APPENDIX A.4: HABITAT ENHANCEMENT
BAYLANDS

Watershed	Existing Condition	Original Cite Reference
Sonoma Creek	Selected Special Status Species: Salt marsh harvest mouse (Reithrodontomys raviventris) [FE]	38
	Invasive exotic species like Peppergrass (Lepidium latifodium) are displacing native species (e.g. native cordgrass). Lepidium is found adjacent to Sonoma Creek, Tolay Creek, and alond tidal shores of Napa-Sonoma salt marsh.	38
	Glasswort (*Solsola soda*) is also an invasive species found in mudflats and amongst pickleweed in salt marshes. Has been found in areas of the Napa-Sonoma salt marsh.	38
	No recorded sites of other invasive species in Sonoma marshes, including: *Spartina alterniflora, Spartina desiflora, Arundo donax, Spartina anglica, Spartina patents* .	38
	Sonoma Baylands provide a unique opportunity to restore large areas of tidal marsh. There are large areas suitable for restoration as managed diked wetlands.	45
Petaluma River	Selected Special Status Species: Salt marsh harvest mouse (Reithrodontomys raviventris) [FE] California clapper rail (Rallus longirostris obsoletus) [FE] California black rail (Laterallus jamaicensis costurniculus) [CT/CSC] Salt marsh yellowthroat (Geothlypis trichas sinuosa) [CSC] Northern harrier (Circus cyaneus) [CSC] Short-eared owl (Asio flammeus) [CSC] Western pond turtle (Clemmys marmorata) [CSC]	27
	Plants: Native cordgrass (Spartina foliosa), Pickleweed (Salicornia virginica), Jaumea (Jaumea carnosa), Alkali heath (Frankenia salina), Saltgrass (Distichlis spicata), Fat hen (Atripex patula var. hastata), Gum plant (Grindelia stricta), Cattail (Typha sp.), Rushes (Juncus balticus, J. xyphioides, J. effusus)	27
	• Petaluma marsh largest remaining salt marsh in San Pablo Bay.	27
	• Basin Plan identifies Petaluma marsh as supporting the following "Beneficial Uses": EST = Estuarine Habitat MIGR = Fish Migration COMM = Ocean, Commercial, and Sport Fishing RARE = Preservation of Rare and Endangered Species REC1 = Water Contact Recreation REC2 = Noncontact Water Recreation SPWN = Fish Spawning	27
	• Ellis and Adobe Creek are within tidal marsh lands.	27
	• Salt marsh harvest mouse inhabits stands of pickleweed, saltbush, and bulrush. Also found in adjacent uplands (e.g. grasslands), within 200 feet of pickleweed.	27
	• Loss of salt marsh habitat, and in particular, pickleweed habitat contributing to declining population of salt marsh harvest mouse. Marsh loss can be attributed to past diking and filling of baylands for farming.	30
	• Suitable habitat for rails found throughout Petaluma marsh. Species observed up to Adobe Creek.	30

APPENDIX A.4: HABITAT ENHANCEMENT
BAYLANDS

Watershed	Existing Condition	Original Cite Reference
Petaluma River (Continued)	• Habitat for clapper rail includes upper salt marsh, near intertidal mudflats, and tidal creeks (e.g. Adobe and Ellis Creek). Nests located in lower salt marsh zones where cordgrass is abundant.	30
	• Loss of salt marsh habitat, and in particular, vegetation in emergent wetlands (e.g. intertidal flat muds) contributing to declining population. In addition, rats prey on eggs. Loss of cordgrass may also be contributing to loss of nesting habitat.	30
	• Western pond turtle found in streams, ponds, marshes and irrigation ditches in Petaluma Valley.	33
	• Tidal salt marshes are distinguished from mudflats by the presence of emergent vegetation.	33
	• Designated by CNDDB as sensitive habitat.	33
	• Identified by San Pablo Bay Restoration Framework as priority habitat for restoration.	33
	• Native cordgrass dominates habitat in lowest part of salt marsh (e.g. between MLLW level and MSWL).	33
	• Middle part of salt marsh where soil is under less tidal influence (e.g. more exposed and therefore higher salinity content due to evaporation), pickleweed dominates habitat. Jaumea also found in this part of salt marsh.	33
	• High salt marsh zone dominated by pickleweed, alkali heat, fat hen, and fum plant. Zone undergoes drastic changes in salinity content from near freshwater conditions during wet-weather months to almost twice sea-water salinity during the dry-weather months.	33
	• Invasive exotic species like Atlantic salt-marsh cordgrass (*Spartina alterniflora*) and Peppergrass (*Lepidium latifodium*) are displacing native species (e.g. native cordgrass).	33
	• SFEI has identified glasswort (*Salsola soda*) as occurring near Petaluma River. Invations sighted and removed in 1998.	33
	• SFEI has identified perennial pepperweed (Lepidium latifolium) found along lower reaches of Petaluma River and within Petaluma marsh, scattered along berms, levees, and creek banks. It has replaced coyote bush (*baccharis pilularis*).	33
Novato Creek	Selected Special Status Species: Salt marsh harvest mouse (Reithrodontomys raviventris) [FE] California clapper rail (Rallus longirostris obsoletus) [FE] California black rail (Laterallus jamaicensis costurniculus) [CT/CSC] Salt marsh yellowthroat (Geothlypis trichas sinuosa) [CSC] Western pond turtle (Clemmys marmorata) [CSC]	33
	Plants: Native cordgrass (*Spartina foliosa*), Pickleweed (*Salicornia virginica*), Jaumea (*Jaumea carnosa*), Alkali heath (*Frankenia salina*), Saltgrass (*Distichlis spicata*), Fat hen (*Atripex patula var. hastata*), Gum plant (*Grindelia stricta*), Cattail (Typha sp.), Rushes (*Juncus balticus, J. xyphioides, J. effusus*), Great bulrush (*Scirpus acutus*), Alkali bulrush (*S. robustus*), Olney bulrush (*S. olneyi*), California bulrush (*S. californicus*)	33

APPENDIX A.4: HABITAT ENHANCEMENT
BAYLANDS

Watershed	Existing Condition	Original Cite Reference
Novato Creek (Continued)	• Novato and Rush Creeks enter San Pablo Bay through tidal marsh lands. Bel Marin Keys former marsh land. Limited fringe of tidal salt marsh left on lands immediately adjacent to San Pablo Bay and along banks of lower Novato Creek.	21
	• Tidal salt marsh divided into three zones: lower salt marsh (frequently inundated, constant and moderately high salinity level), middle salt marsh (inundated during high tides therefore higher exposure resulting in higher salinity levels), and upper salt marsh (inundated only during high tides, also under influence of freshwater flows from creek resulting in widely ranging salinity levels from near freshwater to twice that of sea water).	21
	Cordgrass dominates lower salt marsh. Great bulrush plants interspersed between cordgrass.	21
	Pickleweed and Jaumea dominates middle salt marsh.	21
	Pickleweed, alkali heat, saltgrass, fat hen, and gum plant dominates upper salt marsh.	21
	Invasive/Priority plants for control identified by SFEI for S.F. Bay: Key species of concern: atlantic salt-marsh cordgrass (Spartina alterniflora), dense-flowered cordgrass (Spartina densiflora) Potential Species of Cocern: atlantic salt-marsh cordgrass (Spartina alterniflora), dense-flowered cordgrass (Spartina densiflora), Glasswort (Salsola soda) Watch List: iceplant (Carpobrotus edulis), andean Pampas Grass (Cortaderia jubata), pampas grass (Cortaderia selloana).	21
	Significant water quality issues include wetland modifications associated with new development and flood control in creeks and along the Bay shoreline. In Novato Creek, issue related to major erosion control project on Novato Creek	43
	• Other water quality issue relates to the restoration of Bel Marin Keys.	43
Corte Madera Creek	Selected Special Status Species: Salt marsh harvest mouse (Reithrodontomys raviventris) [FE] California clapper rail (Rallus longirostris obsoletus) [FE] California black rail (Laterallus jamaicensis costurniculus) [CT/CSC] Salt marsh yellowthroat (Geothlypis trichas sinuosa) [CSC] Western pond turtle (Clemmys marmorata) [CSC]	33
	Plants: Native cordgrass (*Spartina foliosa*), Pickleweed (*Salicornia virginica*), Jaumea (*Jaumea carnosa*), Alkali heath (*Frankenia salina*), Saltgrass (*Distichlis spicata*), Fat hen (*Atripex patula var. hastata*), Gum plant (*Grindelia stricta*), Cattail (Typha sp.), Rushes (*Juncus balticus, J. xyphioides, J. effusus*), Great bulrush (*Scirpus acutus*), Alkali bulrush (*S. robustus*), Olney bulrush (*S. olneyi*), California bulrush (*S. californicus*)	33
	According to SFEI, dense-flowered cordgrass (*Spartina densiflora*) found along entire length of Corte Madera Creek and at Creek Side Park.	SFEI Introduced Tidal Marsh Plants in the San Francisco Estuary. November 1998

APPENDIX A.4: HABITAT ENHANCEMENT
STREAM CORRIDORS: IN-STREAM HABITAT

Watershed	Existing Condition	Original Cite Reference
Sonoma Creek	Selected Special Status Species: Central Valley spring-run Chinook salmon (Oncorhynchus tshawytscha) [FE] Central Valley Steelhead (Oncorhynchus mykiss) [FT/CSC] Delta Smelt (Hypomesus transpacificus) [FE] California freshwater shrimp (Syncaris pacifica) [FE/SE] Ricksecker's water scavenger beetle (Hydrochara ricksecker) [CSC]	46 (Martini)
	USFWS surveys found California freshwater shrimp in Sonoma Creek.	38
	No comprehensive assessment of Steelhead populations in watershed. SEC commencing steelhead population study.	38
	SEC has benthic macroinvertebrate monitoring program.	38
	The Chinese mitten crab is an invasive specie in Sonoma Creek and tributaries.	38
Petaluma River	Selected Special Status Species: Central Valley spring-run Chinook salmon (Oncorhynchus tshawytscha) [FE] Central Valley Steelhead (Oncorhynchus mykiss) [FT/CSC] Coho salmon (Oncorhynchus kisutch) [FT/SE] Delta smelt (Hypomesus transapacificus) [FT]	46
	According to CDFG/NMFS, the Petaluma River did not historically support Coho or Chinook salmon since river is low gradient stream.	30
	Chinook salmon has been observed at turning basin and near confluence with Lynch Creek.	30
	USFWS fish survey conducted in 1993 found steelhead, chinook salmon and Sacramento splittail in Petaluma River (at Lakeville Avenue Bridge).	29
	USGS has three streamflow gages in watershed: 11459000 (1948-1963), 11459150 (1998-2002), 11459300 (1975-1981).	27
	CDFG has identified four creeks as having reasonable potential to provide steelhead habitat: Lichau, Adobe, San Antonio, and to a lesser extent, Willow Brook and Lynch Creeks.	30
	Non-native/introduced species found included: American shad, black crappie, chameleon goby.	30
	Petaluma River below Lynch Creek is tidally influenced. As salinity increases, estuarine fish species start dominating lower reaches of Petaluma River including: threadfin shad, yellowfin goby, coast range sculpin, prickly sculpin.	30
	Petaluma River above Lynch Creek is nontidal. Fish species in upper reaches of Petaluma River dominated by golden shiners, mosquito fish, threespine sticklebacks, green sunfish, and coastrange sculpin.	30

APPENDIX A.4: HABITAT ENHANCEMENT
STREAM CORRIDORS: IN-STREAM HABITAT

Watershed	Existing Condition	Original Cite Reference
Petaluma River (Continued)	Lichau Creek Subwatershed: • Steelhead stream as observed from CDFG survey records conducted in 1968. • CDFG has identified creek as having greatest potential to support steelhead habitat in watershed. • 1968 stream survey identified habitat limitations due to large amounts of sand and silt. • Recommendations for fencing and revegetation in middle and lower reaches. • Recommendations for biotechnical erosion control for eroding streambanks. • No WQ data available.	30
	Adobe Creek Subwatershed: • Middle and lower reaches lack riparian vegetation. • Sedimentation occurring in stream. Some erosion in upper reaches caused by large landslides and debris flows. Stream bank erosion in middle reach from scour and poorly vegetated banks. • No WQ information.	30
	San Antonio Creek Subwatershed: • Sedimentation presents limitation for steelhead habitat in stream. Severe streambank erosion in upper reach. Severe sediment deposition in lower reach. • WQ data collected by CDFG identifies high concentrations of ammonia and conductivity. May be due to animal waste. Summer temperatures are higher (e.g. 22 to 26 ^{o}C) than optimal steelhead habitat temperature.(e.g. 13 to 16 ^{o}C). • Riparian vegetation along main stem has moderate to dense canopy.	30
	Willow Brook Subwatershed: • Fish passage to upper watershed is blocked (unknown cause). • High erosion activity in upper reach due to land slides, debris flows, and gullies. Lower reach plagued with vertical streambanks with chronic sloughing. • No WQ data available. • Upper reach densely vegetated. Middle reach has areas of both dense and sparse vegetation. Lower reach lacks riparian vegetation.	30
	Lynch Creek Subwatershed: • Fish passage to upper watershed blocked (unknown cause). • High erosion activity primarily from upper watershed due to land slides and flow debris. • Identified as high repair priority. • No WQ data available. • Riparian vegetation dense along upper reach of watershed. Middle and lower reaches have moderate to sparse riparian vegetation. • Upper Reach Petaluma River (confluence Willow Brook Creek w/ Petaluma River to Rainsville Road) contains remnants of extensive riparian forest. Recognized as unique resource to be protected/enhanced. Will provide stock for restoration of native riparian habitat in lower reaches of Petaluma River. (PR AEP)	30

APPENDIX A.4: HABITAT ENHANCEMENT
STREAM CORRIDORS: IN-STREAM HABITAT

Watershed	Existing Condition	Original Cite Reference
Novato Creek	Selected Special Status Species: Central Valley spring-run Chinook salmon (Oncorhynchus tshawytscha) [FE] Central Valley Steelhead (Oncorhynchus mykiss) [FT/CSC]	46
	Chinook have been observed by Flood Control Staff in Novato Creek and Vinyard Creek 2000-03	20
	Steelhead trout observed in Novato Creek in surveys conducted by Alice Rich and Associates in 1996 for the "Stream Management Guidelines" report.	20
	Chinook salmon not observed in Novato Creek in 1996 survey.	20
	Other fish species observed in creek included: threespine stickleback, California roach, Sacramento sucker, common carp, goldfish	20
	Middle reach of Novato Creek (within city limits) is suitable for roaches and stickleback but only marginally suitable for salmonids. Poor salmonid habitat.	47
	Within middle reaches of Novato Creek (within city limits), some lateral scour pools were present. These were mostly associated with undercut banks, cement walls, rip rap, and tree roots.	47
	Water temperatures in middle reach (e.g. between Diablo and Grant Avenues) during month of April ranged from 11 ^{o}C to 12 ^{o}C, well within acceptable ranges for steelhead trout habitat.	47
	Middle reach (e.g. between Diablo and Grant Avenues) substrate consists mostly of sand and silt, marginally suitable for salmonid spawning.	47
	Pacheco pond fish kills in April 2001 (e.g. lower Novato Creek).	48
	Brown alga found in middle reach during Spring. Eutrophication occurring ahead of normal timing.	47
	Instances of trash (e.g. shopping carts, chair) in middle reach of creek (e.g. between Diablo and Grant Avenues).	20
Corte Madera Creek	Selected Special Status Species: Central Valley spring-run Chinook salmon (Oncorhynchus tshawytscha) [FE] Central Valley Steelhead (Oncorhynchus mykiss) [FT/CSC] Coho salmon (Oncorhynchus kisutch) [FT/SE] - Currently extirpated, present until early 1980's	46
	Watershed maintains steelhead trout population although population declining.	7
	Other fish species in watershed include: threespine stickleback, California roach, sculpin species, and Sacramento sucker.	7
	Limiting factors in stream includes: lack of stream flows, high water temperatures, and habitat modifications	7
	Lack of streamflows resulting in high water temperatures, potentially "thermally stressful" for steelhead. There are still "thermal refuge" areas in streams that could support steelhead habitat during summer months.	7

APPENDIX A.4: HABITAT ENHANCEMENT
STREAM CORRIDORS: IN-STREAM HABITAT

Watershed	Existing Condition	Original Cite Reference
Corte Madera Creek (Continued)	Dozens of hoses in creeks that appear to be diverting water.	7
	USACE flood control channel serves only as difficult migration route. Lack of protective cover exacerbates bird preying on juvenile emigrating steelhead.	7
	Poor condition of fish ladder located upstream of USACE flood control channel.	7
	Upstream reach consists of long lateral scour pools alternating with riffle areas. This habitat is used by a number of fish species although not in great abundance. Stagnant pool areas due to low streamflows, rip rap and wooden retaining walls.	49
	Instances of trash in creeks (plastics, cans, water heater)	7
	Little water quality monitoring.	7
	San Anselmo Creek Subwatershed: • Identified by Marin County as perennial. • Had great variety of habitats since upper reach originates in pristine Cascade Canyon Open Space Preserve. • Alternating lateral scour pool and riffle sequences. In lower reach, lateral scour pools associated with retaining walls and rip rap. In upper reaches, associated with bedrock.	7
	Cascade Creek Subwatershed: • Identified by Marin County as perennial. • Best trout habitat. • Fish boundary to upper reach = Cascade Falls.	7
	Sleepy Hollow Creek Subwatershed: • Identified by Marin County as perennial, although some sections are subterranean during summer months. • Low flows and heavily urbanized channel (e.g. concrete in creek, bridge pillars, retaining walls). • Habitat in low reach suitable for stickleback and roach, steelhead trout are present in pools. Substrate composed primarily of sand and silt. • Some garbage in creeks (cans, plastics, water heater).	7
	Ross Creek Subwatershed: • Identified by Marin County as an intermittent stream. • Creek is dry during summer months. Only area supporting trout habitat is in upper reaches, within Natalie Coffin Greene Park area. • Flow in upper part of creek determined by water seeping from the dam and water overtopping over spillway from Phoenix Lake.	7 (Andrews)
	Fairfax Creek Subwatershed: • Identified by Marin County as perennial. Impassable for steelhead due to the lower 435 feet being culverted up to its confluence with San Anselmo Creek. • Lack of streamflows by end of summer months.	7

APPENDIX A.4: HABITAT ENHANCEMENT
STREAM CORRIDORS: IN-STREAM HABITAT

Watershed	Existing Condition	Original Cite Reference
Miller Creek	Selected Special Status Species: Central Valley Steelhead (Oncorhynchus mykiss) [FT/CSC] Coho salmon (Oncorhynchus kisutch) [FT/SE] - Currently extirpated, present until early 1980's	14
	Marin County Public Works working with Lucas Valley Homeowners Association to promote biotechnical bank restoration projects. Recently conducted a geomorphic assessment and sediment source study for Miller Creek (Laurel Collins, unpublished).	14
	Miller Creek maintains native trout population and provides some of best habitat for anadromous fish in Marin County.	14
	Limiting factors for in-stream habitat is upstream bank and channel erosion within Miller Creek.	14
	Creek's most severe barrier to fish passage due to channel headcut at Wetzel Ranch property. Headcut is approximately 15 feet high. Channel severely degraded upstream of headcut (within Lucas Film ranch). Restoration plan in place to establish step-pool cascade to replace fish barrier.	14
Arroyo Corte Madera del Presidio	Selected Special Status Species: Chinook salmon (Oncorhynchus tshawytscha) [FE] Central Valley Steelhead (Oncorhynchus mykiss) [FT/CSC] Coho salmon (Oncorhynchus kisutch) [FT/SE] - extirpated since early 1981	46
	Limiting factor dictating fish abundance and diversity in watershed is lack of stream flows.	50
	From San Pablo Bay to center of Mill Valley, creek is highly channelized. It offers limited habitat for salmonids and mostly serves strictly as a migration route. Substrate is mostly sand and silt, therefore unsuitable for rearing. There is little protective riparian cover available. Habitat supports fish that can adjust to freshwater/saline conditions (e.g. threespine stickleback, *gasterosteus aculeatus*).	50
	From Mill Valley center to Blithdale Canyon, Creek becomes more natural although there are some large culverts.	50
	Old Mill Creek (tributary) offers the best habitat for salmonids.	50
	Warner Creek (tributary) highly affected by urban encroachment. Lower reaches flow under concrete or through cement channels. Upstream reach passes through Mill Valley Golf Course.	50
	Reed Creek is a very narrow, channelized stream with limited habitat value for salmonids.	50
	Middle reach (e.g. La Goma St. to Locust Ave.) good habitat for: threespine stickleback, rough sculpin, and California roach.	50
	Remains of cement dam upstream of Locust Avenue bridge could impede stream flows during low flow conditions.	50