WADDELL CREEK

Waddell Creek

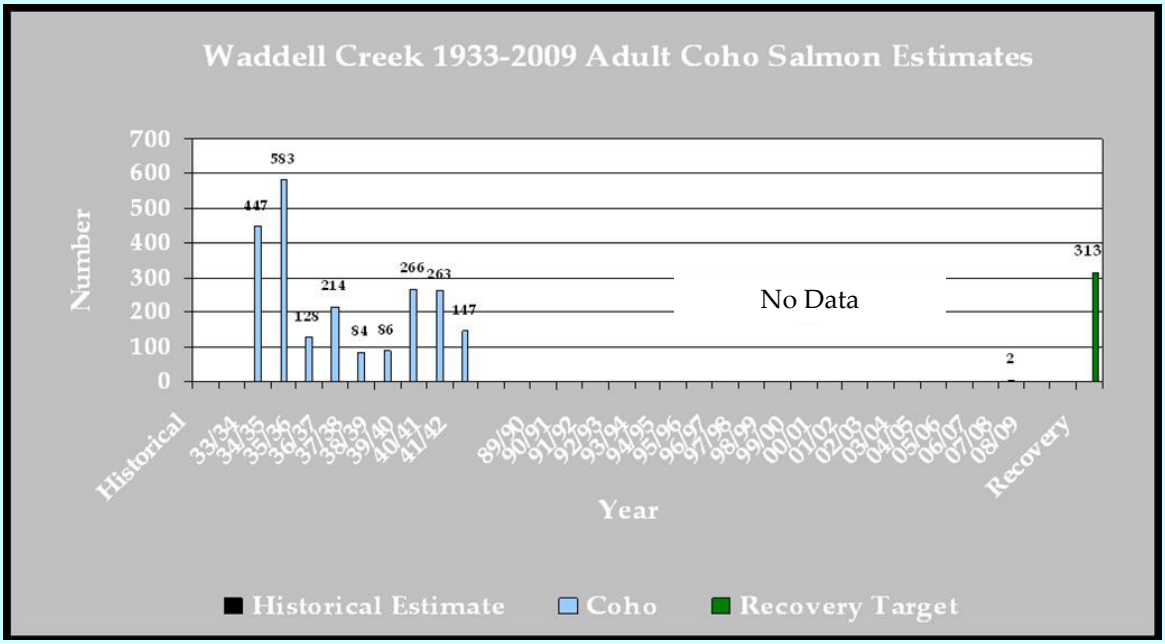
Dependent Population
9.2 IP-km of potential coho salmon habitat
Coho salmon and steelhead present

Waddell Creek drains approximately 24 square miles of the Santa Cruz Mountains in northwestern Santa Cruz County. Waddell Creek enters the Pacific Ocean about 15 miles north of Santa Cruz. About 85 percent of the Waddell Creek watershed is coniferous forest and about 14 percent of the watershed is shrubland. The SWRCB listed the East branch of Waddell Creek as having water quality impaired for nutrients in 2003. The water quality impairment listing determined that nutrients were impairing habitats beneficial to coho salmon including migration, spawning, and rearing habitats, and identified municipal point sources as the probable cause. Eighty-six percent of the Waddell Creek watershed is in state-owned forest lands; the remaining 14 percent is private ownership. There are 2 dams within the watershed that block salmon migration, and an additional 24 other barriers to salmon migration caused by road crossings, diversions, and natural structures. Impassable barriers block salmonids for less than 10 percent of the watershed. Seminal work on the life history of coho salmon and steelhead occurred in Waddell Creek from 1933 to 1942 (Shapavolof and Taft 1954). Their study examined the various life stages of coho salmon with particular emphasis on adult and smolt run timing and survival ratios. Their work serves as the foundation for most studies on coho salmon life history in California. Unfortunately, coho salmon are nearly extripated in Waddell Creek today.

Waddell Creek
Photo by Jerry Smith, SJSU

The Watershed at a Glance

Spawning Quantity & Quality	**VERY GOOD**
Summer Water Temperatures	**FAIR**
Depth & Shelter of Pools	**POOR**
Large Wood Frequency	**POOR**
Riparian Canopy	**GOOD to VERY GOOD**
Off channel/Floodplain Quality	**FAIR**
Estuary Function	**FAIR**



Waddell Creek

Recovery Target: 313 Adult Coho Salmon

Increasing the survival of coho salmon

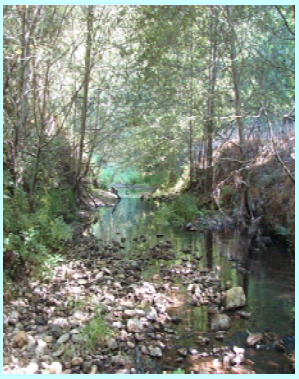
requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Droughts
- Roads and Railroads
- Channel Modifications

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Waddell Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve and expand pool habitat
- Increase the amount of large wood in streams
- Decrease existing and limit new near-stream roads, alleviating effects from remaining roads
- Augment and improve off channel habitat



Waddell Creek
Photo by Jerry Smith, SJSU

Advancing recovery of coho

salmon in Waddell Creek requires these priority **recovery actions:**

- Install LWD, boulders, and other features to increase stream complexity and improve pool frequency and depth.
- Evaluate source of ongoing fish kills in upper Waddell Creek and implement appropriate restoration actions.
- Identify and work with water users and appropriate regulatory agencies to minimize depletion of summer base flows from unauthorized water uses.
- Work with landowners to assess effectiveness of erosion control measures throughout the winter period.

. . . in these **core areas:** Northern and southwestern portion of the Waddell Creek planning watershed.

Conservation Highlights

- Annual juvenile abundance surveys conducted by San Jose State University faculty and students provides important population data on coho salmon in the Waddell Creek watershed.

We Need Your Photo Here

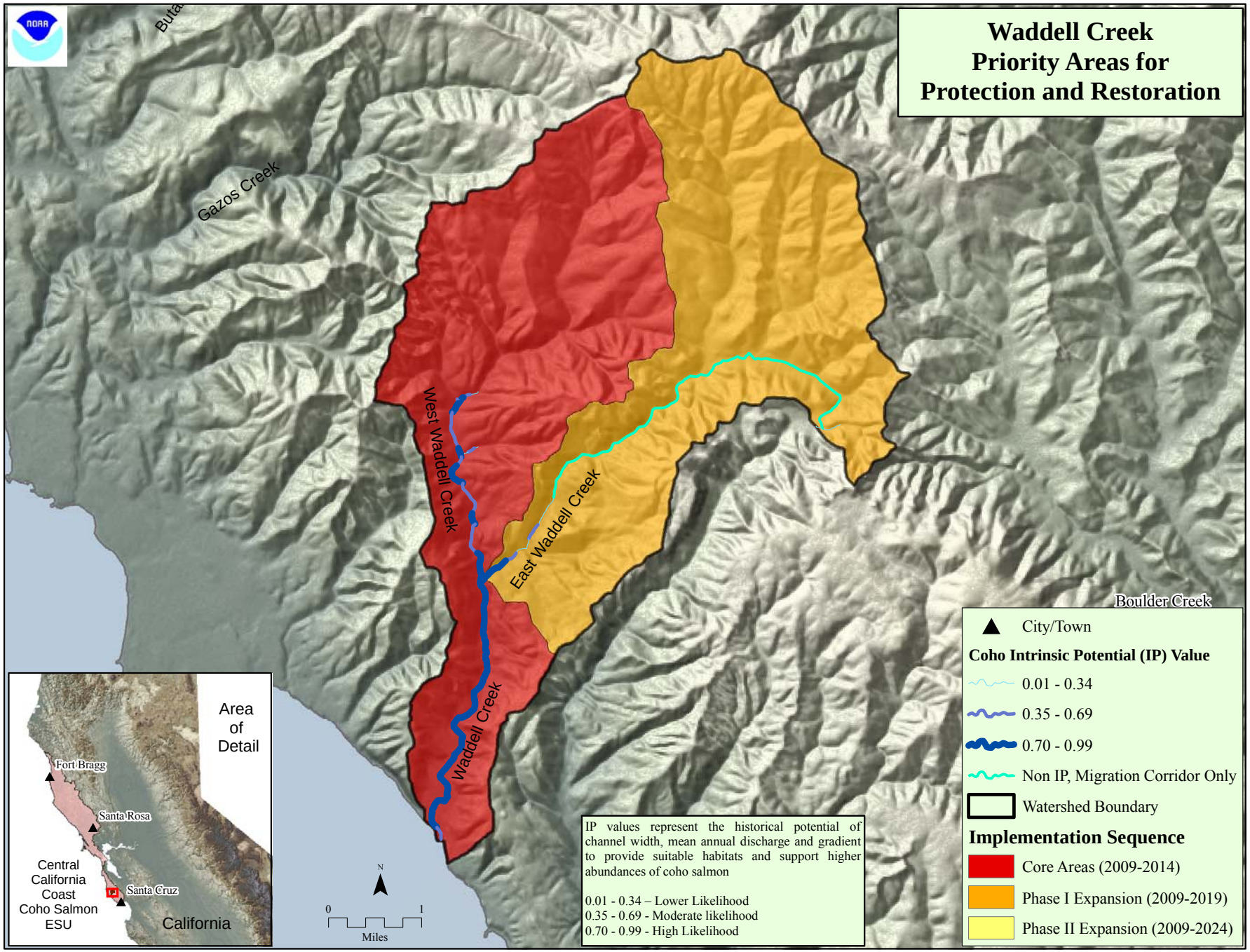
Waddell Creek
Photo © Your Name Here, AFFIL

Recovery Partners

State Parks
San Jose State University
Waddell Creek Association
NOAA SWFSC
Caltrans

Immediate Needs

Identify the source of upper Waddell Creek fish kills √


Waddell Creek
Priority Areas for
Protection and Restoration
Gazos Creek
West Waddell Creek
East Waddell Creek
Waddell Creek
Boulder Creek
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Non IP, Migration Corridor Only
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
N
0
1
Miles
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California

CCC Coho Salmon
Waddell Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	33	Very Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	30-60 days	Fair	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	6,948 m^2	Very Good	Spawning Adults	Sediment	Amount of Gravel*	<100 m^2	100-500 m^2	500-1100 m^2	>1100 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	25	Very Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	75	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Good	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	Fair	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	42	Good	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	38.3	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	8%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	38.3	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	50	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	2.17/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	38.3	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	77%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.17%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0.31%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	0%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	0	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Many Sources	8.8	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	Historical Conditions	Very Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	78%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	80%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	2.1 mi/sq.mi.	Good	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	2 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Waddell Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Droughts	Medium	Medium	High	Medium	High	Medium			High
2	Roads and Railroads	Medium	Low	Medium	High	High	Medium			High
3	Channel Modification	Low	Low	Medium	High	High	Medium			High
4	Climate Change	Medium	Low	High	Medium	Medium	Low			Medium
5	Storms and Flooding	Low	Low	Medium	Medium	High	Medium			Medium
6	Disease, Predation, and Competition	-	-	Medium	-	High	-			Medium
7	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium			Medium
8	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Medium			Medium
11	Residential and Commercial Development	Low	Low	Medium	Medium	Medium	Medium			Medium
12	Logging and Wood Harvesting	Low	Low	Medium	Medium	Medium	Low			Medium
13	Mining	Low	Low	Medium	Medium	Medium	Low			Medium
14	Livestock Farming and Ranching	Low	Low	Low	Medium	Low	Low			Low
15	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
16	Fishing and Collecting	-	-	-	Low	Low	-			Low
Threat Status for Targets and Project		Medium	Medium	High	High	Very High	Medium	-	-	High

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
WadC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
WadC-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.										
WadC-A-1.1.1.1	Action Step	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).	2	10	CA Coastal Commission, California Coastal Conservancy, CDFG, Counties, Private Landowners, USEPA, Water Agencies						TBD	Lower priority for coho but will benefit smolt transition and adult upmigration.
WadC-A-1.1.1.2	Action Step	Estuary	Promote and evaluate alternatives to the current Highway One bridge to improve estuary function.	2	5	CalTrans, CDFG, State Parks, USACE, USFWS						TBD	The current bridge is planned for a rebuild by Caltrans. A new bridge should account for sandbar formation and likely impacts to lagoon function. A new structure should be constructed in order to have minimal influence on sandbar opening and closing during (for all potential water years). Cost could not be determined at this time due to unknown financial considerations being evaluated by Caltrans for bridge design and reconstruction. The bridge location may have resulted in some channel incision which isolates the channel from the marsh and results in a lack of backwater habitat in the estuary.
WadC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
WadC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
WadC-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	5	CDFG, NMFS, Private Consultants, State Parks	4.00	4.00	4.00	4.00	4.00	20	
WadC-A-2.1.1.2	Action Step	Floodplain	Evaluate alternatives to improve habitat at the north and south swales.	3	15	CDFG, NMFS, State Parks						TBD	
WadC-A-2.1.1.3	Action Step	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	20	CDFG, NMFS, Santa Cruz County Fish and Wildlife Advisory Board, State Parks, USACE						TBD	Costs will be determined by the type of project, the number of projects, and site specific constraints.
WadC-A-2.1.1.4	Action Step	Floodplain	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	10	California Coastal Conservancy, CalTrans, CDFG, Private Landowners, Santa Cruz County, Santa Cruz County Land Trust, State Parks							
WadC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
WadC-A-3.1.1	Recovery Action	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.	2	10	CDFG, Private Landowners, State Parks, SWRCB	10.00	10.00	10.00	10.00	10.00	100	Cost will be for outreach and modeling of potential solutions to address ongoing depletion of summer baseflow in the watershed.
WadC-A-3.1.2	Recovery Action	Hydrology	Monitor, identify problems, and prioritize needed changes to water diversion on current or potential coho streams that go dry in some years (DFG 2004).										

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
WadC-A-3.1.2.1	Action Step	Hydrology	Work with the SWRCB to develop and enforce stream flow bypass requirements for diversions in Waddell Creek.	2	10	CDFG, Santa Cruz County, State Parks, SWRCB						0	Costs should be covered by existing programs of SWRCB.
WadC-A-3.1.3	Recovery Action	Hydrology	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.										
WadC-A-3.1.3.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	3	20	CDFG, RCD, RWQCB, Santa Cruz County, State Parks	10.00	10.00	10.00	10.00	10.00	200	Promoting these type of projects will require a sustained effort to target willing landowners in critical stream reaches.
WadC-A-3.1.3.2	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	CDFG, Private Landowners, RCD, Santa Cruz County, State Parks	10.00	10.00	10.00	10.00	10.00	200	Promoting these type of projects will require a sustained effort to target willing landowners in critical stream reaches.
WadC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
WadC-A-6.1.1	Recovery Action	Pool Habitat	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.										
WadC-A-6.1.1.1	Action Step	Pool Habitat	Install LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004).	1	5	California Coastal Conservancy, CDFG, NOAA RC, Private Landowners, Santa Cruz County, Santa Cruz RCD, State Parks	20.00	20.00	20.00	20.00	20.00	100	Cost estimate based on DFG 2004, at approximately $20K/mile, and assuming approximately 5 miles would be treated. Costs will be higher if engineered large wood placement approaches are used. Significant cost savings (and ecological benefits) would likely be realized if unsecured woody material (sized at 1.5 to 2 times bankfull) is used. Large woody debris should be targeted to reach density and volume outlined in the Viability table in this document.
WadC-A-6.1.1.2	Action Step	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	California Coastal Conservancy, CDFG, NOAA RC, Private Landowners, Santa Cruz County, Santa Cruz RCD, USACE						0	Cost should be minimal. This recommendation should be adopted as a reoccurring recommendation for all restoration projects by individuals, agencies, and organizations that fund restoration projects.
WadC-A-6.1.1.3	Action Step	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.	1	60	California Coastal Conservancy, CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD, State Parks						0	
WadC-A-6.1.1.4	Action Step	Pool Habitat	If log jams are opened up for fish passage, retain LWD for instream enhancement projects that address poor shelter rating for juveniles and smolts. Create winter velocity refuge between stream mile 4 and 8 (footbridge). Create winter velocity refuge in stream above and below tramway springs.	2	5	CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD, State Parks	12.00	12.00	12.00	12.00	12.00	60	Costs associated with velocity refuge habitat enhancement assumed to be similar to installation of LWD structures. DFG estimated 20K per structure (DFG 2004). Significant oversight and evaluation should occur prior to removal of any large wood structure.
WadC-A-6.1.2	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.										

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
WadC-A-6.1.2.1	Action Step	Pool Habitat	Explore restoration approaches to regain flooding of the north and south swale during more frequent flow events. Address channel incision issues and reduced stream complexity between the Highway one bridge (stream mile 0) and the footbridge (stream mile 8).	2	5	CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD, State Parks	32.00	32.00	32.00	32.00	32.00	160	Accurate costs depend on selected approaches. DFG estimated LWD installation costs at approximately $20K/mile (DFG 2-004).
WadC-A-6.1.3	Recovery Action	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	1	60	CDFG, NMFS, Private Landowners, Santa Cruz County, State Parks						0	Purpose of action is to stop removal of LWD and other habitat elements, so costs are expected to be minimal, and cost savings may occur.
WadC-A-6.1.4	Recovery Action	Pool Habitat	Conserve and manage forestlands for older forest stages.										
WadC-A-6.1.4.1	Action Step	Pool Habitat	Conduct conifer release to promote growth of larger diameter trees where appropriate.	3	30	CalFire, CDFG, Private Landowners, Santa Cruz County, State Parks						TBD	Conifer release must take a comprehensive approach and should only be initiated in stream reaches with adequate canopy cover and where increases in instream temperatures are unlikely.
WadC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
WadC-A-7.1.1	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).	3	5	CDFG, Santa Cruz County, Santa Cruz RCD, State Parks						TBD	Costs depend on type and extent of reclamation and enhancement required.
WadC-A-7.1.2	Recovery Action	Riparian Vegetation	Manage riparian areas for their site potential composition and structure.	2	60	CDFG, Santa Cruz County, State Parks						0	Costs are expected to be minimal.
WadC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
WadC-A-8.1.1	Recovery Action	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	2	20	California Coastal Conservancy, CalTrans, Private Landowners, Santa Cruz County, Santa Cruz RCD, State Parks						TBD	Decommissioning and rerouting road and trails can be expensive, however, costs cannot be determined due to an unknown number of miles of roads that may be targeted.
WadC-A-8.1.2	Recovery Action	Sediment	Place instream structures to improve gravel retention and habitat complexity.	2	10	CDFG, Private Landowners, Santa Cruz County, Santa Cruz RCD, State Parks	100	100	100	100	100	1,000	DFG estimated LWD structures cost approximately $20K each (DFG 2004). Assumed 50 structures would be needed.
WadC-A-8.1.3	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.	2	15	NRCS, RWQCB, Santa Cruz County, Santa Cruz RCD	3.33	3.33	3.33	3.33	3.33	50	This work would be in addition to the road evaluation study. Cost savings could be realized through the use of air photography and interviews with landowners to identify major sources of sediment input.
WadC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
WadC-A-9.1.1	Recovery Action	Viability	Measure or estimate the condition of key habitat attributes across the watershed.	3	2	CDFG, Private Landowners, State Parks	50.00	50.00				100	Standardized habitat typing per DFG protocol could identify the majority of limiting factors within the watershed.
WadC-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
WadC-A-9.1.2.1	Action Step	Viability	Establish life cycle station in the Waddell Creek watershed, and utilize it to compare productivity with existing historical data for the watershed (Gallagher and Gallagher 2005).	2	6	CDFG, NOAA SWFSC, Private Landowners, State Parks	100	100	100	100	100	600	Cost is a rough estimate and may be reduced through the development of cooperative relationships between researchers. Although Waddell is rated as a Dependent watershed and other monitoring is occurring in an adjacent Dependent watershed (Scott Cr), Waddell is of particular historical importance to assessing long term trends of coastal salmonids due to the past work of Shapovalov and Taft (1954) during the 1930's

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
WadC-A-9.1.2.2	Action Step	Viability	Implement consistent monitoring and reporting methods to ensure ESU-wide consistency.	3	60	CDFG, NOAA RC, NOAA SWFSC, Private Consultants						TBD	While standard methods are available, outreach will be required to encourage all landowners and consultants to utilize them. Costs for outreach and education are difficult to determine due to an unknown number of participants, staff turnover, etc. Costs for a statewide outreach and education program were estimated at $60K (DFG 2004). Costs for a watershed specific program would likely be a fraction of that.
WadC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
WadC-A-10.1.1	Recovery Action	Water Quality	Conserve and manage forestlands for older forest stages.	2	60	CalFire, Private Landowners, State Parks						0	
WadC-A-10.1.2	Recovery Action	Water Quality	Determine site-specific recommendations, including incentives, to remedy high temperatures and implement accordingly (DFG 2004) .										
WadC-A-10.1.2.1	Action Step	Water Quality	Evaluate source of ongoing fish kills in upper Waddell Creek and implement appropriate restoration actions.	1	3	CDFG, NMFS OLE, State Parks	16.67	16.67	16.67			50	
WadC-A-12.1	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
WadC-A-12.1.1	Recovery Action	Channel Modification	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow “emergencies”.										
WadC-A-12.1.1.1	Action Step	Channel Modification	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	1	2	CDFG, Santa Cruz County						0	Cost of policy development are expected to be minimal. These costs were developed for San Lorenzo River strategies and should be able to be applied to Waddell at no additional cost.
WadC-A-12.1.2	Recovery Action	Channel Modification	Projects should seek alternatives to bank hardening.										
WadC-A-12.1.2.1	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. where critical infrastructure is located) for bank hardening projects.	2	60	California Coastal Conservancy, CalTrans, CDFG, NMFS, NRCS, RWQCB, Santa Cruz County, State Parks, USACE						TBD	Costs will vary by project and need.
WadC-A-12.2	Objective	Channel Modification	Ensure current populations of CCC coho salmon are protected from harm or take and protect all historical habitats from further habitat degradation.										
WadC-A-12.2.1	Recovery Action	Channel Modification	Encourage full implementation and enforcement of the Santa Cruz County Sensitive Habitat Ordinance.	3	60	Santa Cruz County						0	
WadC-A-14.1	Objective	Disease, Predation, and Competition	Reduce predation from non-native predators.										
WadC-A-14.1.1	Recovery Action	Disease, Predation, and Competition	Develop a predator control program targeting striped bass in the lower watershed.										
WadC-A-14.1.1.1	Action Step	Disease, Predation, and Competition	Evaluate likely impact of non-native species to anadromous salmonids in the Waddell estuary.	3	2	CDFG, NOAA SWFSC, Private Consultants, State Parks	37.50	37.50				75	Cost is a rough approximation of financial commitment necessary to adequately sample the estuary and write necessary reports. Final reports should include a series of recommendations and the feasibility of implementing these recommendations.

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
WadC-A-14.1.1.2	Action Step	Disease, Predation, and Competition	Coordinate with DFG to develop and implement the predator control program.	3	5	CDFG, NMFS, NOAA SWFSC, Santa Cruz County Fish and Wildlife Advisory Board, State Parks						TBD	Cost cannot be determined until all potential control methods are evaluated and total magnitude of the impact of anadromous salmonids ascertained. Total duration of predator control efforts may be longer depending on recommendations of plan.
WadC-A-15.1	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
WadC-A-15.1.1	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										
WadC-A-15.1.1.1	Action Step	Droughts	Develop and implement critical flow levels for stream reaches impacted by water diversions.	3	10	CDFG, NMFS HCD, State Parks, SWRCB						TBD	
WadC-A-15.1.1.2	Action Step	Droughts	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	3	10	CDFG, NMFS HCD, State Parks, SWRCB						TBD	
WadC-A-15.1.1.3	Action Step	Droughts	If predicted flows are below a level considered critical to maintain habitat conditions for coho salmon, measures to reduce water consumption should be initiated by users in the watershed through conservation programs.	2	10	CDFG, NOAA RC, NRCS, Pacific States Marine Fisheries Commission, SWRCB						TBD	
WadC-A-15.1.1.4	Action Step	Droughts	Identify and work with water users and appropriate regulatory agencies to minimize depletion of summer base flows from unauthorized water uses.	1	5	CDFG, Farm Bureau, NMFS, Private Landowners, State Parks, SWRCB, Trout Unlimited						TBD	Cost should be minimal and would largely consist of staff time to reconnoiter the watershed and conduct outreach to landowners.
WadC-A-15.1.1.5	Action Step	Droughts	Evaluate and implement rainfall capture from impervious surfaces for irrigation use to protect water quality and reduce water demand in summer.	2	15	CDFG, Farm Bureau, NMFS HCD, Private Landowners, State Parks, Trout Unlimited						TBD	
WadC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
WadC-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	3	60	CalTrans, NRCS, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	Similar existing programs could be modified and implemented at minimal cost.
WadC-A-24.1.2	Recovery Action	Roads and Railroads	Encourage ongoing implementation of the County of Santa Cruz's Integrated Vegetation Management Plan for Roads Near Perennial Waters (URS Corporation, 2008) regarding roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	3	60	Santa Cruz County, State Parks						0	
WadC-A-24.2	Objective	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within five years (from 2010).										
WadC-A-24.2.1	Recovery Action	Roads and Railroads	Address sediment sources from road networks and other actions that deliver sediment to stream channels.										
WadC-A-24.2.1.1	Action Step	Roads and Railroads	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.	2	10	California Department of Mines and Geology, NRCS, Private Consultants, Santa Cruz County, State Parks	15.00	15.00	15.00	15.00	15.00	150	Assessment should be conducted by a qualified geologist or road engineer with experience regarding road impacts to anadromous fisheries. The assessment should prioritize sites and outlines implementation and timelines of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.

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WadC-A-24.2.1.2	Action Step	Roads and Railroads	Identify areas at increased risk of mass wasting and elevated fine sediment load, and decrease sediment from transportation projects and land management activities in those areas (DFG 2004).	2	10	California Department of Mines and Geology, CDFG, Private Consultants, Private Landowners, Santa Cruz RCD, State Parks						TBD	
WadC-A-24.2.1.3	Action Step	Roads and Railroads	Identify and modify road maintenance activities that generate fine sediment to decrease fine sediment loads (DFG 2004).	1	5	CalFire, California Department of Mines and Geology, Santa Cruz County	2.00	2.00	2.00	2.00	2.00	10	
WadC-A-24.2.1.4	Action Step	Roads and Railroads	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	1	2	CDFG, NRCS, Santa Cruz RCD	12.50	12.50				25	
WadC-A-24.2.1.5	Action Step	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	15	CalFire, California Department of Mines and Geology, Private Landowners, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz RCD, State Parks, USACE						0	These standards should be applied to all roads in the watershed.
WadC-A-24.2.1.6	Action Step	Roads and Railroads	Encourage enforcement of Erosion Control Ordinance for private roads.	1	60	Santa Cruz County						TBD	County should provide adequate staffing to ensure standards per their Erosion Control Ordinances are applied appropriately.
WadC-A-24.2.2	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific road management plan is created and implemented.	2	10	CalFire, Private Landowners, Santa Cruz County, State Parks						TBD	
WadC-A-25.1	Objective	Storms and Flooding	Support economic incentives to reduce the impacts of storms and flooding from current and future planned urban infrastructure.										
WadC-A-25.1.1	Recovery Action	Storms and Flooding	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.										
WadC-A-25.1.1.1	Action Step	Storms and Flooding	Where existing infrastructure exists within historical floodplains or offchannel habitats in any historical coho watersheds, and restoration is found feasible, encourage willing landowners to restore these areas through conservation easements, etc.	3	60							TBD	Cost of this recommendation could be significant. This recommendation should be implemented on an opportunistic basis such as when a property is damaged after flooding or when a property owner moves away from the property in question. Adoption of these policies may result in significant short term expense but a long-term cost savings as a result of minimal future flood fighting actions.
WadC-A-25.2	Objective	Storms and Flooding	Modify current and future planning of urban infrastructure to address impacts of storms and flooding on watersheds.										
WadC-A-25.2.1	Recovery Action	Storms and Flooding	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC coho salmon watercourse.										
WadC-A-25.2.1.1	Action Step	Storms and Flooding	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.	2	60	California Department of Mines and Geology, Santa Cruz County						TBD	This is a site specific recommendation and costs will vary depending on existing infrastructure and risk tolerance.

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WadC-A-25.2.2	Recovery Action	Storms and Flooding	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.	1	60	California Department of Mines and Geology, CalTrans, Private Landowners, Santa Cruz County, USACE						TBD	Protecting these areas from impacts of development may be costly due to concerns of reverse condemnation, etc. Cost cannot be determined at this time due to a lack of information regarding where these existing habitats remain in juxtaposition to future development.