	Water Diversion /Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of salmonids and their habitats, and avoidance of adverse impacts caused by water diversion (CDFG 2004).	3	60	CDFW, RCD, Water Agencies	
WkC-CCCS-25.1.3	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to the estuary (impaired quality and extent)				
WkC-CCCS-25.1.3.1	Action Step	Water Diversion /Impoundment	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	3	10	CDFW, NMFS, RWQCB	
WkC-CCCS-25.1.3.2	Action Step	Water Diversion /Impoundment	Identify upstream pollution sources which contribute to poor water quality conditions in the estuary.	2	5	County Planning, SWRCB, Water Agencies	
WkC-CCCS-25.2	**Objective**	**Water Diversion /Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
WkC-CCCS-25.2.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
WkC-CCCS-25.2.1.1	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	5	CDFW, County Planning, RCD, RWQCB, Water Agencies	
WkC-CCCS-25.2.1.2	Action Step	Water Diversion /Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	15	NMFS, RWQCB, SWRCB	

CCC Steelhead DPS Rapid Assessment Profile: North Coastal Diversity Stratum Populations

Estero Americano

- Role within DPS: Independent Population
- Spawner Density Target: 210-423
- Current Intrinsic Potential: 35.4 IP-km

Drakes Bay Tributaries

- Role within DPS: Dependent Population
- Spawner Density Target: N/A
- Current Intrinsic Potential: N/A

Pine Gulch

- Role within DPS: Dependent Population
- Spawner Density Target: 56-114 adults
- Current Intrinsic Potential: 9.7 IP-km

Redwood Creek (Marin County)

- Role within DPS: Dependent Population
- Spawner Density Target: 38-78 adults
- Current Intrinsic Potential: 6.7 IP-km

Abundance and Distribution

There has been no sampling or recent documentation of steelhead in Estero Americano; however, infrequent sampling in Drakes Bay tributaries has documented low to moderate numbers of juvenile steelhead. Ongoing annual monitoring by the National Park Service (NPS) in Pine Gulch and Redwood Creek has documented moderate numbers of multiple life stages of steelhead.

There is a paucity of information on the abundance of steelhead in the small tributaries to Drakes Bay; however, juvenile steelhead have been observed in East Schooner Creek, Home Ranch Creek, Glenbrook Creek, Muddy Hollow Creek, Laguna Creek, Coast Camp Creek, and Coast Creek (Brannon Ketchum and Michael Reichmuth, NPS, personal communications, 2013). During the past decade, the NPS has completed several projects designed to enhance the steelhead populations in these streams, including the replacement of culverts with bridges on East Schooner Creek, Home Ranch Creek, and Laguna Creek, restoration of the Estero de Limantour, removal of the Muddy Hollow dam, and riparian fencing on Home Ranch Creek.

The NPS reports that steelhead habitat extends from the mouth of Pine Gulch Creek upstream approximately 6.1 miles on the mainstem, and that the creek's two largest tributaries, McCurdy Creek and McCormick Creek, also provide steelhead habitat (NPS 2005). Carlisle *et al.* (2011) reports that average densities of young-of-year steelhead in pool, riffle, and flatwater habitats of Pine Gulch Creek were 0.32, 0.30 and 1.12 fish/m^2 during the years 2005-2007, and were 0.45, 0.32 and 0.08 fish/m^2 in 2008. Although the Park Service does not report densities of older (age 1+) steelhead, Carlisle *et al.* (2011) states that at six study sites in 2008, a total of 355 young-of-year and 72 age 1+ steelhead were caught.

Carlisle *et al.* (2011) reports that average densities of young-of-year steelhead in pool, riffle, and flatwater habitats of Redwood Creek were 0.39, 0.09 and 0.25 fish/m^2 during the years 2005-2007, and were 0.47, 0.05 and 0.43 fish/m^2 in 2008 (Carlisle *et al.* 2011). Although the Park Service does not report densities of older (age 1+) steelhead, Carlisle *et al.* (2011) states that at six study sites in 2008, a total of 566 young-of-year and 105 age 1+ steelhead were caught.

History of Land Use

Agriculture has been occurring within Estero Americano watershed since European colonization (GRRCD 2007). Land within the watershed was cleared of native vegetation and used for cultivated crops, with potatoes being the primary crop through the late 1800s and early 1900s, resulting in erosion and sediment filling the creek channels and the Estero (estuary/lagoon) (GRRCD 2007). Production of potatoes transitioned into barley and wheat, and to hay in the 1970s (GRRCD 2007).

Current Resources and Land Management

Today there are only a few small scale hay fields with 80 percent of the land currently being used for pasture and rangeland grazing. The land is mostly comprised of small multigenerational family run dairies and livestock ranches (GRRCD 2007). Annual grasslands and agriculture are the primary vegetation cover within the watershed, with about 73 percent cover as annual grassland and 17 percent as agriculture. The Gold Ridge RCD and Marin County RCD along with NRCS are working with ranch operators in the watershed to implement best management practices to reduce impacts related to ranchland management. As such, the Gold Ridge RCD has developed The Estero Americano Watershed Management Plan and Estero Americano Dairy Enhancement Program.

NPS (2004) reports that the Drakes Bay watersheds are part of a system of ranches that date to the 19th century and primarily specialized in dairying, cheese, and butter production, although

some moved into beef cattle ranching and artichoke farming. NPS (2004) indicates that these ranches were connected by a road that crossed several of the tributaries entering Drakes Bay as well as a second road that follows the current path of the Sir Francis Drake Boulevard. Ranches in the Drakes Estero watershed also shipped goods from docks on Schooner Bay, Limantour Bay, and below Drakes Head Ranch (NPS 2004). Since the mid-1960s, the area has been managed primarily as parkland, although the existing ranch on Home Ranch Creek has continued operations.

Except for its lowermost 2 miles, the Pine Gulch Creek watershed is entirely within the Point Reyes National Seashore and is essentially managed as wilderness (Brannon Ketchum, National Park Service, personal communication, 2013). The lowermost 2 miles of Pine Gulch Creek is privately owned and bordered by five small organic farms. About 50 percent of the watershed is conifer forest; about 22 percent is hardwood woodland; and the remainder of the vegetation cover is comprised of shrubs, grassland, and agriculture.

The Redwood Creek watershed is primarily publicly owned, except for 5 percent of the watershed including roads (managed by the California Department of Transportation, Marin County, and local service districts) and private properties in the communities of Muir Beach, Muir Woods Park, and Green Gulch Farm (Stillwater Sciences 2009). About 32 percent of the watershed is shrubs; 31 percent is conifer forest; 16 percent is hardwood woodland; and the remainder of the vegetation cover is comprised mostly of grassland. The majority of the Redwood Creek watershed is located on NPS and California State Parks land, where recreational activities are the primary land use. Development within the Redwood Creek watershed is primarily associated with recreational facilities including parking lots, roads, recreational trails, visitor buildings, and toilet facilities serviced by septic systems. Agricultural development has increased sediment delivery into lower Redwood Creek.

Conditions

Current impaired conditions result directly or indirectly from human activities, and are expected to continue until restored and/or the threat acting on the conditions is abated. Using a Rapid Assessment Protocol and existing data, NMFS staff rated 12 potential habitat related conditions to determine their effect on five lifestages of steelhead (adult, eggs, summer rearing juveniles, winter rearing juveniles, and migratory smolts) in Estero Americano, Drakes Bay, Pine Gulch Creek and Redwood Creek (See North Coastal Diversity Stratum Rapid Assessment Stresses Results). The steelhead populations in these streams face markedly different habitat conditions. Estero Americano has a general lack of stream habitat complexity and impaired gravel quality due to sedimentation and water diversions for small domestic use and agricultural irrigation that

appreciably diminish streamflow and the quality of steelhead habitat. Through NPS restoration activities, the tributaries entering Drakes Bay are now effectively without significant anthropogenic habitat conditions. However, because of their small size, the Drakes Bay streams contain only modest amounts of steelhead habitat, and the geology and vegetation of the Glenbrook Creek, Muddy Hollow Creek and Laguna Creek watersheds appear to support relatively low numbers of deep pools, limited large woody debris, and relatively sandy substrates. The lowermost two miles of Pine Gulch Creek has impaired summer streamflow due to the cumulative water diversions from bordering agricultural operations. Although mostly in park lands, Redwood Creek has areas with modified channels that lack stream habitat complexity mostly due to roads, recreational trails, and levees. There were no conditions that rated Poor for their effects to steelhead life history stages for the North Coastal Diversity Stratum; however, those conditions that rated as Fair are identified and discussed in the next section.

Conditions Rated Fair

Since there were no conditions rated Poor, conditions rated as Fair are discussed below and are presented in North Coastal Diversity Stratum Rapid Assessment Stresses Results. The following discussion focuses on those conditions that rated as Fair for their effects to steelhead life history stages for the North Coastal Diversity Stratum. These were: (1) Riparian Vegetation: Composition, Cover & Tree Diameter; (2) Estuary: Quality & Extent; (3) Hydrology: Baseflow & Passage Flows; (4) Passage/Migration: Mouth or Confluence & Physical Barriers; (5) Habitat Complexity: Percent Primary Pools & Pool/Riffle/Flatwater Ratios; (6) Habitat Complexity: Large Wood & Shelter; (7) Sediment: Gravel Quality & Distribution of Spawning Gravels; and (8) 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.

Riparian Vegetation: Composition, Cover & Tree Diameter

Riparian conditions within the Estero Americano watershed are in a degraded state with an estimated 45 percent of streams with minimal vegetation, 22 percent with partial vegetation, and 32 percent abundantly vegetated based on Gold Ridge RCD's assessment (GRRCD 2007). Loss of high quality riparian vegetation can expose a stream to increased solar radiation, thereby increasing water temperatures beyond the tolerance of summer rearing juvenile steelhead. Low quality riparian vegetation can also reduce the supply of potential large woody debris that plays an important role in creating rearing (summer and winter) habitat for juvenile steelhead and temporary holding areas for adult fish. Within the Drakes Bay watershed, riparian habitat is typically impaired on ranch property experiencing active grazing.

Riparian conditions in the Drakes Bay tributaries are essentially unimpaired except near road and trail crossings. Pine Gulch and Redwood creeks riparian conditions are generally not altered to a level that poses more than a minor effect to steelhead.

Estuary: Quality & Extent

Out of the four populations, the estuary in Estero Americano is currently impaired and lacks conditions suitable for steelhead. Severe erosion in the Estero Americano watershed has filled in large areas of the estuary, significantly reducing available estuarine habitat and the amount of tidal marsh habitat (GRRCD 2007). Agricultural runoff from dairies and livestock ranches has resulted in elevated ammonia levels and anoxic conditions (GRRCD 2007). The Estero Americano estuary is on the RWQCB Clean Water Act section 303(d) list of water quality impaired segments for Nutrients and Sedimentation/siltation. High siltation affects incubating eggs, and high nutrient loading can affect summer rearing conditions through affecting temperature and levels of oxygen. Turbidity is also considered to be a problem for winter rearing smolts affecting foraging ability for food and predator avoidance. Additionally, all streams in the watershed are now mostly intermittent in summer months causing high salinity levels within the estuary due to the lack of freshwater input, and elevated ammonia levels and anoxic conditions due to agricultural runoff from dairies and livestock ranches (GRRCD 2007).

Pine Gulch and the Drakes Bay tributaries estuary conditions are generally not altered to a level that poses more than a minor effect to steelhead. However, agriculture in lower Pine Gulch alters estuarine conditions, especially in the gospel flats area. Redwood Creek estuary conditions are improving due to restoration activities implemented by NPS, including the Big Lagoon and Banducci property restoration projects.

Hydrology: Baseflow & Passage Flows

During summer, streamflows are exceedingly low or non-existent in Estero Americano, and all streams within the watershed are intermittent in most years except for Ebabias Creek (GRRCD 2007). Because most of the Pine Gulch Creek watershed is within the protected Point Reyes National Seashore, its hydrology is largely unimpaired. However, in the downstream-most three km segment of Pine Gulch, several agricultural operations can cumulatively divert streamflow at a rate that can exceed the entire summertime streamflow, and these operations routinely cause extensive and unnatural variation in daily flows during the low flow season (NPS 2005; NMFS 2013). Although Redwood Creek is mostly in park lands, water is diverted directly from Redwood Creek and tributaries, including Green Gulch Creek for municipal and agricultural purposes (Stillwater Sciences 2010). The Muir Beach Community Services District operates a well on the Redwood Creek floodplain near the Banducci property (Stillwater Sciences 2010), resulting in a decrease in flows downstream of the well (J. McKeon, NMFS, personal communication, 2013).

During sampling by Smith (Smith 2003) from 1992-2003 at Redwood Creek, the stream was dry or intermittent downstream of the Muir Beach Services District well by late summer in about half the years, and the impacts (dry or intermittent with insufficient flow to maintain good dissolved oxygen levels) extended downstream to Muir Beach in many years.

Passage/Migration: Mouth of Confluence and Physical Barriers

Estero Americano and tributaries have impaired passage and migration conditions due to the sedimentation of creek channels and lack of flows that affect adult steelhead, juvenile steelhead and smolts.

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

Estero Americano and tributaries have altered pool complexity and pool/riffle ratios due to the sedimentation, lack of riparian habitat and lack of flows that affect adult steelhead, juvenile steelhead and smolts. Adequate numbers of pools with adequate shelter are specifically lacking and are of particular concern in Estero Americano and its tributaries.

Habitat Complexity: Large Wood & Shelter

Estero Americano and tributaries have reduced large wood and shelter due to the sedimentation of creek channels and lack of riparian habitat that primarily affects adult steelhead, rearing juveniles and smolts. The existing low level of instream cover directly reduces the quality of rearing habitat for juvenile steelhead. Channel simplification due to sedimentation and the loss of riparian habitat and large woody debris has also created high velocity flume-like environments within creek channels during runoff events. Such high velocity conditions probably limit the number of days that adult steelhead can migrate up these creeks.

Sediment: Gravel Quality & Distribution of Spawning Gravels

Estero Americano and tributaries have impaired gravel quality and quantity due to the sedimentation of creek channels and lack of riparian habitat that primarily affects adult steelhead, rearing juveniles, and smolts.

Viability: Density, Abundance & Spatial Structure

Estero Americano and its tributaries currently do not support a population of steelhead due to impaired riparian, instream, and estuary habitat conditions, including lack of summer flows that affect water temperature and quality. All populations are likely reduced from historic levels, although small populations persist in several of the streams.

Threats

The following discussion focuses on those threats that rate as High (See North Coastal Diversity Stratum Rapid Assessment Threats Results). Recovery strategies will focus on ameliorating High threats; however, some strategies may address other threat categories when the strategy is essential to recovery efforts.

Agriculture

Although cultivated crops were more widespread throughout the Estero Americano watershed historically, today there are only a few small scale hay fields (Gold Ridge RCD 2007). Agricultural operations in the lowermost 3 km of Pine Gulch Creek do not appear to have significantly affected the creek's habitat, except for the significant diversion of water during summertime. In some areas agricultural practices occur within the creek's riparian zone, and some channel modification has occurred. Periodically the landowners erect wire fences across the creek to restrict deer access to their properties (Reichmuth, NPS, personal communication, 2016). These fences do not pose a problem during summer months; however, they can contribute to debris jams and potential injury to migrating adult steelhead during the wintertime (M. Reichmuth, NPS, personal communication, 2013). NPS staff periodically requests that landowners remove these fences during winter and early spring. Agriculture was more predominant within Redwood Creek watershed in the 1800s and early 1900s (Stillwater Sciences 2010). Green Gulch Farm was established in 1972 on land that had been previously operated as a ranch located along Green Gulch Creek, a tributary to lower Redwood Creek (Stillwater Sciences 2010). The farm relies on Green Gulch Creek, its tributaries, and several springs for drinking water and irrigation (Stillwater Sciences 2010).

Channel Modification

Channel modification (e.g., floodplain and riparian removal) has impacted steelhead resources within Estero Americano through sedimentation from livestock farming and historical agricultural activities. Simplification of streams through bank revetment and channel straightening disconnect streams from their floodplain. As a result, complex riffle-pool habitats needed by summer-rearing juvenile steelhead are lost. Likewise, winter rearing habitat is compromised when steelhead cannot find refugia from high velocities and are flushed from headwater reaches into marginal downstream habitat. Low velocity holding pools needed by migrating adult steelhead are also lost. In many areas, channel modification has caused channel incision, over-steepened banks, high erosional forces and gravel embeddedness, and ultimately loss of riparian trees. Redwood Creek has had significant channel modification including grade control structures, incision, and bank stabilization. Pine Gulch also has undergone channel modification and incision within the lower reach (NPS 2016).

Livestock Farming and Ranching

Livestock grazing is known to adversely affect salmon and trout populations especially if cattle have access to and utilize riparian areas in large numbers for prolonged periods (Ballard and Krueger 2005). Depending on the period of time, and the numbers of animals utilizing these areas, cattle may adversely affect steelhead by disrupting spawning or feeding behaviors, trampling or smothering redds, and crushing individual juvenile salmonids. Armour *et al.* (1991) state that livestock grazing can affect the riparian environment by changing and reducing vegetation or by eliminating riparian areas through channel widening, channel aggradation or lowering the water table. Moreover, they report that the most apparent effects of livestock grazing on fish habitat are the reductions of shade, cover, and terrestrial food supply, and resultant increases in stream temperature and sedimentation through bank degradation and soil erosion.

Today there are only a few small scale hay fields, with 80 percent of the land currently being used for pasture and rangeland grazing; mostly comprised of small multigenerational family run dairies and livestock ranches throughout Estero Americano (GRRCD 2007). Therefore, livestock ranching is an ongoing threat to steelhead in Estero Americano although efforts are being implemented by ranch owners in coordination with the Gold Ridge RCD to address this threat. Most of Drakes Bay watershed is still used for grazing (NPS 2016).

Roads and Railroads

While road and railroads pose a minor threat to these populations, roads, old railroads and trails have interrupted sediment transport, often disconnecting the floodplain and contributing sediment to the channel from surface erosion. Undersized culverts also reduce the availability of spawning gravel and increase channel incision, resulting in the risk of failing or causing flow diversion down roads. Roads represent a higher threat for Redwood Creek than other North Coastal populations (NPS 2016).

Severe Weather Patterns

These watersheds experience a Mediterranean-type climate receiving the most precipitation during winter months. Summer streamflows are already pressured by agricultural and residential uses; long-lasting drought patterns could pose a significant threat to maintaining adequate streamflows and aquatic habitat. Flooding can contribute positive as well as negative changes to streams through the initiation or acceleration of natural processes respectively.

Limiting Conditions, Lifestages, and Habitats

Our analysis of habitat-related conditions indicate that the steelhead populations in these streams are currently limited by the availability of juvenile rearing habitat and general lack of deep pools and other velocity refugia for winter migrating adult steelhead. High levels of sediment in the substrates within some stream reaches may also affect steelhead densities by reducing the survival of incubating eggs, pool volume, and growth rates of juvenile fish deprived of a healthy macroinvertebrate forage base. The limited amount of quality rearing and spawning habitat is undoubtedly a major factor limiting presence within Estero Americano.

General Recovery Strategy

In general, recovery strategies focus on improving conditions and ameliorating conditions and the 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 strategies for the populations in this Stratum are discussed below with more detailed and site-specific recovery actions provided in North Coastal Diversity Stratum Rapid Assessment Recovery Actions Table.

Efforts to recover steelhead populations in these watersheds at varying degrees should focus on the following: (1) conserving (Drakes Bay tributaries, Redwood Creek) and restoring (Americano and Pine Gulch Creek) streamflows; (2) restoring complex pool habitats by increasing large woody debris and/or boulder structures; (3) restoring the integrity of riparian habitats (Estero Americano); (4) reducing the incidence of stream sedimentation by mapping and then treating agriculture, road and trail related sediment sources (Estero Americano, Redwood Creek); (5) improving stream water quality conditions (turbidity, sediment, and/or toxicity); and (6) improving the quality and extent of freshwater lagoon and estuarine habitats within the Estero Americano lagoon/estuary and Estero Americano. Watershed assessments, plans and programs (i.e., The Estero Americano Watershed Management Plan) that assess/address threats to steelhead habitat should continue to be developed and implemented. A project in the lower Pine Gulch Creek watershed that will reduce the amount of water diverted from the creek during summer and early fall should be promoted and implemented. Specific strategies for Redwood Creek should include strategies to promote a return of natural stream function with a focus on removing bank controls and adding large woody debris (NPS 2016).

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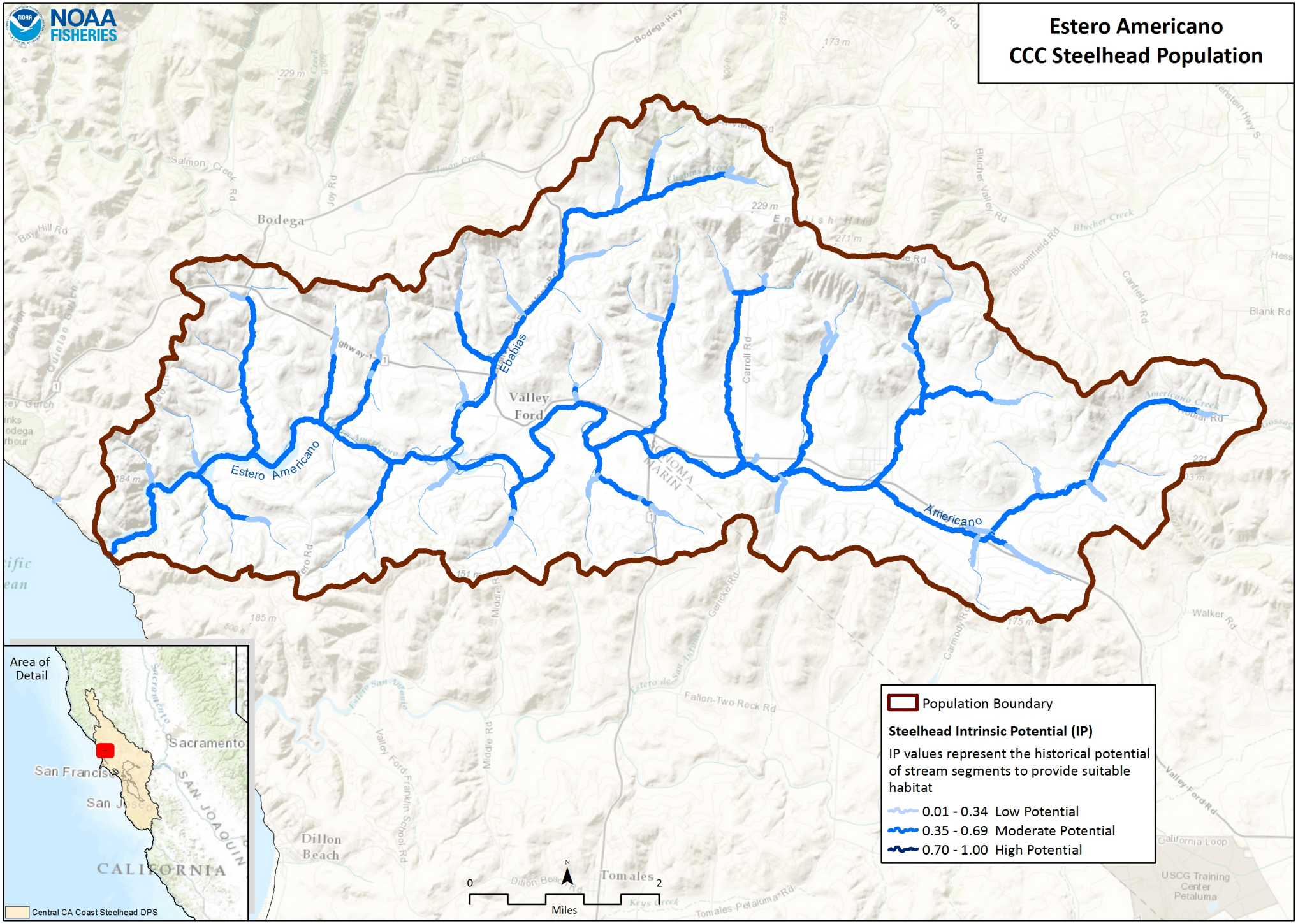

NOAA FISHERIES
Estero Americano
CCC Steelhead Population
Bodega
Valley Ford
Ebabias
Estero Americano
Americano
Carroll Rd
Bodega Hwy
Salmon Creek Rd
Joy Rd
Bay Hill Rd
Bluchet Valley Rd
Bloomfield Rd
Blanch Creek
Canfield Rd
Blank Rd
Walker Rd
Fallon-Two Rock Rd
Valley Ford Franklin School Rd
Middle Rd
Gericke Rd
Carmody Rd
Valley Ford Rd
California Loop
USCG Training Center Petaluma
Tomales
Dillon Beach
Tomales-Petaluma Rd
Area of Detail
Sacramento
San Francisco
San Jose
SAN JOAQUIN
CALIFORNIA
Central CA Coast Steelhead DPS
0
2
Miles
N
Population Boundary
Steelhead 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

Drakes Bay
CCC Steelhead Population
NOAA FISHERIES
E. Schooner
Home Ranch
Glenbrook
Muddy Hollow
Laguna
Coast Camp
Santa Maria
Coast
Alamere
Arroyo Hondo
Tomales Bay State Park
Inverness
Drakes Estero
Point Reyes National Seashore
Estero de Limantour
Olema
Golden Gate Nat'l Recreation Area
Samuel P Taylor State Park
Nicasio Reservoir
Population Boundary
Steelhead Intrinsic Potential (IP)
Drakes Bay tributaries do not have IP modeled, therefore IP values are not available.
Footprint for Recovery
Area of Detail
Sacramento
San Francisco
San Jose
SAN JOAQUIN
CALIFORNIA
Central CA Coast Steelhead DPS
N
0
2
Miles

NOAA FISHERIES
Pine Gulch Creek
CCC Steelhead Population
Population Boundary
Steelhead 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
Pine Gulch
McCormick
Area of Detail
Sacramento
San Francisco
San Jose
SAN JOAQUIN
CALIFORNIA
Central CA Coast Steelhead DPS
0
1
Miles
N

NOAA FISHERIES
Redwood Creek
CCC Steelhead Population
Population Boundary
Steelhead 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
Rattlesnake
Laguna
Fern
Bootjack
Spike Buck
Redwood
Kent
MOUNT TAMALPAIS
Mill Valley
Stinson Beach
Larkspur
Muir Woods National Monument
Area of Detail
Sacramento
San Jose
Central CA Coast Steelhead DPS
0
1
Miles
N

CCC Steelhead DPS: North Coastal Diversity Stratum (Estero Americano/Drakes Bay/Pine Gulch/Redwood)

Habitat & Population Condition Scores By Life Stage: VG = Very Good G = Good F = Fair P = Poor		Steelhead Life History Stages				
		Adults	Eggs	Summer-Rearing Juveniles	Winter-Rearing Juveniles	Smolts
Stresses: Key Attribute: Indicators	Riparian Vegetation: Composition, Cover & Tree Diameter			F	F	
	Estuary: Quality & Extent	G		F	G	G
	Velocity Refuge: Floodplain Connectivity	G			G	G
	Hydrology: Redd Scour		VG			
	Hydrology: Baseflow & Passage Flows	VG	VG	F		F
	Passage/Migration: Mouth or Confluence & Physical Barriers	G		F	G	G
	Habitat Complexity: Percent Primary Pools & Pool/Riffle/Flatwater Ratios	F		F	F	
	Habitat Complexity: Large Wood & Shelter	F		F	F	F
	Sediment: Gravel Quality & Distribution of Spawning Gravels	F	F	F	G	
	Viability: Density, Abundance & Spatial Structure	F		F		F
	Water Quality: Temperature			G		G
	Water Quality: Turbidity & Toxicity	G		G	G	G

CCC Steelhead DPS: North Coastal Diversity Stratum (Estero Americano/Drakes Bay/Pine Gulch/Redwood)

Threat Scores
L: Low
M: Medium
H: High

Threats - Sources of Stress	Stresses: Altered Riparian Species: Composition & Structure	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 Complexity and/or Pool/Riffle Ratio	Instream Habitat Complexity: Reduced Large Wood and/or Shelter	Instream Substrate/Food Productivity: Impaired Gravel Quality & Quantity	Reduced Density, Abundance & Diversity	Water Quality: Impaired Instream Temperatures	Water Quality: Increased Turbidity or Toxicity
Agriculture	L	L	L	L		L	L	L	L		L	L
Channel Modification	L	L	L	L	L	L	L	L	L		L	L
Disease, Predation, and Competition	L	L	L			L	L	L		L	L	L
Fire, Fuel Management, and Fire Suppression	L	L	L	L		L	L	L	L		L	L
Livestock Farming and Ranching	M	L	L	L		L	M	L	M		L	L
Logging and Wood Harvesting	L	L	L	L		L	L	L	L		L	L
Mining	L	L	L	L		L	L	L	L		L	L
Recreational Areas and Activities	L	L	L	L		L	L	L	L		L	L
Residential and Commercial Development	L	L	L	L		L	L	L	L		L	L
Roads and Railroads	L	L	L	L		L	L	L	M		L	L
Severe Weather Patterns	L	L	L	L	H	L	L	L	L		L	L
Water Diversions and Impoundments	L	M	L	L	H	L	L	L	L	M	L	L
Fishing and Collecting										L		
Hatcheries and Aquaculture										L	L	L

Estero Americano, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
EAmer-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
EAmer-CCCS-1.1.1	Recovery Action	Estuary	Increase the quality and extent of estuarine habitat				
EAmer-CCCS-1.1.1.1	Action Step	Estuary	Develop and implement estuary rehabilitation and enhancement strategies.	3	10	California Coastal Conservancy, Gold Ridge RCD, Marin RCD, Private Landowners	
EAmer-CCCS-1.1.1.2	Action Step	Estuary	Restore estuarine wetlands and sloughs, and improve prey abundance by increasing shoreline perimeter and planting native emergent and riparian species to improve foraging and cover.	2	10	California Coastal Conservancy, CDFW, Gold Ridge RCD, Marin RCD, Private Landowners	
EAmer-CCCS-1.1.2	Recovery Action	Estuary	Increase rate of lagoon formation and/or freshwater conversion				
EAmer-CCCS-1.1.2.1	Action Step	Estuary	Restore estuary function by increasing in-stream flow in Estero Americano Creek and tributaries that will provide greater freshwater input into the estuary.	2	20	CDFW, Gold Ridge RCD, Marin RCD, NMFS, Private Landowners	
EAmer-CCCS-1.1.2.2	Action Step	Estuary	Improve estuarine water quality by identifying and addressing upstream pollution sources which contribute to poor water quality conditions in the estuary	2	10	CDFW, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, Private Landowners	
EAmer-CCCS-1.1.3	Recovery Action	Estuary	Improve the quality of each estuarine habitat zone				
EAmer-CCCS-1.1.3.1	Action Step	Estuary	Restore estuary function by reducing fine sediment input from the upper watershed.	3	30	Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, Private Landowners	
EAmer-CCCS-1.1.3.2	Action Step	Estuary	Monitor the habitat use of various life stages of steelhead in the Estero Americano estuary and associated wetlands.	2	10	CDFW, Gold Ridge RCD, Marin RCD, NMFS	
EAmer-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
EAmer-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
EAmer-CCCS-3.1.1.1	Action Step	Hydrology	Develop cooperative projects with private landowners to conserve summer flows	3	5	CDFW, Gold Ridge RCD, Marin RCD, NMFS, NOAA RC, NRCS, Private Landowners, RCD	
EAmer-CCCS-3.1.1.2	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	3	20	Gold Ridge RCD, NMFS, NOAA RC, NRCS, Private Landowners, SWRCB	
EAmer-CCCS-3.1.1.3	Action Step	Hydrology	Low in-stream flow should be addressed by increasing summer baseflows during the low rainfall seasons especially in reaches impacted by water diversions and by increasing riparian protection and restoration, erosion control, and employing best management practices that encourage permeability and infiltration.	2	20	CDFW, Gold Ridge RCD, Marin RCD, NMFS, NOAA RC, NRCS, Private Landowners	
EAmer-CCCS-3.1.1.4	Action Step	Hydrology	Work with recovery partners to ensure that patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	2	20	CDFW, Gold Ridge RCD, Marin RCD, Private Landowners, Sonoma County	
EAmer-CCCS-3.2	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**				
EAmer-CCCS-3.2.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
EAmer-CCCS-3.2.1.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	3	20	Marin County, Marin RCD, NPS, State Parks	
EAmer-CCCS-3.2.1.2	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	2	30	CDFW, DWR, Marin County, Marin RCD, NMFS, RWQCB, SWRCB	

Estero Americano, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
EAmer-CCCS-3.2.1.3	Action Step	Hydrology	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).	3	60	CA Coastal Commission, California Coastal Conservancy, CDFW, Farm Bureau, Gold Ridge RCD, Marin County, Marin RCD, NRCS, RWQCB, Sonoma County, SWRCB	
EAmer-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
EAmer-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
EAmer-CCCS-5.1.1.1	Action Step	Passage	Develop and implement plan to address fish passage barriers within Ebabias Creek.	2	10	CDFW, Gold Ridge RCD, NMFS, NOAA RC, Private Landowners	
EAmer-CCCS-5.1.1.2	Action Step	Passage	Develop and implement plan to address fish passage barriers within Estero Americano Creek.	2	10	California Coastal Conservancy, CDFW, Gold Ridge RCD, Marin RCD, NMFS, NRCS, Private Landowners	
EAmer-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
EAmer-CCCS-7.1.1	Recovery Action	Riparian	Improve riparian conditions				
EAmer-CCCS-7.1.1.1	Action Step	Riparian	Prioritize and fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream).	2	20	California Coastal Conservancy, CDFW, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, Private Landowners	
EAmer-CCCS-7.1.1.2	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 and other vegetation management to encourage the development of a denser more extensive riparian canopy.	3	10	California Coastal Conservancy, CDFW, Gold Ridge RCD, Marin RCD, NRCS, Private Landowners	
EAmer-CCCS-7.1.1.3	Action Step	Riparian	Locate water sources away from riparian areas.	2	20	California Coastal Conservancy, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, Private Landowners	
EAmer-CCCS-7.1.1.4	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers.	3	20	California Coastal Conservancy, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, Private Landowners	
EAmer-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
EAmer-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality				
EAmer-CCCS-8.1.1.1	Action Step	Sediment	Address high and medium priority sediment delivery sites	2	20	California Coastal Conservancy, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, State Parks	
EAmer-CCCS-8.1.1.2	Action Step	Sediment	Establish and/or maintain continuous native riparian buffers.	3	60	California Coastal Conservancy, CDFW, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, State Parks	
EAmer-CCCS-8.1.1.3	Action Step	Sediment	Fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream).	3	30	California Coastal Conservancy, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, Private Landowners	
EAmer-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				

Estero Americano, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
EAmer-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream water quality conditions				
EAmer-CCCS-10.1.1.1	Action Step	Water Quality	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004).	3	60	California Coastal Conservancy, Gold Ridge RCD, Marin County, Marin RCD, NRCS, Private Landowners, Sonoma County	
EAmer-CCCS-10.2	**Objective**	**Water Quality**	**Address the inadequacy of existing regulatory mechanisms.**				
EAmer-CCCS-10.2.1	Recovery Action	Water Quality	Improve stream water quality conditions				
EAmer-CCCS-10.2.1.1	Action Step	Water Quality	Evaluate and reduce nutrient and pathogen loading from upstream areas to minimize oxygen demand in lower Estero Americano Creek.	2	2	California Coastal Conservancy, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, Private Landowners	
EAmer-CCCS-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
EAmer-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
EAmer-CCCS-12.1.1.1	Action Step	Agriculture	Incentive programs and incentive-based approaches should be explored for landowners who conduct operations in a manner compatible with steelhead recovery requirements.	3	20	California Coastal Conservancy, CDFW, Gold Ridge RCD, Marin County, NCRWQB, NRCS, Private Landowners, SWRCB	
EAmer-CCCS-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.	3	20	California Coastal Conservancy, CDFW, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, Private Landowners, SWRCB	
EAmer-CCCS-12.1.1.3	Action Step	Agriculture	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	20	California Coastal Conservancy, CDFW, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, Private Landowners	
EAmer-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
EAmer-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
EAmer-CCCS-18.1.1.1	Action Step	Livestock	Continue to implement recommendations within The Estero Americano Watershed Management Plan (GRRCD 2007) and the Estero Americano Dairy Enhancement Program.	2	20	California Coastal Conservancy, Gold Ridge RCD, Marin RCD, NRCS, Private Landowners, SWRCB	
EAmer-CCCS-18.1.1.2	Action Step	Livestock	Incentive programs and incentive-based approaches should be explored for landowners who conduct operations in a manner compatible with steelhead recovery requirements.	3	20	California Coastal Conservancy, CDFW, Gold Ridge RCD, Marin County, NCRWQB, NRCS, Private Landowners, SWRCB	
EAmer-CCCS-18.1.1.3	Action Step	Livestock	Encourage and assist the NRCS and RCDs to increase the number of landowners participating in sediment reduction planning and implementation.	3	20	California Coastal Conservancy, CDFW, Gold Ridge RCD, Marin RCD, NCRWQB, NRCS, Private Landowners, SWRCB	
EAmer-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize impairment to the estuary (impaired quality and extent)				
EAmer-CCCS-18.1.2.1	Action Step	Livestock	Continue to implement recommendations within The Estero Americano Watershed Management Plan (GRRCD 2007).	3	20	California Coastal Conservancy, Gold Ridge RCD, Marin RCD, NRCS, Private Landowners	
EAmer-CCCS-18.1.3	Recovery Action	Livestock	Prevent or minimize impairment to instream habitat complexity (altered pool complexity and/or pool riffle ratio)				

Estero Americano, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
EAmer-CCCS-18.1.3.1	Action Step	Livestock	Continue to implement recommendations within The Estero Americano Watershed Management Plan (GRRCD 2007).	3	20	California Coastal Conservancy, Gold Ridge RCD, Marin RCD, Private Landowners, SWRCB	
EAmer-CCCS-24.1	**Objective**	**Severe Weather Patterns**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
EAmer-CCCS-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
EAmer-CCCS-24.1.1.1	Action Step	Severe Weather Patterns	Work with water users to minimize depletion of summer base flows.	3	20	CDFW, Gold Ridge RCD, Marin RCD, NCRWQB, Private Landowners, SWRCB	
EAmer-CCCS-24.2	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
EAmer-CCCS-24.2.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
EAmer-CCCS-24.2.1.1	Action Step	Severe Weather Patterns	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	3	60	CDFW, Marin County, Sonoma County, SWRCB	

Drakes Bay Tributaries, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
DrB-CCCS-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DrB-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria				
DrB-CCCS-11.1.1.1	Action Step	Viability	Conduct adult and juvenile monitoring to inform recovery criteria.	2	5	NPS	

Pine Gulch Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
PGC-CCCS-25.1	**Objective**	**Water Diversion/Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
PGC-CCCS-25.1.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
PGC-CCCS-25.1.1.1	Action Step	Water Diversion/Impoundment	Implement the Pine Gulch Creek Watershed Enhancement Project. The proposed project includes appropriation of water to storage during the winter season, controlled riparian diversion between April and July 1, and no diversion between July 1 and December 15 of each year.	2	20	Marin County, NMFS, NPS, Private Landowners, SWRCB	
PGC-CCCS-25.1.1.2	Action Step	Water Diversion/Impoundment	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	3	25	CDFW, NMFS, NPS, RWQCB	
PGC-CCCS-25.2	**Objective**	**Water Diversion/Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
PGC-CCCS-25.2.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to floodplain connectivity (impaired quality and extent)				
PGC-CCCS-25.2.1.1	Action Step	Water Diversion/Impoundment	Develop off channel water storage for farming operation within the watershed to increase summer pool habitat in the lower portion of the watershed.	2	30	California Coastal Conservancy, CDFW, Marin County, NPS, Private Landowners, State Water Resources Control Board	
PGC-CCCS-25.2.2	Recovery Action	Water Diversion/Impoundment	Prevent or minimize reduced density, abundance, and diversity				
PGC-CCCS-25.2.2.1	Action Step	Water Diversion/Impoundment	Adequately screen water diversions to prevent juvenile salmonid mortalities.	2	100	Marin County, NMFS, NPS, Private Landowners	

Redwood Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RedC-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-1.1.1	Recovery Action	Estuary	Improve the quality and extent of freshwater lagoon habitat				
RedC-CCCS-1.1.1.1	Action Step	Estuary	Enhance and restore estuary function by improving complex habitat features.	2	10	Marin County, NPS	
RedC-CCCS-1.1.1.2	Action Step	Estuary	Continue restoration efforts on Big Lagoon to benefit salmonids during all life stages and seasons.	2	10	NPS	
RedC-CCCS-1.1.1.3	Action Step	Estuary	Where appropriate, remove structures and/or modify practices which impair or reduce the historical tidal prism and/or estuarine function where feasible and where benefits to salmonids and/or the estuarine environment are predicted.	2	60	NPS	
RedC-CCCS-1.1.1.4	Action Step	Estuary	Support efforts of NPS to restore functional floodplain and lagoon habitat in the lower portion of the watershed.	2	60	Marin County, Marin RCD, NPS	
RedC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
RedC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	20	NPS	
RedC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	60	CDFW, Marin County, Marin RCD, NMFS, NPS	
RedC-CCCS-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	60	Marin County, Marin RCD, NPS	
RedC-CCCS-2.1.1.4	Action Step	Floodplain Connectivity	Identify potential sites for construction/restoration of alcoves, backwaters, etc. based on land use and geomorphic constraints.	2	60	Marin County, Marin RCD, NPS	
RedC-CCCS-2.1.1.5	Action Step	Floodplain Connectivity	Support efforts to remove levees on the Banducci property to create backwater and alcove habitat by having the county raise the lower section of Muir Woods road where it meets Highway One. Raising the road will address flooding and create vital off channel habitat in this section of creek. Coordinate with the NMFS and/or CDFW geomorphologist on design features and implementation techniques.	2	10	Marin County, NPS	
RedC-CCCS-2.1.1.6	Action Step	Floodplain Connectivity	Restore connectivity and enhance habitat in Green Gulch.	2	10	CDFW, NOAA RC, NPS, Private Landowners	
RedC-CCCS-2.1.1.7	Action Step	Floodplain Connectivity	Continue to monitor restored reaches in the “Bowling Alley” and “Upper Alley” sections to promote off channel habitat formation. Consult with NMFS and or CDFW geomorphologist before and during the design and implementation phase.	3	20	NPS	
RedC-CCCS-2.2	**Objective**	**Floodplain Connectivity**	**Address the inadequacy of existing regulatory mechanisms**				
RedC-CCCS-2.2.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
RedC-CCCS-2.2.1.1	Action Step	Floodplain Connectivity	Encourage landowners to restore historical floodplains or offchannel habitats through conservation easements, etc.	2	60	Marin County, NPS	
RedC-CCCS-2.2.1.2	Action Step	Floodplain Connectivity	Minimize urban development of any kind in existing areas with floodplains or off channel habitats	2	60	Marin County, NPS	
RedC-CCCS-2.2.1.3	Action Step	Floodplain Connectivity	Purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	60	CDFW, NMFS, NPS, USFWS	
RedC-CCCS-2.2.1.4	Action Step	Floodplain Connectivity	Evaluate, develop solutions and implement immediate needs to address problems resulting from channelization.	3	10	Marin County, Marin RCD, NPS	
RedC-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
RedC-CCCS-3.1.1.1	Action Step	Hydrology	Assess and map water diversions (CDFG 2004).	2	5	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-3.1.1.2	Action Step	Hydrology	Investigate channel incision effects on groundwater storage, streamflow and floodplain processes; prioritize, implement and monitor actions intended to reverse these processes.	2	5	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-3.1.1.3	Action Step	Hydrology	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	60	CDFW, DWR, NPS, RWQCB, State Parks, SWRCB	

Redwood Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RedC-CCCS-3.2	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**				
RedC-CCCS-3.2.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
RedC-CCCS-3.2.1.1	Action Step	Hydrology	Maintain water operations agreements between NPS, CDFW, and MBCSD to operate in a manner that does not alter summer surface flow	2	60	CDFW, MBCSD, NPS, State Parks	
RedC-CCCS-3.2.1.2	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-3.2.1.3	Action Step	Hydrology	Promote conjunctive use of water with water projects whenever possible to maintain or restore salmonid habitat.	2	60	Marin County, Marin RCD, NPS, NRCS, State Parks	
RedC-CCCS-3.2.1.4	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	2	30	CDFW, DWR, Marin County, Marin RCD, NMFS, NPS, RWQCB, SWRCB	
RedC-CCCS-3.2.1.5	Action Step	Hydrology	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of salmonids and their habitats, and avoidance of adverse impacts caused by water diversion.	3	60	CA Coastal Commission, CDFW, DWR, Farm Bureau, Marin County, Marin RCD, NPS, RWQCB, State Parks, SWRCB	
RedC-CCCS-3.2.2	Recovery Action	Hydrology	Improve passage flows				
RedC-CCCS-3.2.2.1	Action Step	Hydrology	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	2	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-3.2.2.2	Action Step	Hydrology	Evaluate requests for on-stream dams above salmonid migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream.	3	60	CDFW, DWR, NMFS, NPS, RWQCB, SWRCB	
RedC-CCCS-3.2.2.3	Action Step	Hydrology	Encourage use of the most recent update of NMFS' Water Diversion Guidelines.	3	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency (BFW 0-10 meters)				
RedC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Incorporate large woody material into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	3	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-6.1.1.2	Action Step	Habitat Complexity	Place unsecured LWD in the stream and monitor how it is distributed in the watershed.	2	10	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-6.1.1.3	Action Step	Habitat Complexity	Install properly sized large woody debris to appropriate viability table targets.	2	20	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-6.1.1.4	Action Step	Habitat Complexity	Assess and prioritize restoration of channelized sections to enhance pool depths in Redwood Creek through Muir Woods while maintaining the historic resource to the greatest degree possible.	2	10	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD and shelters				
RedC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Evaluate the potential and specific locations (e.g. State and Federal lands) for the re-location and re-introduction of beaver populations	2	10	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter				
RedC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase shelters in 75% of streams across the watershed to improve conditions for adults, and winter/summer rearing juveniles	2	20	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-6.2	**Objective**	**Habitat Complexity**	**Address the inadequacy of existing regulatory mechanisms**				
RedC-CCCS-6.2.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD and shelters				
RedC-CCCS-6.2.1.1	Action Step	Habitat Complexity	Educate landowners, land managers, and County and municipal staffs on the importance of LWD to salmonid survival and recovery and watershed processes.	3	20	Marin County, Marin RCD, NPS, Private Landowners, State Parks	
RedC-CCCS-6.2.1.2	Action Step	Habitat Complexity	Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody debris.	3	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-6.2.1.3	Action Step	Habitat Complexity	Fully implement the Programmatic Section 7 consultation for restoration projects administered by the NOAA Restoration Center that permits placement of instream large woody debris.	3	60	Marin County, Marin RCD, NMFS, NOAA RC, NPS, State Parks	

Redwood Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RedC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover				
RedC-CCCS-7.1.1.1	Action Step	Riparian	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (CDFG 2004).	3	20	NPS, State Parks	
RedC-CCCS-7.1.1.2	Action Step	Riparian	Fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream).	2	20	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-7.1.1.3	Action Step	Riparian	Locate water sources away from riparian areas.	2	60	Marin County, NPS, State Parks	
RedC-CCCS-7.1.1.4	Action Step	Riparian	Plant native vegetation to promote streamside shade.	3	20	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-7.1.1.5	Action Step	Riparian	Promote bio-engineering solutions as appropriate (e.g. where critical infrastructure is located) for bank hardening projects.	3	60	CDFW, Marin County, Marin RCD, NMFS, NPS, State Parks	
RedC-CCCS-7.1.2	Recovery Action	Riparian	Improve tree diameter				
RedC-CCCS-7.1.2.1	Action Step	Riparian	Increase tree diameter within 55% of watershed to achieve optimal riparian forest conditions (55 - 69% Class 5 & 6 tree)	2	30	Marin County, MMWD, NPS	
RedC-CCCS-7.1.2.2	Action Step	Riparian	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other salmonid needs.	2	20	Marin County, MMWD, NPS	
RedC-CCCS-7.1.2.3	Action Step	Riparian	Encourage programs to purchase land/conservation easements to re-establish and enhance natural riparian communities.	2	10	Marin RCD, MMWD, NPS	
RedC-CCCS-7.2	**Objective**	**Riparian**	**Address the inadequacy of existing regulatory mechanisms**				
RedC-CCCS-7.2.1	Recovery Action	Riparian	Improve riparian conditions				
RedC-CCCS-7.2.1.1	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004).	3	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-7.2.1.2	Action Step	Riparian	Review and develop preferred protocols for Pierce's Disease Control that would maintain a native riparian corridor and develop an outreach program (CDFG 2004).	3	60	Marin County, NPS, State Parks	
RedC-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality				
RedC-CCCS-8.1.1.1	Action Step	Sediment	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.	2	5	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-8.1.1.2	Action Step	Sediment	Address high and medium priority sediment delivery sites	2	20	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-8.1.1.3	Action Step	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (CDFG 2004).	2	10	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-8.1.1.4	Action Step	Sediment	Establish and/or maintain continuous native riparian buffers.	3	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-8.1.1.5	Action Step	Sediment	Fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream).	3	30	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-8.2	**Objective**	**Sediment**	**Address the inadequacy of existing regulatory mechanisms**				
RedC-CCCS-8.2.1	Recovery Action	Sediment	Improve instream gravel quality				
RedC-CCCS-8.2.1.1	Action Step	Sediment	Limit winter use of unsurfaced roads and recreational trails by unauthorized vehicles to decrease fine sediment loads.	3	60	Marin County, NPS, State Parks	
RedC-CCCS-8.2.1.2	Action Step	Sediment	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	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				

Redwood Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RedC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream water quality conditions				
RedC-CCCS-10.1.1.1	Action Step	Water Quality	Conduct conifer release to promote growth of larger diameter trees where appropriate.	3	10	NPS, State Parks	
RedC-CCCS-10.1.1.2	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.	2	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-10.1.1.3	Action Step	Water Quality	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004).	3	60	Marin County, NPS, State Parks	
RedC-CCCS-10.2	**Objective**	**Water Quality**	**Address the inadequacy of existing regulatory mechanisms**				
RedC-CCCS-10.2.1	Recovery Action	Water Quality	Improve stream water quality conditions				
RedC-CCCS-10.2.1.1	Action Step	Water Quality	Evaluate and reduce nutrient and pathogen loading from upstream areas to minimize oxygen demand in lower Redwood Creek.	2	2	NPS	
RedC-CCCS-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure and diversity				
RedC-CCCS-11.1.1.1	Action Step	Viability	Conduct upslope watershed assessments to define limiting factors. Encourage all major landowners to participate	2	20	CDFW, NPS	
RedC-CCCS-11.1.1.2	Action Step	Viability	Conduct an instream habitat assessment to develop restoration recommendations	2	60	NPS	
RedC-CCCS-11.1.1.3	Action Step	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.	2	10	CDFW, MMWD, NMFS, NPS	
RedC-CCCS-11.1.1.4	Action Step	Viability	Continue to rescue juvenile salmonids with existing permittees that are under an imminent risk of stranding and mortality and relocate to suitable habitat when deemed appropriate by NMFS and CDFW	2	10	CDFW, MMWD, NMFS, NPS	
RedC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment of floodplain connectivity (impaired quality and extent)				
RedC-CCCS-13.1.1.1	Action Step	Channel Modification	Conduct education with public works staff in this area relative to Fishnet 4C Roads Manual or a more recent manual.	2	20	NPS	
RedC-CCCS-13.1.1.2	Action Step	Channel Modification	Where feasible, remove obsolete bank stabilization structures from the channel which contribute to channel incision and reduced habitat complexity.	3	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-13.1.1.3	Action Step	Channel Modification	Minimize additional channel modification or utilize BMP's to address flood control or bank stabilization issue	3	60	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-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. Identify and target remediation of watershed process disruption as an overall priority.	3	20	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-13.1.1.5	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. except where critical infrastructure is located) for bank hardening projects.	3	20	Marin County, NPS	
RedC-CCCS-13.1.1.6	Action Step	Channel Modification	Restore habitat complexity in modified channel areas	2	10	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-15.1	**Objective**	**Fire/Fuel Management**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-15.1.1	Recovery Action	Fire/Fuel Management	Prevent or minimize adverse alterations to riparian species composition and structure				
RedC-CCCS-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	60	NPS, State Parks	
RedC-CCCS-15.1.1.2	Action Step	Fire/Fuel Management	Conduct fuel load monitoring and compare the results to estimated historical fuel loads.	3	10	NPS, State Parks	
RedC-CCCS-15.1.2	Recovery Action	Fire/Fuel Management	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
RedC-CCCS-15.1.2.1	Action Step	Fire/Fuel Management	Avoid use of aerial fire retardants and foams within 300 feet of riparian areas.	2	50	NPS, State Parks	
RedC-CCCS-15.1.2.2	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	NPS, State Parks	

Redwood Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RedC-CCCS-21.1	**Objective**	**Recreation**	**Address the present of threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-21.1.1	Recovery Action	Recreation	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
RedC-CCCS-21.1.1.1	Action Step	Recreation	Evaluate trail crossings to ensure bridges are constructed to support horses.	2	50	NPS, State Parks	
RedC-CCCS-21.1.1.2	Action Step	Recreation	Eliminate horse access to creeks for watering or as fords.	2	20	NPS, State Parks	
RedC-CCCS-21.1.1.3	Action Step	Recreation	Increase education to the equestrian community regarding impacts to riparian and instream habitat from horse manure and hooves.	3	10	NPS, State Parks	
RedC-CCCS-21.1.1.4	Action Step	Recreation	Recreational trails should be set back from the creek and built to reduce erosion and minimize stream crossings.	2	50	NPS, State Parks	
RedC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
RedC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Re-evaluate high and high-moderate priority treatment recommendations for roads from the PWA assessment and implement recommended treatments if they are still relevant. If not, reassess and make new recommendations for treatment. Urge and support decommissioning when feasible.	2	10	NPS, State Parks, MMWD	
RedC-CCCS-23.1.1.2	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	50	NPS, State Parks, MMWD	
RedC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
RedC-CCCS-23.1.2.1	Action Step	Roads/Railroads	NMFS and other stakeholders will work with RCD or NRCS to encourage hiring of consultants to conduct road assessments.	2	50	NPS, State Parks, MMWD, NMFS, RCD, NRCS	
RedC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Address sediment sources from road networks and other actions that deliver sediment to stream channels.	2	50	NPS, State Parks, MMWD, NMFS, RCD	
RedC-CCCS-23.1.2.3	Action Step	Roads/Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats.	3	10	NPS, State Parks, MMWD	
RedC-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize impairment to the estuary (impaired quality and extent)				
RedC-CCCS-23.1.3.1	Action Step	Roads/Railroads	Support efforts to remove levees on the Banducci property to create backwater and alcove habitat by having the county raise the lower section of Muir Woods road where it meets Highway One. Raising the road will address flooding and create vital off channel habitat in this section of creek. Coordinate with the NMFS and/or CDFW geomorphologist on design features and implementation techniques.	2	30	NPS	
RedC-CCCS-23.1.3.2	Action Step	Roads/Railroads	Remove levees along Pacific Way. Address issues with culverts, road network, and development within the Big Lagoon Area.	2	10	NPS	
RedC-CCCS-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
RedC-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
RedC-CCCS-23.2.1.1	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	NPS	
RedC-CCCS-24.1	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**				
RedC-CCCS-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)				
RedC-CCCS-24.1.1.1	Action Step	Severe Weather Patterns	Work with NPS and State Parks on emergency drought operations and contingency plans (i.e. fish rescues etc.)	2	60	Marin County, Marin RCD, NPS, State Parks	

Redwood Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
RedC-CCCS-24.1.1.2	Action Step	Severe Weather Patterns	Work with CDFW, County and knowledgeable biologists to develop drought emergency rules that consider the life history requirements of salmonids and adopt implementation agreements regarding contingency efforts.	3	100	Marin County, Marin RCD, NPS, State Parks	
RedC-CCCS-24.1.1.3	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, which will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.	2	60	CDFW, DWR, Marin County, Marin RCD, NPS, RWQCB, State Parks, SWRCB	
RedC-CCCS-24.1.1.4	Action Step	Severe Weather Patterns	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	3	60	Marin County, Marin RCD, NPS, State Parks, SWRCB	
RedC-CCCS-25.1	**Objective**	**Water Diversion/Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
RedC-CCCS-25.1.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
RedC-CCCS-25.1.1.1	Action Step	Water Diversion/Impoundment	Work with the Muir Beach CSD and Green Gulch farm to eliminate water diversions that affect flow within Redwood Creek.	2	20	Muir Beach CSD, Green Gulch Farm	
RedC-CCCS-25.1.2	Recovery Action	Water Diversion/Impoundment	Prevent or minimize reduced density, abundance, and diversity				
RedC-CCCS-25.1.2.1	Action Step	Water Diversion/Impoundment	Adequately screen water diversions to prevent juvenile salmonid mortalities.	2	100	NMFS, Private Landowners, NPS, State Parks, MMWD	
RedC-CCCS-25.2	**Objective**	**Water Diversion/Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
RedC-CCCS-25.2.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
RedC-CCCS-25.2.1.1	Action Step	Water Diversion/Impoundment	Support SWRCB in regulating the use of streamside wells and groundwater.	3	100	NMFS, NPS, SWRCB	
RedC-CCCS-25.2.1.2	Action Step	Water Diversion/Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of salmonids and their habitats, and avoidance of adverse impacts caused by water diversion (CDFG 2004).	3	100	NMFS, Private Landowners, NPS, State Parks, MMWD	
RedC-CCCS-25.2.1.3	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.	3	100	CDFW, Marin County, NMFS, NMFS OLE, NPS, SWRCB	

CCC Steelhead DPS Rapid Assessment Profile: North Coastal Diversity Stratum Populations

Porter Creek

- Role within DPS: Dependent Population
- Spawner Abundance Target: 60-122 adults
- Current Intrinsic Potential: 10.3 IP-km

Hulbert Creek

- Role within DPS: Dependent Population
- Spawner Abundance Target: 59-120 adults
- Current Intrinsic Potential: 10.2 IP-km

Dutch Bill Creek

- Role within DPS: Dependent Population
- Spawner Abundance Target: 77-156 adults
- Current Intrinsic Potential: 13.2 IP-km

Freezeout Creek

- Role within DPS: Dependent Population
- Spawner Abundance Target: 6-14 adults
- Current Intrinsic Potential: 1.3 IP-km

Sheephouse Creek

- Role within DPS: Dependent Population
- Spawner Abundance Target: 21-44 adults
- Current Intrinsic Potential: 3.8 IP-km

Willow Creek

- Role within DPS: Dependent Population
- Spawner Abundance Target: 46-94 adults
- Current Intrinsic Potential: 8.0 IP-km

Abundance and Distribution

Steelhead are present in fair numbers and are widely distributed throughout anadromous stream reaches and the smaller tributaries in these watersheds. Baseline habitat surveys were conducted by CDFG between 1994 and 1997 that documented the presence and distribution of juvenile and

adult steelhead, but did not provide quantifiable estimates (Coey *et al.* 2002). From 2005 to 2012, UCCE has operated downstream migrant traps in Dutch Bill (2010-2012 5-50 smolts), Sheephouse (2005-2008 3-18 smolts) and Willow Creeks for the purposes of quantifying conservation hatchery program coho, and have incidentally captured steelhead during a portion of the migration (Coey *et al.* 2002). Spawner surveys were conducted in several years, which documented low numbers of adult steelhead in Sheephouse (1) and Ducthbill Creeks (5).

History of Land Use

The lower Russian River populations have had an active land use history, with timber harvest occurring from the late 1800s through the turn of the century, and again after World War II migration (Coey *et al.* 2002). Timber railways were converted to carry vacationers and weekend travelers who constructed vacation homes in popular destinations throughout the Lower Russian River from Rio Nido to Duncan's Mills migration (Coey *et al.* 2002). By the 1930s, logging roads and residences had been converted to residential roads and vacation homes to capitalize on Russian River recreation and fishing opportunities migration (Coey *et al.* 2002).

Current Resources and Land Management

The bottomlands of Freezeout and Willow Creeks, which were cleared for grazing operations, still exist today, though much of Willow Creek is now in State Park ownership. Hulbert and Porter Creek watersheds have fairly low acreage in rural residential development, while Dutch Bill Creek watershed has fairly high with numerous riparian and upslope roads. Lower Porter Creek holds substantial vineyard development.

Conditions

The following discussion focuses on those conditions that were rated as Fair, as no conditions were rated as Poor in the assessment process (North Coastal Diversity Stratum Rapid Assessment Stresses Results). The lack of habitat complexity in the form of wood or other shelter components and high levels of instream sediment are rated as Fair for their effects on the juvenile and egg life stages in all streams within the Diversity Stratum. Stream temperatures and summer flows are impaired for juveniles in both Porter and Dutch Bill Creeks, reducing smolt recruitment. Impaired passage was rated as moderate in Dutch Bill for adults, and in Willow Creek for both smolts and adults. Low floodplain connectivity hampers adult migration and limits winter juvenile refugia in the lower portions of Willow, Dutch Bill, Porter and Hulbert Creeks. Summer flows and water quality for summer and winter rearing juveniles are a concern in Dutch Bill, Porter and Freezeout Creeks. Please see the Russian River Overview for a complete discussion on the Russian River Estuary.

Threats

The following discussion focuses on those threats that were rated as a High (North Coastal Diversity Stratum Rapid Assessment Threats Results). Recovery strategies will focus on ameliorating primary threats; however, some strategies may address other threat categories when the strategy is essential to recovery efforts.

Agriculture

Historic vegetation clearing and stream channelization have occurred in lower Porter and lower Willow Creeks, altering the riparian composition and structure and reducing shelter values for quality juvenile rearing. While agricultural development has ceased in Willow Creek due to acquisition by State Parks, grape growing is the primary land use in the floodplain of lower Porter Creek. The thin buffer width and adjacent management limits expansion of the riparian corridor and, along with the lack of an adjacent upland forest, impair stream temperatures.

Channel Modification

Channel straightening and bank stabilization in Porter and Dutch Bill creeks have led to channel incision, limiting the natural meandering required to foster habitat diversity and complexity. In Willow Creek, levee construction and channel straightening have led to channel aggradation which is aggravated by a high source of upslope sediment loading. Consequently, pool depths and shelter values are low in these streams, compromising both summer and winter lifestage rearing.

Livestock Farming and Ranching

Upslope runoff and resultant turbidity arise from cattle operations in Freezeout and Willow Creeks and continue to alter and/or limit the riparian zone. Bank stability and erosion are high where cattle have direct access to the stream.

Logging and Wood Harvesting

Historical timber harvest removed much of the mature trees, limiting the potential for eventual large wood recruitment in all stream within the Diversity Stratum (DS), with the exception of Willow Creek. High shelter values exist in Willow Creek, though pool development and depth are hampered by high sediment loading.

Residential and Commercial Development

Streamside and upslope residential development with associated urban runoff is high in Dutch Bill Creek. Consequently, habitat diversity and complexity are lower than the historic potential.

The potential for future development to reduce habitat quality in Hulbert, Porter, and Freezeout Creek is high if large parcels were to be split and current land use subject to change.

Roads and Railroads

High levels of instream sediment from roads are having a Medium effect on the juvenile and egg life stages respectively in all streams within the DS. While road upgrades have been planned or implemented in most watersheds of the DS, roads remain a major threat to Dutch Bill, Hulbert and Willow Creeks. Levees associated with bridge crossings in Willow Creek in particular limit the ability of the channel to process legacy sediments associated with historic logging and upslope livestock grazing (Prunuske Chatham Inc 2004). Road crossings limit adult passage to tributaries of Dutch Bill Creek.

Water Diversion and Impoundments

Water diversions and impoundments were rated High in Dutch Bill Creek, where numerous riparian diverters and appropriated storage tanks and dams exist. Current efforts by Goldridge RCD and other partners are addressing solutions to conflicts with needed fish flows. Porter Creek watershed has a large dam, though recently landowners have collaborated with resource agencies to release flows during critical summer months to provide cooler water for rearing juvenile salmonids.

Limiting Conditions, Life Stages, and Habitats

The highest condition-threat rated interactions occur due to the effects of channel modification on floodplain connectivity and residential development and associated water development on water quality and hydrology. The highest impacts are in Willow, Porter and Dutch Bill Creeks. Moderate condition-threat interactions also occur with livestock management (Freezeout and Willow Creeks), legacy effects of timber harvest (Willow, Hulbert and Porter Creeks), and road development (all streams). Lifestages most threatened are summer and winter rearing juveniles. Habitats most threatened include riparian corridors and adjacent floodplain, and water quality and flow.

General Recovery Strategy

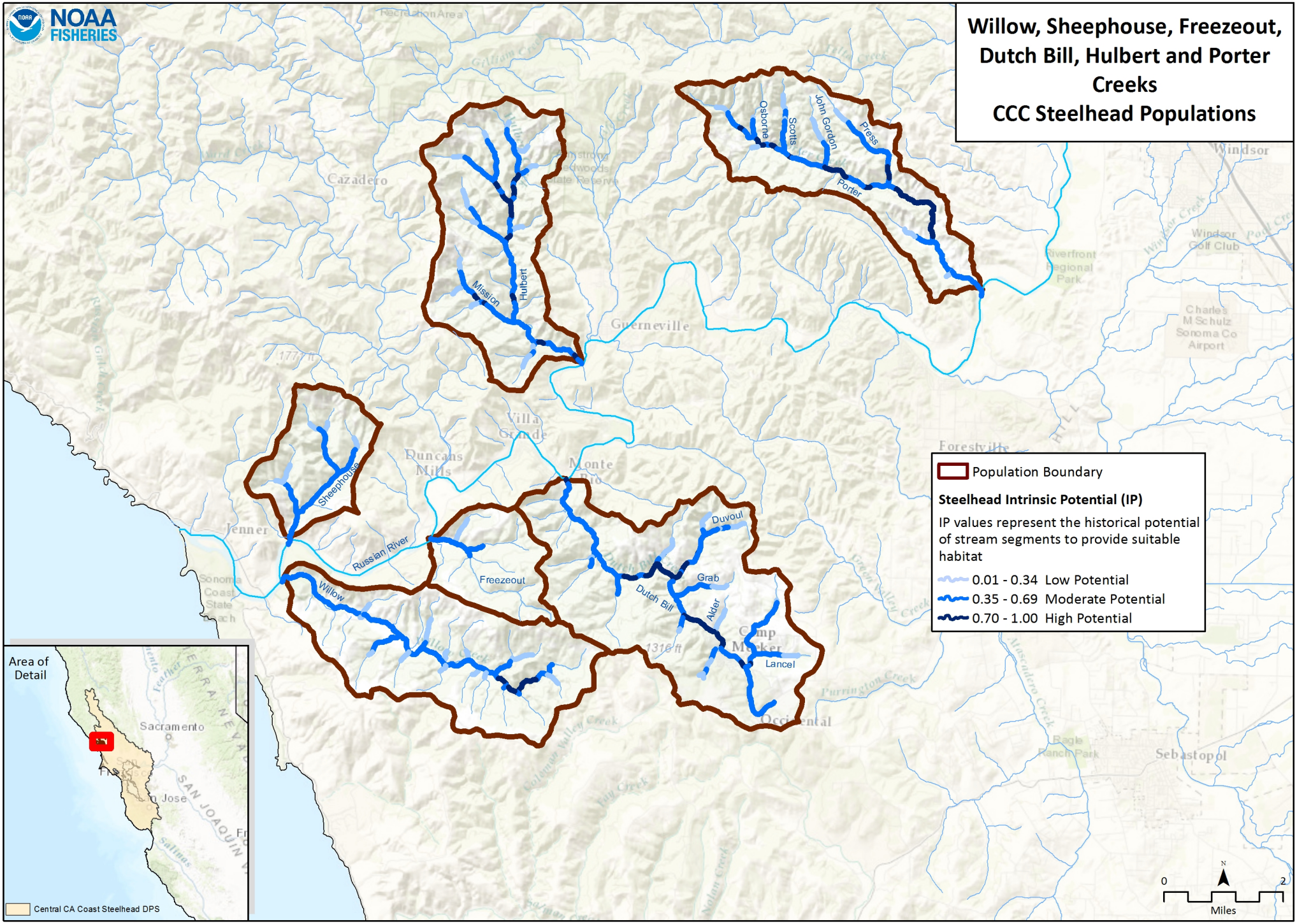
In general, recovery strategies focus on improving conditions and ameliorating conditions and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. The general recovery strategies for the populations in this Stratum are discussed below with more detailed and site-specific recovery actions provided in North Coastal Diversity Stratum Rapid Assessment Recovery Actions.

Recovery strategies for this DS will focus on ameliorating the effects of channel modification on floodplain connectivity through the development of restoration projects that reconnect the stream with the adjacent floodplain, and improve migration for adult and smolt salmonids. Efforts to restore habitat complexity, increase riparian areas, and reduce sediment are also recommended in specific streams and reaches to improve juvenile summer and winter rearing habitat. BMPs are recommended to mitigate ongoing effects from residential development and associated water diversions on water quality and hydrology, and to reduce impacts from livestock and existing roads on riparian and spawning habitats.

Literature Cited

Coey, R., S. Nassaman-Pearce, C. Brooks, and Z. Young. 2002. California Department of Fish and Game 2002 Draft Russian River Basin Fisheries Restoration Plan. California Department of Fish and Game,.

Prunuske Chatham Inc. 2004. Sustainable Channel Development in Lower Willow Creek, Sonoma County, California. Prepared for Stewards of the Coast and Redwoods. Prunuske Chatham, Inc. Occidental, California. March 15, 2005. 25pp.



Coastal Multispecies Recovery Plan
Vol. IV, Central California Coast Steelhead

Rapid Assessment
North Coastal Diversity Stratum
Lower Russian River Tributaries

CCC Steelhead DPS: North Coastal Stratum: Russian River (Willow/Sheephouse/Freezeout/Hulbert/Porter/Dutchbill)

Habitat & Population Condition Scores By Life Stage: VG = Very Good G = Good F = Fair P = Poor		Steelhead Life History Stages				
		Adults	Eggs	Summer-Rearing Juveniles	Winter-Rearing Juveniles	Smolts
Stresses: Key Attribute: Indicators	Riparian Vegetation: Composition, Cover & Tree Diameter			G	G	
	Estuary: Quality & Extent					
	Velocity Refuge: Floodplain Connectivity	F			F	G
	Hydrology: Redd Scour		G			
	Hydrology: Baseflow & Passage Flows	G	VG	F		G
	Passage/Migration: Mouth or Confluence & Physical Barriers	F		G	G	F
	Habitat Complexity: Percent Primary Pools & Pool/Riffle/Flatwater Ratios	G		G	G	
	Habitat Complexity: Large Wood & Shelter	G		F	F	G
	Sediment: Gravel Quality & Distribution of Spawning Gravels	VG	F	F	G	
	Viability: Density, Abundance & Spatial Structure	G		G		G
	Water Quality: Temperature			F		VG
	Water Quality: Turbidity & Toxicity	VG		F	VG	VG

CCC Steelhead DPS: North Coastal Stratum: Russian River (Willow/Sheephouse/Freezeout/Hulbert/Porter/Dutchbill)

Threat Scores
L: Low
M: Medium
H: High

Threats - Sources of Stress	Stresses											
	Altered Riparian Species: Composition & Structure	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 Complexity and/or Pool/Riffle Ratio	Instream Habitat Complexity: Reduced Large Wood and/or Shelter	Instream Substrate/Food Productivity: Impaired Gravel Quality & Quantity	Reduced Density, Abundance & Diversity	Water Quality: Impaired Instream Temperatures	Water Quality: Increased Turbidity or Toxicity
Agriculture	M	L	L	L		L	L	M	L		M	L
Channel Modification	L	L	H	L	L	L	L	M	M		M	L
Disease, Predation, and Competition	L	L	L			L	L	L		L	L	L
Fire, Fuel Management, and Fire Suppression	L	L	L	L		L	L	L	L		L	M
Livestock Farming and Ranching	M	L	L	L		L	L	L	M		M	M
Logging and Wood Harvesting	M	L	L	L		L	L	M	L		M	L
Mining	L	L	M	L		L	L	L	L		L	L
Recreational Areas and Activities	L	L	L	L		L	L	L	L		L	L
Residential and Commercial Development	M	L	M	L		L	L	L	L		M	H
Roads and Railroads	L	L	L	L		M	L	L	M		L	M
Severe Weather Patterns	L	L	L	L	M	L	L	L	L		L	L
Water Diversions and Impoundments	L	L	L	L	H	L	L	L	L	L	L	L
Fishing and Collecting										L		
Hatcheries and Aquaculture										L	L	L

Porter Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
PortC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
PortC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
PortC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches.	2	10	Farm Bureau, NMFS, Public Works, RCD	
PortC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target winter and summer rearing habitat for juvenile steelhead. Improve conditions to re-create, and restore alcove, backwater, or perennial pond habitats in lower areas where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats.	2	20	NMFS, Private Landowners, Public Works, RCD, Sonoma County	
PortC-CCCS-2.1.2	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
PortC-CCCS-2.1.2.1	Action Step	Floodplain Connectivity	Add or incorporate features to enhance winter habitat refugia to existing and new habitat projects	2	10	Farm Bureau, Private Landowners, Public Works, RCD, Sonoma County	
PortC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
PortC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
PortC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in all reaches of the watershed to improve conditions for adults, and winter/summer rearing juveniles.	2	10	CDFW, NOAA RC, Private Landowners, State Parks, Trout Unlimited	
PortC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools				
PortC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase primary pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order stream reaches; >3 feet in third order or larger stream reaches)) in Reaches 4-7 within the watershed to improve conditions for adults, and summer/winter juveniles.	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
PortC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Increase pool/riffle/flatwater ratio (hydraulic diversity)				
PortC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase riffle frequency to 20% by converting flatwater habitats (glides, runs, etc.) utilizing boulders and log structures in Reaches within the watershed.	2	5	CDFW, NOAA RC, Private Landowners, RCD, Trout Unlimited	
PortC-CCCS-6.1.4	Recovery Action	Habitat Complexity	Increase shelter				
PortC-CCCS-6.1.4.1	Action Step	Habitat Complexity	Increase shelters to optimal conditions (>80 pool shelter value) in all reaches	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
PortC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
PortC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover				
PortC-CCCS-7.1.1.1	Action Step	Riparian	Improve canopy to 80% by planting riparian and coniferous species within Reaches 1, 3, 4 and 7 to provide shade, large woody debris input, nutrient input, and bank stabilization.	2	10	CDFW, NOAA RC, Private Landowners, RCD	
PortC-CCCS-7.1.1.2	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers throughout the watershed (CDFG 2004).	2	25	City Planning, Land Trusts, Sonoma County	
PortC-CCCS-7.1.2	Recovery Action	Riparian	Improve tree diameter				
PortC-CCCS-7.1.2.1	Action Step	Riparian	Increase tree diameter within 40% of watershed to achieve optimal riparian forest conditions (55 - 69% Class 5 & 6 tree). Plant native riparian species and native conifers/hardwoods throughout riparian zones within the watershed to increase overall tree diameter.	3	20	CDFW, NOAA RC, Private Landowners, RCD	
PortC-CCCS-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
PortC-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				

Porter Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
PortC-CCCS-12.1.1.1	Action Step	Agriculture	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels (see Roads for specific actions/areas).	2	10	CDFW, Private Landowners, RCD	
PortC-CCCS-12.1.1.2	Action Step	Agriculture	Implement Best Management Practices such as those in the Fish Friendly Farming program (California Land Stewardship Institute), or other cooperative conservation programs.	3	25	NRCS, Private Landowners, RCD	
PortC-CCCS-12.1.1.3	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	
PortC-CCCS-12.1.1.4	Action Step	Agriculture	Complete Farm Conservation Plans (through the SRCD, 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	
PortC-CCCS-12.1.1.5	Action Step	Agriculture	Assess the effectiveness of erosion control measures throughout the winter period.	3	20	CDFW, NMFS, NRCS, Private Landowners, RCD	
PortC-CCCS-12.1.1.6	Action Step	Agriculture	Continue the use of cover crops in agriculture fields.	3	25	CDFW, NMFS, NRCS, Private Landowners, RCD	
PortC-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure				
PortC-CCCS-12.1.2.1	Action Step	Agriculture	Implement programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	20	Land Trusts, Sonoma County	
PortC-CCCS-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
PortC-CCCS-12.1.3.1	Action Step	Agriculture	Add large woody debris to reach optimal frequencies.	2	10	CDFW, Private Landowners, RCD	
PortC-CCCS-12.1.3.2	Action Step	Agriculture	Avoid the removal of large wood and other shelter components from the stream system.	3	50	NRCS, Private Landowners, RCD	
PortC-CCCS-12.1.4	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (impaired stream temperature)				
PortC-CCCS-12.1.4.1	Action Step	Agriculture	Re-establish native plant communities in riparian zones to increase stream canopy to 80%.	2	20	CDFW, Private Landowners, RCD, UC Extension	
PortC-CCCS-12.1.5	Recovery Action	Agriculture	Prevent or minimize impairment to stream hydrology (impaired water flow)				
PortC-CCCS-12.1.5.1	Action Step	Agriculture	Promote off-channel storage to reduce impacts of water diversion during the spring and summer (e.g. diversion during winter high flow).	2	20	NRCS, Private Landowners, RCD, UC Extension	
PortC-CCCS-12.1.5.2	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.	3	25	NRCS, Private Landowners, RCD	
PortC-CCCS-12.2	**Objective**	**Agriculture**	**Address the inadequacy of existing regulatory mechanisms**				
PortC-CCCS-12.2.1	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
PortC-CCCS-12.2.1.1	Action Step	Agriculture	Develop legislation that will fund county planning for environmentally sound agricultural growth and water supply.	2	10	Farm Bureau, NRCS, Sonoma County, UC Extension	
PortC-CCCS-12.2.1.2	Action Step	Agriculture	Coordinate with the agencies that authorize forest land conversions to discourage conversions to agriculture.	3	25	Board of Forestry, CDFW, Sonoma County	
PortC-CCCS-12.2.1.3	Action Step	Agriculture	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do.	3	20	City Planning, RWQCB, Sonoma County	
PortC-CCCS-12.2.1.4	Action Step	Agriculture	Increase setbacks of existing agricultural activities from the top of bank to 100'.	3	25	City Planning, NRCS, RCD, Sonoma County	
PortC-CCCS-12.2.1.5	Action Step	Agriculture	Streamline permit processing where landowners are conducting actions aligned with recovery priorities.	3	5	CDFW, NMFS, NRCS, RCD, SWRCB, USACE	
PortC-CCCS-12.2.1.6	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	
PortC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				

Porter Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
PortC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment of floodplain connectivity (impaired quality and extent)				
PortC-CCCS-13.1.1.1	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	FEMA, Sonoma County, USACE	
PortC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration				
PortC-CCCS-13.1.2.1	Action Step	Channel Modification	Ensure that all future and existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	3	50	NMFS, USACE	
PortC-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize increased landscape disturbance				
PortC-CCCS-13.1.3.1	Action Step	Channel Modification	All proposed flood control projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.	3	25	NMFS, Sonoma County, USACE	
PortC-CCCS-13.1.3.2	Action Step	Channel Modification	Channel modifying projects should be designed to ensure potential effects to CCC steelhead habitat are fully minimized or mitigated, and where possible, existing poor conditions should be remediated.	3	20	NMFS, USACE	
PortC-CCCS-13.1.3.3	Action Step	Channel Modification	Evaluate design alternatives to riprap bank repairs. Where riprap is necessary, evaluate integration of other habitat-forming features – including large woody debris to ensure improved habitat at the restoration site.	3	30	CDFW, NMFS, USACE	
PortC-CCCS-13.1.3.4	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. carefully evaluate feasibility where critical infrastructure is located) for bank hardening projects.	2	25	CDFW, NMFS, USACE	
PortC-CCCS-13.2	**Objective**	**Channel Modification**	**Address the inadequacy of existing regulatory mechanisms**				
PortC-CCCS-13.2.1	Recovery Action	Channel Modification	Prevent or minimize increased landscape disturbance				
PortC-CCCS-13.2.1.1	Action Step	Channel Modification	Modify city and county regulatory and planning processes to minimize new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historical CCC steelhead watersheds.	3	10	City Planning, Sonoma County, USACE	
PortC-CCCS-13.2.1.2	Action Step	Channel Modification	Local agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	3	50	City Planning, Sonoma County	
PortC-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
PortC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
PortC-CCCS-18.1.1.1	Action Step	Livestock	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take first priority for riparian fencing programs over steer operations.	2	60	CDFW, NOAA RC, NRCS, RCD	
PortC-CCCS-18.1.1.2	Action Step	Livestock	Encourage develop and fund riparian restoration projects to regain riparian corridors damaged from livestock and other causes.	2	30	NRCS, RCD	
PortC-CCCS-18.1.1.3	Action Step	Livestock	Substitute continuous season-long use of pastures in favor of rotational grazing strategies to reduce runoff. Short term, seasonal and long term rest from grazing in overgrazed areas would improve soil conditions for native revegetation and land values as well.	3	60	NRCS, RCD, Private Landowners	
PortC-CCCS-18.1.1.4	Action Step	Livestock	Manage rotational grazing to aid in the reduction of noxious weeds.	3	60	NRCS, RCD, Private Landowners	
PortC-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize impairment to water quality (e.g. turbidity, suspended sediment and/or toxicity)				
PortC-CCCS-18.1.2.1	Action Step	Livestock	Aid landowners willing to fence off riparian areas with development of offstream alternative water sources.	2	30	CDFW, NOAA RC, NRCS, RCD	
PortC-CCCS-18.1.2.2	Action Step	Livestock	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	60	NRCS, RCD, Private Landowners	
PortC-CCCS-18.1.2.3	Action Step	Livestock	To minimize gully initiation, grazing should be kept at relatively low intensities on steeper slopes.	3	60	NRCS, RCD, Private Landowners	

Porter Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
PortC-CCCS-18.1.2.4	Action Step	Livestock	Establish conservative residual dry matter (RDM) target per acre that ensures area is not overgrazed with 1000 lbs RDM (residual dry matter)/acre left at end of grazing season. Remove cattle from pasture before soils dry out.	3		NRCS, RCD, Private Landowners	
PortC-CCCS-20.1	**Objective**	**Mining**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
PortC-CCCS-20.1.1	Recovery Action	Mining	Prevent or minimize impairment to passage and migration				
PortC-CCCS-20.1.1.1	Action Step	Mining	Improve passage where mining and other activities have resulted in diminished migration windows.	2	10	CDFW, NMFS, Private Landowners, Sonoma County, USACE	
PortC-CCCS-20.1.1.2	Action Step	Mining	Implement gravel mining practices recommended by NMFS and CDFW	2	10	CDFW, NMFS, Private Landowners, Sonoma County, USACE	
PortC-CCCS-20.1.2	Recovery Action	Mining	Prevent or minimize impairment to instream habitat complexity (altered pool complexity and/or pool riffle ratio)				
PortC-CCCS-20.1.2.1	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	
PortC-CCCS-20.1.2.2	Action Step	Mining	Continue to implement and support BMP's which improve, maintain or prevent impacts to habitat complexity when reviewing new mining plans.	3	5	CDFW, Counties, NMFS, Private Landowners, USACE	
PortC-CCCS-20.1.3	Recovery Action	Mining	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
PortC-CCCS-20.1.3.1	Action Step	Mining	Develop and enhance offchannel habitats such as alcoves to promote fry and juvenile rearing habitat.	2	20	CDFW, Counties, Private Landowners, USACE	
PortC-CCCS-20.1.3.2	Action Step	Mining	Retain LWD, boulders and vegetation on riffles where structure is beneficial to migration and resting cover.	3	50	CDFW, Counties, NMFS, Private Landowners, USACE	
PortC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
PortC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road construction/density, dams, etc.)				
PortC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Assess existing road networks and implement actions that hydrologically disconnect roads and reduce sediment sources.	2	10	CDFW, NOAA RC, NRCS,Private Landowners, RCD	
PortC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources. Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	2	10	Private Landowners, Public Works, RCD, State Parks	
PortC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	3	10	Private Landowners, Public Works	
PortC-CCCS-23.1.1.4	Action Step	Roads/Railroads	Utilize best management practices for road construction (e.g. Fishnet 4c County Roads Manual; Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	3	25	Private Landowners, Public Works, Sonoma County	
PortC-CCCS-23.1.1.5	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips.	3	25	Private Landowners, Public Works, RCD, State Parks	
PortC-CCCS-23.1.1.6	Action Step	Roads/Railroads	Utilize BMP's to upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	3	20	Private Landowners, Public Works, State Parks	
PortC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
PortC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Assess private road stream crossings for barrier potential and implement recommendations.	2	10	CDFW, NOAA RC, Private Landowners	
PortC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Implement public road barrier survey recommendations in high then medium value areas as a priority (See Passage).	2	5	CDFW, NOAA RC, Private Landowners, RCD	
PortC-CCCS-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				

Porter Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
PortC-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
PortC-CCCS-23.2.1.1	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	5	CDFW, RCD	
PortC-CCCS-23.2.1.2	Action Step	Roads/Railroads	Utilize the Fishnet 4C or similar manual in training and operations.	3	10	City Planning, Public Works, Sonoma County	
PortC-CCCS-23.2.1.3	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	60	Board of Forestry, CalTrans, CDFW, City Planning, Private Landowners, RCD, Sonoma County	
PortC-CCCS-23.2.1.4	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	50	Sonoma County, State Parks	
PortC-CCCS-25.1	**Objective**	**Water Diversion/Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
PortC-CCCS-25.1.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
PortC-CCCS-25.1.1.1	Action Step	Water Diversion/Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	2	20	CDFW, NMFS, NOAA RC, Private Landowners, RCD, RWQCB, Sonoma County, Sonoma County Water Agency, SWRCB	
PortC-CCCS-25.1.1.2	Action Step	Water Diversion/Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	3	20	CDFW, Farm Bureau, NRCS, Sonoma County Water Agency, SWRCB	
PortC-CCCS-25.1.1.3	Action Step	Water Diversion/Impoundment	Promote the use of reclaimed water for agricultural or other uses.	3	60	CDFW, RCD, Sonoma County Water Agency, State Parks	
PortC-CCCS-25.1.1.4	Action Step	Water Diversion/Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	3	30	NMFS, RCD, RWQCB, Sonoma County Water Agency, SWRCB	
PortC-CCCS-25.1.2	Recovery Action	Water Diversion/Impoundment	Prevent or minimize reduced density, abundance, and diversity				
PortC-CCCS-25.1.2.1	Action Step	Water Diversion/Impoundment	Adequately screen water diversions to prevent juvenile salmonid mortalities.	1	10	CDFW, NMFS, NOAA RC	
PortC-CCCS-25.2	**Objective**	**Water Diversion/Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
PortC-CCCS-25.2.1	Recovery Action	Water Diversion/Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
PortC-CCCS-25.2.1.1	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.	1	5	CDFW, County Planning, Farm Bureau, NMFS, NOAA NWS, NOAA RC, Private Landowners, RCD	
PortC-CCCS-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	

Porter Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
PortC-CCCS-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	
PortC-CCCS-25.2.1.4	Action Step	Water Diversion/Impoundment	Request that SWRCB review and/or modify water use based on the needs of steelhead and authorized diverters (CDFG 2004).	3	5	CDFW, RCD, RWQCB, Sonoma County, Sonoma County Water Agency, SWRCB	
PortC-CCCS-25.2.1.5	Action Step	Water Diversion/Impoundment	Evaluate requests for on-stream dams above migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (CDFG 2004).	2	30	CDFW, NMFS, RWQCB, SWRCB	
PortC-CCCS-25.2.1.6	Action Step	Water Diversion/Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	15	CDFW, NMFS, RWQCB, SWRCB	

Hulbert Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
HulC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HulC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
HulC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in all reaches of the watershed to improve conditions for adults, and winter/summer rearing juveniles.	2	10	CDFW, NOAA RC, Private Landowners, State Parks, Trout Unlimited	
HulC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools				
HulC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase primary pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order stream reaches; >3 feet in third order or larger stream reaches)) in Reaches 1-3 within the watershed to improve conditions for adults, and summer/winter juveniles.	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
HulC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HulC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover				
HulC-CCCS-7.1.1.1	Action Step	Riparian	Improve canopy to 80% by planting riparian and coniferous species.	2	10	CDFW, NOAA RC, Private Landowners, RCD	
HulC-CCCS-7.1.1.2	Action Step	Riparian	"Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers throughout the watershed" (CDFG 2004).	3	30	Counties, Private Landowners, RCD	
HulC-CCCS-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HulC-CCCS-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
HulC-CCCS-19.1.1.1	Action Step	Logging	Acquire key large tracts of forestlands identified as a priority by Federal, State, local government, and non-governmental organizations.	3	60	CDFW, NMFS, RCD, Sonoma County, State Parks	
HulC-CCCS-19.1.1.2	Action Step	Logging	Conserve and manage forestlands for older forest stages.	3	60	Board of Forestry, CDFW, NMFS, Sonoma County, State Parks, USEPA	
HulC-CCCS-19.1.1.3	Action Step	Logging	Encourage forest management which allows for optimal levels of natural LWD recruitment of larger older trees into stream channels.	3	60	Board of Forestry, NMFS, Private Landowners, Sonoma County, State Parks, USEPA	
HulC-CCCS-19.1.2	Recovery Action	Logging	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
HulC-CCCS-19.1.2.1	Action Step	Logging	Prevent or minimize future sediment and runoff sources from logging by utilizing BMP's that prevent or minimize the delivery of sediment and runoff to stream channels.	3	20	CalFire, Private Landowners, RCD	
HulC-CCCS-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
HulC-CCCS-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
HulC-CCCS-19.2.1.1	Action Step	Logging	Prevent or minimize future conversion of forestlands to agriculture or other land uses.	2	60	CalFire, NMFS, Private Landowners	
HulC-CCCS-19.2.1.2	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	2	CalFire, CDFW, NMFS	
HulC-CCCS-19.2.1.3	Action Step	Logging	Provide information to BOF regarding CCC steelhead priorities and recommend upgrading relevant forest practices.	3	2	NMFS	
HulC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
HulC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize adverse alterations to sediment transport (road condition/density, dams, etc.)				
HulC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Assess existing road networks and implement actions that hydrologically disconnect roads and reduce sediment sources.	2	5	CDFW, NOAA RC, NRCS, Private Landowners, RCD	

Hulbert Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
HulC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources. Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	2	10	Private Landowners, Public Works, RCD, State Parks	
HulC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	3	20	Private Landowners, Public Works	
HulC-CCCS-23.1.1.4	Action Step	Roads/Railroads	Utilize best management practices for road construction (e.g. Fishnet 4c County Roads Manual; Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	3	25	Private Landowners, Public Works, Sonoma County	
HulC-CCCS-23.1.1.5	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips.	3	20	Private Landowners, Public Works, RCD, State Parks	
HulC-CCCS-23.1.1.6	Action Step	Roads/Railroads	Utilize BMP's to upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	3	20	Private Landowners, Public Works, State Parks	
HulC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
HulC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Assess private road stream crossings for barrier potential and implement recommendations.	2	10	CDFW, NOAA RC, Private Landowners	
HulC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Implement public road barrier survey recommendations in high then medium value areas as a priority (See Passage).	2	5	CDFW, NOAA RC, Private Landowners, RCD	
HulC-CCCS-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
HulC-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
HulC-CCCS-23.2.1.1	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	5	CDFW, RCD	
HulC-CCCS-23.2.1.2	Action Step	Roads/Railroads	Utilize the Fishnet 4C or similar manual in training and operations.	3	10	City Planning, Public Works, Sonoma County	
HulC-CCCS-23.2.1.3	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	60	Board of Forestry, CalTrans, CDFW, City Planning, Private Landowners, RCD, Sonoma County	
HulC-CCCS-23.2.1.4	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	Sonoma County, State Parks	

Dutch Bill Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
DBC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DBC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
DBC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches of lower Dutchbill Creek	2	10	Farm Bureau, NMFS, Public Works, RCD	
DBC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target winter and summer rearing habitat for juvenile steelhead. Improve conditions to re-create, and restore alcove, backwater, or perennial pond habitats in lower Dutchbill Creeks or other areas where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats.	2	20	NMFS, Private Landowners, Public Works, RCD, Sonoma County	
DBC-CCCS-2.1.2	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
DBC-CCCS-2.1.2.1	Action Step	Floodplain Connectivity	Add or incorporate features to enhance winter habitat refugia to existing and new habitat projects	2	20	Farm Bureau, Private Landowners, Public Works, RCD, Sonoma County	
DBC-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DBC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)				
DBC-CCCS-3.1.1.1	Action Step	Hydrology	Continue and support the Russian River Resources Partnership led by NFWF to model flows and water usage	2	5	CDFW, NFWF, NMFS, Private Landowners, RCD, UC Extension	
DBC-CCCS-3.1.1.2	Action Step	Hydrology	Develop cooperative projects with private landowners to conserve summer flows based on results of the NFWF efforts	2	5	CDFW, NFWF, NMFS, Private Landowners, RCD	
DBC-CCCS-3.1.1.3	Action Step	Hydrology	Develop rearing habitat curves in Dutchbill Creek to identify optimal base flow conditions	3	10	CDFW, SWRCB	
DBC-CCCS-3.1.2	Recovery Action	Hydrology	Improve flow conditions (instantaneous conditions)				
DBC-CCCS-3.1.2.1	Action Step	Hydrology	Reduce the rate of frost protection and domestic drawdown in the spring	2	5	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, Private Landowners, RCD, SWRCB, UC Extension	
DBC-CCCS-3.1.3	Recovery Action	Hydrology	Minimize redd scour				
DBC-CCCS-3.1.3.1	Action Step	Hydrology	Develop floodplain enhancement and LWD projects in modified areas of Dutchbill Creeks, and in incised channel areas of major tributaries	2	10	California Conservation Corps, CDFW, NOAA RC, Private Landowners, Trout Unlimited	
DBC-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DBC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
DBC-CCCS-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) at multiple sites along Dutchbill Creek and tributaries	2	5	CDFW, NOAA RC, Private Landowners, Sonoma County	
DBC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DBC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
DBC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in all reaches of the watershed to improve conditions for adults, and winter/summer rearing juveniles.	2	10	CDFW, NOAA RC, Private Landowners, State Parks, Trout Unlimited	
DBC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools				

Dutch Bill Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
DBC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase primary pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order stream reaches; >3 feet in third order or larger stream reaches)) in Reaches 1, 4, 7 and 8 within the watershed to improve conditions for adults, and summer/winter juveniles.	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
DBC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Increase pool/riffle/flatwater ratio				
DBC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase riffle frequency to 20% by converting flatwater habitats (glides, runs, etc.) utilizing boulders and log structures in Reaches 1 and 5 within the watershed.	2	5	CDFW, NOAA RC, Private Landowners, RCD, Trout Unlimited	
DBC-CCCS-6.1.4	Recovery Action	Habitat Complexity	Improve shelter				
DBC-CCCS-6.1.4.1	Action Step	Habitat Complexity	Increase shelters to optimal conditions (>80 pool shelter value) to improve conditions for adults, and winter/summer rearing juveniles in all reaches.	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
DBC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DBC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream water quality conditions				
DBC-CCCS-10.1.1.1	Action Step	Water Quality	Install continuous water quality monitoring stations in key reaches to evaluate summer conditions for juvenile steelhead	2	5	NMFS, Private Landowners, RWQCB	
DBC-CCCS-10.1.1.2	Action Step	Water Quality	Identify and provide solutions for point and non-point sources contributing to poor water quality and pollution.	2	5	CDFW, CDFW Law Enforcement, RWQCB, USEPA	
DBC-CCCS-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DBC-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
DBC-CCCS-12.1.1.1	Action Step	Agriculture	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels (see Roads for specific actions/areas)	2	20	CDFW, Private Landowners, RCD	
DBC-CCCS-12.1.1.2	Action Step	Agriculture	Implement Best Management Practices such as those in the Fish Friendly Farming program (California Land Stewardship Institute), or other cooperative conservation programs.	3	25	NRCS, Private Landowners, RCD	
DBC-CCCS-12.1.1.3	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	
DBC-CCCS-12.1.1.4	Action Step	Agriculture	Complete Farm Conservation Plans (through the SRCD, 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	
DBC-CCCS-12.1.1.5	Action Step	Agriculture	Assess the effectiveness of erosion control measures throughout the winter period.	3	20	CDFW, NMFS, NRCS, Private Landowners, RCD	
DBC-CCCS-12.1.1.6	Action Step	Agriculture	Continue the use of cover crops in agriculture fields.	3	25	Private Landowners	
DBC-CCCS-12.1.1.7	Action Step	Agriculture	Forest and ranch managers should utilize the Handbook for Forest and Ranch Roads (PWA, 1994). See ROADS for additional actions	3	20	Private Landowners, RCD	
DBC-CCCS-12.1.1.8	Action Step	Agriculture	Livestock and Ranch Managers should 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 (Sonoma RCD, 2007), and The Grazing Handbook (Sonoma RCD, 2007)	3	20	Farm Bureau, Private Landowners, RCD	
DBC-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure				
DBC-CCCS-12.1.2.1	Action Step	Agriculture	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to provide future recruitment of large wood and other shelter components	2	15	NRCS, Private Landowners, RCD	
DBC-CCCS-12.1.2.2	Action Step	Agriculture	Implement programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	25	Land Trusts, Sonoma County	
DBC-CCCS-12.1.2.3	Action Step	Agriculture	Utilize native plants when landscaping and discourage the use of exotic invasive	3	20	Private Landowners, RCD, UC Extension	

Dutch Bill Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
DBC-CCCS-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
DBC-CCCS-12.1.3.1	Action Step	Agriculture	Add large woody debris to reach optimal frequencies	2	10	CDFW, Private Landowners, RCD	
DBC-CCCS-12.1.3.2	Action Step	Agriculture	Avoid the removal of large wood and other shelter components from the stream system	3	10	NRCS, Private Landowners, RCD	
DBC-CCCS-12.1.4	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (impaired stream temperature)				
DBC-CCCS-12.1.4.1	Action Step	Agriculture	Re-establish native plant communities in riparian zones to increase stream canopy to 80%.	2	10	CDFW, Private Landowners, RCD, UC Extension	
DBC-CCCS-12.1.5	Recovery Action	Agriculture	Prevent or minimize impairment to stream hydrology (impaired water flow)				
DBC-CCCS-12.1.5.1	Action Step	Agriculture	Promote off-channel storage to reduce impacts of water diversion during the spring and summer (e.g. diversion during winter high flow).	2	10	NRCS, Private Landowners, RCD, UC Extension	
DBC-CCCS-12.1.5.2	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.	3	20	NRCS, Private Landowners, RCD	
DBC-CCCS-12.2	**Objective**	**Agriculture**	**Address the inadequacies of regulatory mechanisms**				
DBC-CCCS-12.2.1	Recovery Action	Agriculture	Prevent or minimize increased landscape disturbance				
DBC-CCCS-12.2.1.1	Action Step	Agriculture	Develop legislation that will fund county planning for environmentally sound agricultural growth and water supply.	2	10	Farm Bureau, NRCS, Sonoma County, UC Extension	
DBC-CCCS-12.2.1.2	Action Step	Agriculture	Coordinate with the agencies that authorize forest land conversions to discourage conversions to agriculture.	3	10	Board of Forestry, CDFW, Sonoma County	
DBC-CCCS-12.2.1.3	Action Step	Agriculture	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do	3	20	City Planning, RWQCB, Sonoma County	
DBC-CCCS-12.2.1.4	Action Step	Agriculture	Increase setbacks of existing agricultural activities from the top of bank to 100'	3	20	City Planning, NRCS, RCD, Sonoma County	
DBC-CCCS-12.2.1.5	Action Step	Agriculture	Streamline permit processing where landowners are conducting actions aligned with recovery priorities.	3	5	CDFW, NMFS, NRCS, RCD, SWRCB, USACE	
DBC-CCCS-12.2.1.6	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	
DBC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DBC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)				
DBC-CCCS-13.1.1.1	Action Step	Channel Modification	Evaluate undeveloped and developed floodplain property for potential function and conservation easement and/or acquisition potential.	3	5	RCD, Sonoma County	
DBC-CCCS-13.1.1.2	Action Step	Channel Modification	Conduct rehabilitation activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows (see FLOODPLAIN for specific actions)	2	10	CDFW, NOAA RC, NRCS, Private Landowners, Sonoma County, USACE	
DBC-CCCS-13.1.1.3	Action Step	Channel Modification	Set-back existing levees in strategic areas to increase flood-flow detention and promote flood-tolerant land uses.	2	20	CDFW, FEMA, NMFS, NOAA RC, Private Landowners, RCD, Sonoma County, USACE	
DBC-CCCS-13.1.1.4	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	FEMA, Sonoma County, USACE	
DBC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration				
DBC-CCCS-13.1.2.1	Action Step	Channel Modification	Ensure that all future and existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	3	20	NMFS, USACE	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
DBC-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent increased landscape disturbances				
DBC-CCCS-13.1.3.1	Action Step	Channel Modification	All proposed flood control projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.	3	20	NMFS, Sonoma County, USACE	
DBC-CCCS-13.1.3.2	Action Step	Channel Modification	Channel modifying projects should be designed to ensure potential effects to CCC steelhead habitat are fully minimized or mitigated, and where possible, existing poor conditions should be remediated.	3	20	NMFS, USACE	
DBC-CCCS-13.1.3.3	Action Step	Channel Modification	Evaluate design alternatives to riprap bank repairs. Where riprap is necessary, evaluate integration of other habitat-forming features – including large woody debris to ensure improved habitat at the restoration site.	3	25	CDFW, NMFS, USACE	
DBC-CCCS-13.1.3.4	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. carefully evaluate feasibility where critical infrastructure is located) for bank hardening projects.	2	25	CDFW, NMFS, USACE	
DBC-CCCS-13.2	**Objective**	**Channel Modification**	**Address the inadequacy of existing regulatory mechanisms**				
DBC-CCCS-13.2.1	Recovery Action	Channel Modification	Prevent increased landscape disturbances				
DBC-CCCS-13.2.1.1	Action Step	Channel Modification	Modify city and county regulatory and planning processes to minimize new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historical CCC steelhead watersheds.	3	25	City Planning, Sonoma County, USACE	
DBC-CCCS-13.2.1.2	Action Step	Channel Modification	Local agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	3	20	City Planning, Sonoma County	
DBC-CCCS-22.1	**Objective**	**Residential/ Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DBC-CCCS-22.1.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize reduced density, abundance, and diversity				
DBC-CCCS-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	
DBC-CCCS-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	
DBC-CCCS-22.1.1.3	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	
DBC-CCCS-22.1.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize increased landscape disturbance				
DBC-CCCS-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	
DBC-CCCS-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	
DBC-CCCS-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	
DBC-CCCS-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	
DBC-CCCS-22.1.2.5	Action Step	Residential/ Commercial Development	Identify areas at high risk of conversion from forestland to rural residential etc., and develop incentives and alternatives for landowners that discourage conversion.	3	25	CDFW, Counties, NMFS, Private Landowners, RCD	

Dutch Bill Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
DBC-CCCS-22.1.2.6	Action Step	Residential/ Commercial Development	Design new developments to minimize impacts to 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	
DBC-CCCS-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	
DBC-CCCS-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	
DBC-CCCS-22.1.2.9	Action Step	Residential/ Commercial Development	Minimize new development, or road construction within floodplains, riparian areas, unstable soils or other sensitive areas	3	20	Cities, Counties, Public Works, USACE	
DBC-CCCS-22.1.2.10	Action Step	Residential/ Commercial Development	Conserve open space in un-fractured landscapes, protect floodplain areas and riparian corridors, and develop conservation easements	3	20	Cities, Counties, Public Works, USACE	
DBC-CCCS-22.1.3	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
DBC-CCCS-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	
DBC-CCCS-22.1.3.2	Action Step	Residential/ Commercial Development	Residential landowners should utilize the Stewardship Guide for the Russian River (Sonoma RCD, 2011), and 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 (Sonoma RCD, 2007)	3	20	CDFW, Private Landowners, RCD, RWQCB, Sonoma County Water Agency	
DBC-CCCS-22.1.3.3	Action Step	Residential/ Commercial Development	Residential landowners should utilize BMP's from Basins Of Relations: A Citizen's Guide to Protecting and Restoring Our Watersheds (OAEC, 2007), Slow it. Spread it. Sink it! (Santa Cruz Resource Conservations District, 2009) to conserve water resources.	3	10	CDFW, City Planning, Private Landowners, Public Works, Sonoma County Water Agency, SWRCB	
DBC-CCCS-22.1.4	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to stream hydrology (impaired water flow)				
DBC-CCCS-22.1.4.1	Action Step	Residential/ Commercial Development	Encourage the use of rooftop water storage and other conservation devices	2	20	Private Landowners, Sonoma County	
DBC-CCCS-22.2	**Objective**	**Residential/ Commercial Development**	**Address the inadequacy of existing regulatory mechanisms**				
DBC-CCCS-22.2.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize reduced density, abundance, and diversity				
DBC-CCCS-22.2.1.1	Action Step	Residential/ Commercial Development	Implement performance standards in Stormwater Management Plans.	3	100	Mendocino County, Private Landowners, Sonoma County	
DBC-CCCS-22.2.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
DBC-CCCS-22.2.2.1	Action Step	Residential/ Commercial Development	Avoid, or at a minimum 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, USEPA	
DBC-CCCS-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	
DBC-CCCS-22.2.3	Recovery Action	Residential/ Commercial Development	Prevent or minimize increased landscape disturbance				
DBC-CCCS-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	

Dutch Bill Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
DBC-CCCS-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	
DBC-CCCS-22.2.3.3	Action Step	Residential/ Commercial Development	Enforce existing building permit programs to minimize unpermitted construction.	3	100	Cities, Counties	
DBC-CCCS-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	
DBC-CCCS-22.2.3.5	Action Step	Residential/ Commercial Development	Minimize new construction in undeveloped areas within the 100-year flood prone zones in all historical CCC steelhead watersheds.	3	5	CDFW, NMFS, Sonoma County	
DBC-CCCS-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	
DBC-CCCS-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	
DBC-CCCS-22.2.3.8	Action Step	Residential/ Commercial Development	Explore the use of conservation easements to provide incentives for private landowners to preserve riparian corridors	2	10	Land Trusts, Private Landowners, RCD	
DBC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DBC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
DBC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Assess private road stream crossings for barrier potential and implement recommendations.	2	10	CDFW, NOAA RC, Private Landowners	
DBC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Implement public road barrier survey recommendations in high then medium value areas as a priority (See Passage).	2	5	CDFW, NOAA RC, Private Landowners, RCD	
DBC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
DBC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources. Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	2	20	Private Landowners, Public Works, RCD, State Parks	
DBC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Assess existing road networks and implement actions that hydrologically disconnect roads and reduce sediment sources.	2	10	CDFW, NOAA RC, NRCS, Private Landowners, RCD	
DBC-CCCS-23.1.2.3	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	3	10	Private Landowners, Public Works	
DBC-CCCS-23.1.2.4	Action Step	Roads/Railroads	Utilize best management practices for road construction (e.g. Fishnet 4c County Roads Manual; Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	3	20	Private Landowners, Public Works, Sonoma County	
DBC-CCCS-23.1.2.5	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips	3	25	Private Landowners, Public Works, RCD, State Parks	
DBC-CCCS-23.1.2.6	Action Step	Roads/Railroads	Utilize BMP's to upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	3	25	Private Landowners, Public Works, State Parks	
DBC-CCCS-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
DBC-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
DBC-CCCS-23.2.1.1	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	5	CDFW, RCD	
DBC-CCCS-23.2.1.2	Action Step	Roads/Railroads	Utilize the Fishnet 4C or similar manual in training and operations	3	10	City Planning, Public Works, Sonoma County	

Dutch Bill Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
DBC-CCCS-23.2.1.3	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	60	Board of Forestry, CalTrans, CDFW, City Planning, Private Landowners, RCD, Sonoma County	
DBC-CCCS-23.2.1.4	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	30	Sonoma County, State Parks	
DBC-CCCS-25.1	**Objective**	**Water Diversion /Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
DBC-CCCS-25.1.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
DBC-CCCS-25.1.1.1	Action Step	Water Diversion /Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	2	20	CDFW, NMFS, NOAA RC, Private Landowners, RCD, RWQCB, Sonoma County, Sonoma County Water Agency, SWRCB	
DBC-CCCS-25.1.1.2	Action Step	Water Diversion /Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	3	20	CDFW, Farm Bureau, NRCS, Sonoma County Water Agency, SWRCB	
DBC-CCCS-25.1.1.3	Action Step	Water Diversion /Impoundment	Promote the use of reclaimed water for agricultural or other uses.	3	60	CDFW, RCD, Sonoma County Water Agency, State Parks	
DBC-CCCS-25.1.1.4	Action Step	Water Diversion /Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	3	30	NMFS, RCD, RWQCB, Sonoma County Water Agency, SWRCB	
DBC-CCCS-25.1.2	Recovery Action	Water Diversion /Impoundment	Prevent or minimize reduced density, abundance, and diversity				
DBC-CCCS-25.1.2.1	Action Step	Water Diversion /Impoundment	Adequately screen water diversions to prevent juvenile salmonid mortalities.	1	20	CDFW, NMFS, NOAA RC	
DBC-CCCS-25.2	**Objective**	**Water Diversion /Impoundment**	**Address the inadequacy of existing regulatory mechanisms**				
DBC-CCCS-25.2.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)				
DBC-CCCS-25.2.1.1	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.	1	5	CDFW, County Planning, Farm Bureau, NMFS, NOAA NWS, NOAA RC, NRCS, Private Landowners, RCD	
DBC-CCCS-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	
DBC-CCCS-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	

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Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
DBC-CCCS-25.2.1.4	Action Step	Water Diversion /Impoundment	Request that SWRCB review and/or modify water use based on the needs of steelhead and authorized diverters (CDFG 2004).	3	5	CDFW, RCD, RWQCB, Sonoma County, Sonoma County Water Agency, SWRCB	
DBC-CCCS-25.2.1.5	Action Step	Water Diversion /Impoundment	Evaluate requests for on-stream dams above migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (CDFG 2004).	3	5	CDFW, SWRCB, USACE	
DBC-CCCS-25.2.1.6	Action Step	Water Diversion /Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	15	NMFS, RWQCB, SWRCB	

Freezeout Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
FrezC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
FrezC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
FrezC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches	1	10	Farm Bureau, NMFS, Public Works, RCD	
FrezC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target winter and summer rearing habitat for juvenile steelhead. Improve conditions to re-create, and restore alcove, backwater, or perennial pond habitats in lower areas where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats.	1	10	NMFS, Private Landowners, Public Works, RCD, Sonoma County	
FrezC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
FrezC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
FrezC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in reaches 1,2 and 4 of the watershed to improve conditions for adults, and winter/summer rearing juveniles.	2	10	CDFW, NOAA RC, Private Landowners, State Parks, Trout Unlimited	
FrezC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools				
FrezC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase primary pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order stream reaches; >3 feet in third order or larger stream reaches)) in Reaches 1-3 within the watershed to improve conditions for adults, and summer/winter juveniles.	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
FrezC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Increase pool/riffle/flatwater ratio (hydraulic diversity)				
FrezC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase riffle frequency to 20% by converting flatwater habitats (glides, runs, etc.) utilizing boulders and log structures in Reaches within the watershed.	2	5	CDFW, NOAA RC, Private Landowners, RCD, Trout Unlimited	
FrezC-CCCS-6.1.4	Recovery Action	Habitat Complexity	Improve shelter conditions				
FrezC-CCCS-6.1.4.1	Action Step	Habitat Complexity	Increase shelters to optimal conditions (>80 pool shelter value) in all reaches	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
FrezC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
FrezC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream water quality conditions				
FrezC-CCCS-10.1.1.1	Action Step	Water Quality	Install continuous water quality monitoring stations in lower Freezeout Creek	2	5	NMFS, Private Landowners, RWQCB	
FrezC-CCCS-10.1.1.2	Action Step	Water Quality	Identify and provide solutions for point and non-point sources contributing to poor water quality and pollution.	2	5	CDFW, CDFW Law Enforcement, RWQCB, USEPA	
FrezC-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
FrezC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
FrezC-CCCS-18.1.1.1	Action Step	Livestock	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take first priority for riparian fencing programs over steer operations.	2	60	CDFW, NOAA RC, NRCS, RCD	
FrezC-CCCS-18.1.1.2	Action Step	Livestock	Encourage develop and fund riparian restoration projects to regain riparian corridors damaged from livestock and other causes.	2	30	NRCS, Private Landowners, RCD	
FrezC-CCCS-18.1.1.3	Action Step	Livestock	Substitute continuous season-long use of pastures in favor of rotational grazing strategies to reduce runoff. Short term, seasonal and long term rest from grazing in overgrazed areas would improve soil conditions for native revegetation and land values as well.	3	60	NRCS, Private Landowners, RCD	
FrezC-CCCS-18.1.1.4	Action Step	Livestock	Manage rotational grazing to aid in the reduction of noxious weeds.	3	60	NRCS, Private Landowners, RCD	

Freezeout Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
FrezC-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
FrezC-CCCS-18.1.2.1	Action Step	Livestock	Aid landowners willing to fence off riparian areas with development of offstream alternative water sources	2	30	CDFW, NOAA RC, NRCS, RCD	
FrezC-CCCS-18.1.2.2	Action Step	Livestock	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	60	NRCS, Private Landowners, RCD	
FrezC-CCCS-18.1.2.3	Action Step	Livestock	To minimize gully initiation, grazing should be kept at relatively low intensities on steeper slopes	2	60	NRCS, Private Landowners, RCD	
FrezC-CCCS-18.1.2.4	Action Step	Livestock	Establish conservative residual dry matter (RDM) target per acre that ensures area is not overgrazed with 1000 lbs RDM (residual dry matter)/acre left at end of grazing season. Remove cattle from pasture before soils dry out.	3	25	NRCS, Private Landowners, RCD	
FrezC-CCCS-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
FrezC-CCCS-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
FrezC-CCCS-19.1.1.1	Action Step	Logging	Acquire key large tracts of forestlands identified as a priority by Federal, State, local government, and non-governmental organizations	3	60	CDFW, NMFS, RCD, Sonoma County, State Parks	
FrezC-CCCS-19.1.1.2	Action Step	Logging	Conserve and manage forestlands for older forest stages.	3	60	Board of Forestry, CDFW, NMFS, Sonoma County, State Parks, USEPA	
FrezC-CCCS-19.1.1.3	Action Step	Logging	Encourage forest management which allows for optimal levels of natural LWD recruitment of larger older trees into stream channels	3	60	Board of Forestry, NMFS, Private Landowners, Sonoma County, State Parks, US EPA	
FrezC-CCCS-19.1.2	Recovery Action	Logging	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
FrezC-CCCS-19.1.2.1	Action Step	Logging	Prevent or minimize future sediment and runoff sources from logging by utilizing BMP's that prevent or minimize delivery of sediment and runoff to stream channels.	3	25	CalFire, Private Landowners, RCD	
FrezC-CCCS-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
FrezC-CCCS-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
FrezC-CCCS-19.2.1.1	Action Step	Logging	Prevent or minimize future conversion of forestlands to agriculture or other land uses.	2	60	CalFire, NMFS, Private Landowners	
FrezC-CCCS-19.2.1.2	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	2	CalFire, CDFW, NMFS	
FrezC-CCCS-19.2.1.3	Action Step	Logging	Establish greater oversight and post-harvest monitoring by the permitting agency for operations within high value habitat areas	3	10	BOF, NMFS, State	
FrezC-CCCS-19.2.1.4	Action Step	Logging	Provide information to BOF regarding CCC steelhead priorities and recommend upgrading relevant forest practices.	3	2	CalFire, CDFW, NMFS	
FrezC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
FrezC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
FrezC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Assess existing road networks and implement actions that hydrologically disconnect roads and reduce sediment sources.	2	5	CDFW, NOAA RC, NRCS, Private Landowners, RCD	
FrezC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources. Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	2	10	Private Landowners, Public Works, RCD, State Parks	
FrezC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	3	10	Private Landowners, Public Works	

Freezeout Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
FrezC-CCCS-23.1.1.4	Action Step	Roads/Railroads	Utilize best management practices for road construction (e.g. Fishnet 4c County Roads Manual; Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	3	25	Private Landowners, Public Works, Sonoma County	
FrezC-CCCS-23.1.1.5	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips.	3	25	Private Landowners, Public Works, RCD, State Parks	
FrezC-CCCS-23.1.1.6	Action Step	Roads/Railroads	Utilize BMP's to upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	3	25	Private Landowners, Public Works, State Parks	
FrezC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
FrezC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Assess private road stream crossings for barrier potential and implement recommendations.	2	10	CDFW, NOAA RC, Private Landowners	
FrezC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Implement public road barrier survey recommendations in high then medium value areas as a priority (See Passage).	2	5	CDFW, NOAA RC, Private Landowners, RCD	
FrezC-CCCS-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
FrezC-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
FrezC-CCCS-23.2.1.1	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	5	CDFW, RCD	
FrezC-CCCS-23.2.1.2	Action Step	Roads/Railroads	Utilize the Fishnet 4C or similar manual in training and operations.	3	10	City Planning, Public Works, Sonoma County	
FrezC-CCCS-23.2.1.3	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	60	Board of Forestry, CalTrans, CDFW, City Planning, Private Landowners, RCD, Sonoma County	
FrezC-CCCS-23.2.1.4	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	25	Sonoma County, State Parks	

Sheephouse Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ShepC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
ShepC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
ShepC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches	1	10	Farm Bureau, NMFS, Public Works, RCD	
ShepC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target winter and summer rearing habitat for juvenile steelhead. Improve conditions to re-create, and restore alcove, backwater, or perennial pond habitats in lower areas where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats.	1	10	NMFS, Private Landowners, Public Works, RCD, Sonoma County	
ShepC-CCCS-2.1.2	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
ShepC-CCCS-2.1.2.1	Action Step	Floodplain Connectivity	Add or incorporate features to enhance winter habitat refugia to existing and new habitat projects	2	15	Farm Bureau, Private Landowners, Public Works, RCD, Sonoma County	
ShepC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
ShepC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
ShepC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in reaches 1,2 and 4 of the watershed to improve conditions for adults, and winter/summer rearing juveniles.	2	10	CDFW, NOAA RC, Private Landowners, State Parks, Trout Unlimited	
ShepC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools				
ShepC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase primary pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order stream reaches; >3 feet in third order or larger stream reaches)) in Reaches 1-3 within the watershed to improve conditions for adults, and summer/winter juveniles.	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
ShepC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter				
ShepC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase shelters to optimal conditions (>80 pool shelter value) in all reaches	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
ShepC-CCCS-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
ShepC-CCCS-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
ShepC-CCCS-19.1.1.1	Action Step	Logging	Acquire key large tracts of forestlands identified as a priority by Federal, State, local government, and non-governmental organizations	3	60	CDFW, NMFS, RCD, Sonoma County, State Parks	
ShepC-CCCS-19.1.1.2	Action Step	Logging	Conserve and manage forestlands for older forest stages.	3	60	Board of Forestry, CDFW, NMFS, Sonoma County, State Parks, USEPA	
ShepC-CCCS-19.1.1.3	Action Step	Logging	Encourage forest management which allows for optimal levels of natural LWD recruitment of larger older trees into stream channels	3	60	Board of Forestry, NMFS, Private Landowners, Sonoma County, State Parks, US EPA	
ShepC-CCCS-19.1.2	Recovery Action	Logging	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
ShepC-CCCS-19.1.2.1	Action Step	Logging	Prevent or minimize future sediment and runoff sources from logging by utilizing BMP's that prevent or minimize delivery of sediment and runoff to stream channels.	3	25	CalFire, Private Landowners, RCD	
ShepC-CCCS-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
ShepC-CCCS-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
ShepC-CCCS-19.2.1.1	Action Step	Logging	Minimize future conversion of forestlands to agriculture or other land uses.	2	60	CalFire, NMFS, Private Landowners	

Sheephouse Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
ShepC-CCCS-19.2.1.2	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	2	CalFire, CDFW, NMFS	
ShepC-CCCS-19.2.1.3	Action Step	Logging	Provide information to BOF regarding CCC steelhead priorities and recommend upgrading relevant forest practices.	3	2	CalFire, CDFW, NMFS	

Willow Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WlwC-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WlwC-CCCS-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat				
WlwC-CCCS-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.	1	5	California Coastal Conservancy, CDFW, NMFS, NOAA NOS, NOAA RC, Private Landowners, Public Works, RWQCB, Sonoma County, Sonoma County Water Agency, State Parks, USACE	
WlwC-CCCS-1.1.1.2	Action Step	Estuary	Continue implementation of the Russian River estuary management program, as described within NMFS' Russian River Biological Opinion.	2	5	CDFW, NMFS, Sonoma County Water Agency, USACE	
WlwC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WlwC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity				
WlwC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches of Willow Creek.	1	10	Farm Bureau, NMFS, Public Works, RCD	
WlwC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target winter and summer rearing habitat for juvenile steelhead. Improve conditions to re-create, and restore alcove, backwater, or perennial pond habitats in lower Willow Creek or other reaches where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats.	1	10	NMFS, Private Landowners, Public Works, RCD, Sonoma County	
WlwC-CCCS-2.1.2	Recovery Action	Floodplain Connectivity	Increase and enhance velocity refuge				
WlwC-CCCS-2.1.2.1	Action Step	Floodplain Connectivity	Add or incorporate features to enhance winter habitat refugia to existing and new habitat projects.	2	20	Farm Bureau, Private Landowners, Public Works, RCD, Sonoma County	
WlwC-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WlwC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers				
WlwC-CCCS-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) at multiple sites along Willow Creek and tributaries. Modify the 3rd bridge to allow sediment transport and fish passage.	1	5	CDFW, NOAA RC, Private Landowners, Sonoma County	
WlwC-CCCS-5.1.1.2	Action Step	Passage	Monitor fish passage at and downstream of Bridge 2 to ensure adequate adult upstream migration, and downstream smolt emigration. Implement necessary recommendations to ensure passage.	2	10	CDFW, NMFS, NOAA RC, Sonoma County, UC Extension	
WlwC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WlwC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency				
WlwC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in all reaches of the watershed to improve conditions for adults, and winter/summer rearing juveniles.	2	5	CDFW, NOAA RC, Private Landowners, State Parks, Trout Unlimited	
WlwC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools				
WlwC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase primary pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order stream reaches; >3 feet in third order or larger stream reaches)) in Reach 1 within the watershed to improve conditions for adults, and summer/winter juveniles.	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
WlwC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve pool/riffle/flatwater ratio (hydraulic diversity)				

Willow Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WlwC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase riffle frequency to 20% by converting flatwater habitats (glides, runs, etc.) utilizing boulders and log structures in Reach 1 within the watershed.	2	5	CDFW, NOAA RC, Private Landowners, RCD, Trout Unlimited	
WlwC-CCCS-6.1.4	Recovery Action	Habitat Complexity	Improve shelter				
WlwC-CCCS-6.1.4.1	Action Step	Habitat Complexity	Increase shelters to optimal conditions (>80 pool shelter value) in all reaches to improve conditions for adults, and winter/summer rearing juveniles.	2	10	CDFW, NOAA RC, Private Landowners, Trout Unlimited	
WlwC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WlwC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality and extent)				
WlwC-CCCS-13.1.1.1	Action Step	Channel Modification	Evaluate undeveloped and developed floodplain property for potential function and conservation easement and/or acquisition potential.	2	10	RCD, Sonoma County	
WlwC-CCCS-13.1.1.2	Action Step	Channel Modification	Conduct rehabilitation activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows (see FLOODPLAIN for specific actions).	2	10	CDFW, NOAA RC, NRCS, Private Landowners, Sonoma County, USACE	
WlwC-CCCS-13.1.1.3	Action Step	Channel Modification	Set-back existing levees in strategic areas to increase flood-flow detention and promote flood-tolerant land uses.	1	10	CDFW, FEMA, NMFS, NOAA RC, Private Landowners, RCD, Sonoma County, USACE	
WlwC-CCCS-13.1.1.4	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	FEMA, Sonoma County, USACE	
WlwC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration				
WlwC-CCCS-13.1.2.1	Action Step	Channel Modification	Ensure that all future and existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	3	25	NMFS, USACE	
WlwC-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize increased landscape disturbance				
WlwC-CCCS-13.1.3.1	Action Step	Channel Modification	All proposed flood control projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.	3	25	NMFS, Sonoma County, USACE	
WlwC-CCCS-13.1.3.2	Action Step	Channel Modification	Channel modifying projects should be designed to ensure potential effects to CCC steelhead habitat are fully minimized or mitigated, and where possible, existing poor conditions should be remediated.	3	20	NMFS, USACE	
WlwC-CCCS-13.1.3.3	Action Step	Channel Modification	Evaluate design alternatives to riprap bank repairs. Where riprap is necessary, evaluate integration of other habitat-forming features – including large woody debris to ensure improved habitat at the restoration site.	3	20	CDFW, NMFS, USACE	
WlwC-CCCS-13.1.3.4	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. carefully evaluate feasibility where critical infrastructure is located) for bank hardening projects.	2	20	CDFW, NMFS, USACE	
WlwC-CCCS-13.2	**Objective**	**Channel Modification**	**Address the inadequacy of existing regulatory mechanisms**				
WlwC-CCCS-13.2.1	Recovery Action	Channel Modification	Prevent or minimize increased landscape disturbance				
WlwC-CCCS-13.2.1.1	Action Step	Channel Modification	Modify city and county regulatory and planning processes to minimize new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historical CCC steelhead watersheds.	3	25	City Planning, Sonoma County, USACE	
WlwC-CCCS-13.2.1.2	Action Step	Channel Modification	Local agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow “emergencies”.	3	10	City Planning, Sonoma County, USACE	
WlwC-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WlwC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure				
WlwC-CCCS-18.1.1.1	Action Step	Livestock	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take first priority for riparian fencing programs over steer operations.	2	60	CDFW, NOAA RC, NRCS, RCD	

Willow Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WlwC-CCCS-18.1.1.2	Action Step	Livestock	Encourage develop and fund riparian restoration projects to regain riparian corridors damaged from livestock and other causes.	2	30	NRCS, RCD	
WlwC-CCCS-18.1.1.3	Action Step	Livestock	Remove portions of existing cross fencing.	2	60	NRCS, Private Landowners, RCD	
WlwC-CCCS-18.1.1.4	Action Step	Livestock	Substitute continuous season-long use of pastures in favor of rotational grazing strategies to reduce runoff. Short term, seasonal and long term rest from grazing in overgrazed areas would improve soil conditions for native revegetation and land values as well.	3	60	NRCS, Private Landowners, RCD	
WlwC-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)				
WlwC-CCCS-18.1.2.1	Action Step	Livestock	Aid landowners willing to fence off riparian areas with development of offstream alternative water sources.	2	30	CDFW, NOAA RC, NRCS, RCD	
WlwC-CCCS-18.1.2.2	Action Step	Livestock	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	60	NRCS, Private Landowners, RCD	
WlwC-CCCS-18.1.2.3	Action Step	Livestock	To minimize gully initiation, grazing should be kept at relatively low intensities on steeper slopes.	2	60	NRCS, Private Landowners, RCD	
WlwC-CCCS-19.1	**Objective**	**Logging**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WlwC-CCCS-19.1.1	Recovery Action	Logging	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)				
WlwC-CCCS-19.1.1.1	Action Step	Logging	Acquire key large tracts of forestlands identified as a priority by Federal, State, local government, and non-governmental organizations.	3	60	CDFW, NMFS, RCD, Sonoma County, State Parks	
WlwC-CCCS-19.1.1.2	Action Step	Logging	Conserve and manage forestlands for older forest stages.	3	60	Board of Forestry, CDFW, NMFS, Sonoma County, State Parks, USEPA	
WlwC-CCCS-19.1.1.3	Action Step	Logging	Encourage forest management which allows for optimal levels of natural LWD recruitment of larger older trees into stream channels.	3	60	Board of Forestry, NMFS, Private Landowners, Sonoma County, State Parks, USEPA	
WlwC-CCCS-19.1.2	Recovery Action	Logging	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
WlwC-CCCS-19.1.2.1	Action Step	Logging	Prevent or minimize future sediment and runoff sources from logging by utilizing BMP's that prevent or minimize the delivery of sediment and runoff to stream channels.	3	25	CalFire, Private Landowners, RCD	
WlwC-CCCS-19.2	**Objective**	**Logging**	**Address the inadequacy of existing regulatory mechanisms**				
WlwC-CCCS-19.2.1	Recovery Action	Logging	Prevent or minimize increased landscape disturbance				
WlwC-CCCS-19.2.1.1	Action Step	Logging	Prevent or minimize the future conversion of forestlands to agriculture or other land uses.	2	60	CalFire, Private Landowners, RCD	
WlwC-CCCS-19.2.1.2	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	2	CalFire, CDFW, NMFS	
WlwC-CCCS-19.2.1.3	Action Step	Logging	Provide information to BOF regarding CCC steelhead priorities and recommend upgrading relevant forest practices.	3	2	CalFire, CDFW, NMFS	
WlwC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**				
WlwC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)				
WlwC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources. Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	2	10	Private Landowners, Public Works, RCD, State Parks	
WlwC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Implement remaining surface treatments on the County Road network (culvert upgrades were completed but surface treatments were not).	2	10	CDFW, NOAA RC, NRCS, Private Landowners, RCD	
WlwC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Decommission legacy logging roads and reconnect springs bisected by roads.	2	10	CDFW, NOAA RC, Private Landowners	

Willow Creek, Central California Coast Steelhead (North Coastal) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Comment
WlwC-CCCS-23.1.1.4	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	2	10	Private Landowners, Public Works	
WlwC-CCCS-23.1.1.5	Action Step	Roads/Railroads	Utilize best management practices for road construction (e.g. Fishnet 4c County Roads Manual; Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	3	25	Private Landowners, Public Works, Sonoma County	
WlwC-CCCS-23.1.1.6	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips.	3	20	Private Landowners, Public Works, Sonoma County	
WlwC-CCCS-23.1.1.7	Action Step	Roads/Railroads	Utilize BMP's to upgrade existing crossings (bridges, culverts, fills, and other crossings) to accommodate 100-year flood flows and associated bedload and debris.	3	25	Private Landowners, Public Works, RCD, State Parks	
WlwC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration				
WlwC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Implement road barrier survey recommendations in high then medium value areas as a priority.	2	10	CDFW, NOAA RC, Private Landowners, RCD	
WlwC-CCCS-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**				
WlwC-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize increased landscape disturbance				
WlwC-CCCS-23.2.1.1	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	5	CDFW, RCD	
WlwC-CCCS-23.2.1.2	Action Step	Roads/Railroads	Utilize the Fishnet 4C or similar manual in training and operations.	3	10	City Planning, Public Works, Sonoma County	
WlwC-CCCS-23.2.1.3	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	60	Board of Forestry, CalTrans, CDFW, City Planning, Private Landowners, RCD, Sonoma County	
WlwC-CCCS-23.2.1.4	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	25	Sonoma County, State Parks	