

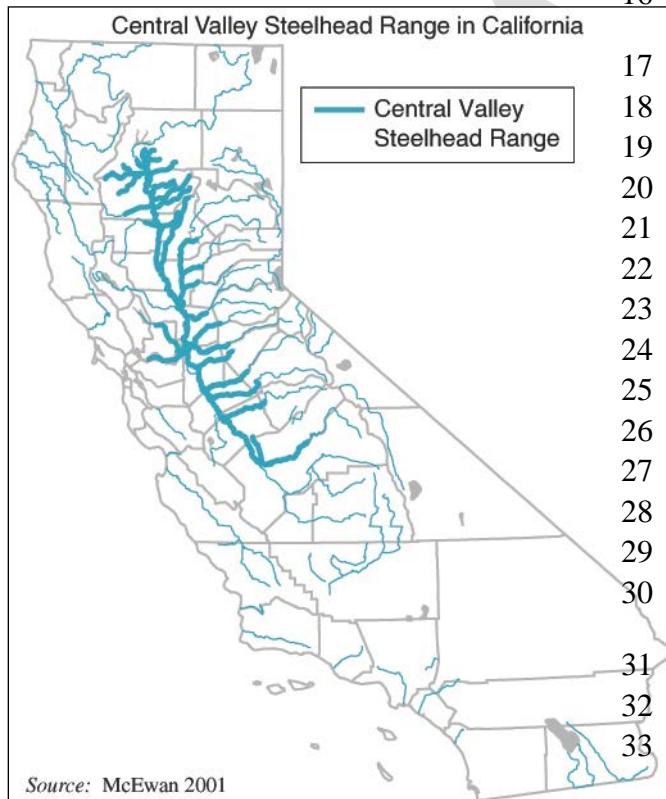
1 **A.17 CENTRAL VALLEY STEELHEAD**
 2 **(*ONCORHYNCHUS MYKISS*)**



illustration by Joseph Tomelleri

3 **A.17.1 Legal and Other Status**

4 The Central Valley steelhead Evolutionarily Significant Unit
 5 (ESU)¹ was federally listed as threatened on March 19, 1998 (NOAA 1998). This listing
 6 included, “only natural spawned populations of steelhead (and their progeny) residing below
 7 naturally and man-made impassable barriers (e.g., impassible waterfalls and dams). . . in the
 8 Sacramento and San Joaquin Rivers and their tributaries” (NOAA 1998). Steelhead in San Pablo
 9 and San Francisco Bays and their tributaries were not included in this ESU. On June 14, 2004,
 10 the National Marine Fisheries Service (NMFS) proposed that all West Coast steelhead be
 11 reclassified from ESUs to Distinct Population Segments (DPS)² and proposed to retain Central
 12 Valley steelhead as threatened (69 FR 33102). Threatened status of the Central Valley DPS was
 13 reaffirmed on January 5, 2006 (NOAA 2006). This decision included the Coleman National Fish
 14 Hatchery and Feather River Hatchery steelhead populations. Although previously included in
 15 the ESU, these populations were not deemed essential for conservation and were, therefore, not
 16 included in the listed steelhead population.



17 Critical habitat for the Central Valley
 18 steelhead was designated throughout the
 19 Central Valley on September 2, 2005
 20 (NOAA 2005a). Critical habitat was
 21 further characterized in the Federal
 22 Register Final Rule for steelhead (NOAA
 23 2006). Critical habitat for the species is
 24 divided into 22 hydrologic units by
 25 watersheds. Of these, two occur in Butte
 26 County and include the Marshville and
 27 Butte Creek Hydrologic Units. These
 28 units include the Feather River through
 29 Oroville and Little Chico, Butte, Little
 30 Butte, and Little Dry creeks near Paradise.

31 Central Valley steelhead are not listed
 32 under the California Endangered Species
 33 Act but are designated as a California

¹ An ESU is defined as a population that: 1) is substantially reproductively isolated from conspecific populations and 2) represents an important component in the evolutionary legacy of the species” (Johnson et al. 1994).
² A DPS is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or distinct population segments of vertebrate species (NOAA 2011).

1 Species of Special Concern.

2 **A.17.2 Species Distribution and Status**

3 **A.17.2.1 Range and Status**

4 West Coast steelhead occur in Washington, Oregon, Idaho, and throughout California as far
5 south as San Mateo Creek in San Diego County (McEwan 2001). The Central Valley steelhead
6 DPS was once widespread throughout the Central Valley. Historically, steelhead likely occurred
7 from the McCloud River and other northern tributaries in the Central Valley to Tulare Lake and
8 the Kings River in the southern San Joaquin Valley (McEwan 2001, Good et al. 2005). More
9 than 95 percent of historical spawning habitat is currently inaccessible to steelhead, and, before
10 major dam construction, between 1 and 2 million steelhead may have spawned in Central Valley
11 waterways (McEwan 2001).

12 No reliable estimates of historical Central Valley steelhead population size currently exist. Based on
13 monitoring below the confluence of the Sacramento and San Joaquin rivers at Chipps Island in
14 1997 to 1999 and calculations reported in Good et al. (2005) using generous assumptions,
15 roughly 100,000–300,000 steelhead juveniles are produced naturally each year in the Central
16 Valley. In the 1950s, the average estimated spawning population size above the mouth of the Feather
17 River in the Sacramento River system was 20,540 fish (McEwan and Jackson 1996). In 1991-1992,
18 the annual run size for the total Sacramento River system was likely less than 10,000 adult fish.

19 The population numbers returning to the Red Bluff Diversion Dam fish ladders have decreased
20 substantially since 1966. In the late 1960s, roughly 20,000 fish passed through the fish ladders;
21 in 1994, only 2,000 returned (Good et al. 2005). These statistics include hatchery fish from
22 Coleman National Fish Hatchery.

23 The present distribution of Central Valley steelhead is greatly reduced from their historical range,
24 mostly due to impassible dams that block access to spawning and rearing habitat. Naturally
25 spawning populations that support anadromy have been found in the upper Sacramento River and
26 tributaries, Mill, Deer, and Butte creeks, and the Feather, Yuba, Mokelumne, Calaveras, and
27 Stanislaus rivers (McEwan 2001). Incidental captures of juvenile steelhead during Chinook
28 salmon monitoring in the Cosumnes, Tuolumne, and Merced rivers confirm a widespread
29 distribution of steelhead in accessible streams and rivers (Good et al. 2005).

30 **A.17.2.2 Distribution and Status in the Plan Area**

31 Central Valley steelhead have been observed spawning in the Plan Area in the Feather River
32 upstream of the Thermalito Afterbay outlet to the Fish Diversion Dam (DWR 1999, NOAA
33 2005b); Big Chico Creek (CDFG 1993, NOAA 2005b); Butte Creek upstream of River Mile (RM)
34 13 to upstream of the Plan Area (USFWS 2000); Little Dry Creek throughout its length in the Plan
35 Area (NOAA 2005); Little Chico Creek throughout its length in the Plan Area (NOAA 2005b);
36 and Mud Creek (NOAA 2005b) (Figure A-17). Juvenile rearing occurs in all of these waterways

1 as well as in Rock Creek and Lindo Channel. Although the California Natural Diversity Database
2 (CNDDDB 2006) has no records of Central Valley steelhead within Butte County, critical habitat
3 has been identified by NMFS to include the Feather River, Little Chico Creek, Butte Creek, Little
4 Butte Creek, and Little Dry Creek (NOAA 2005b).

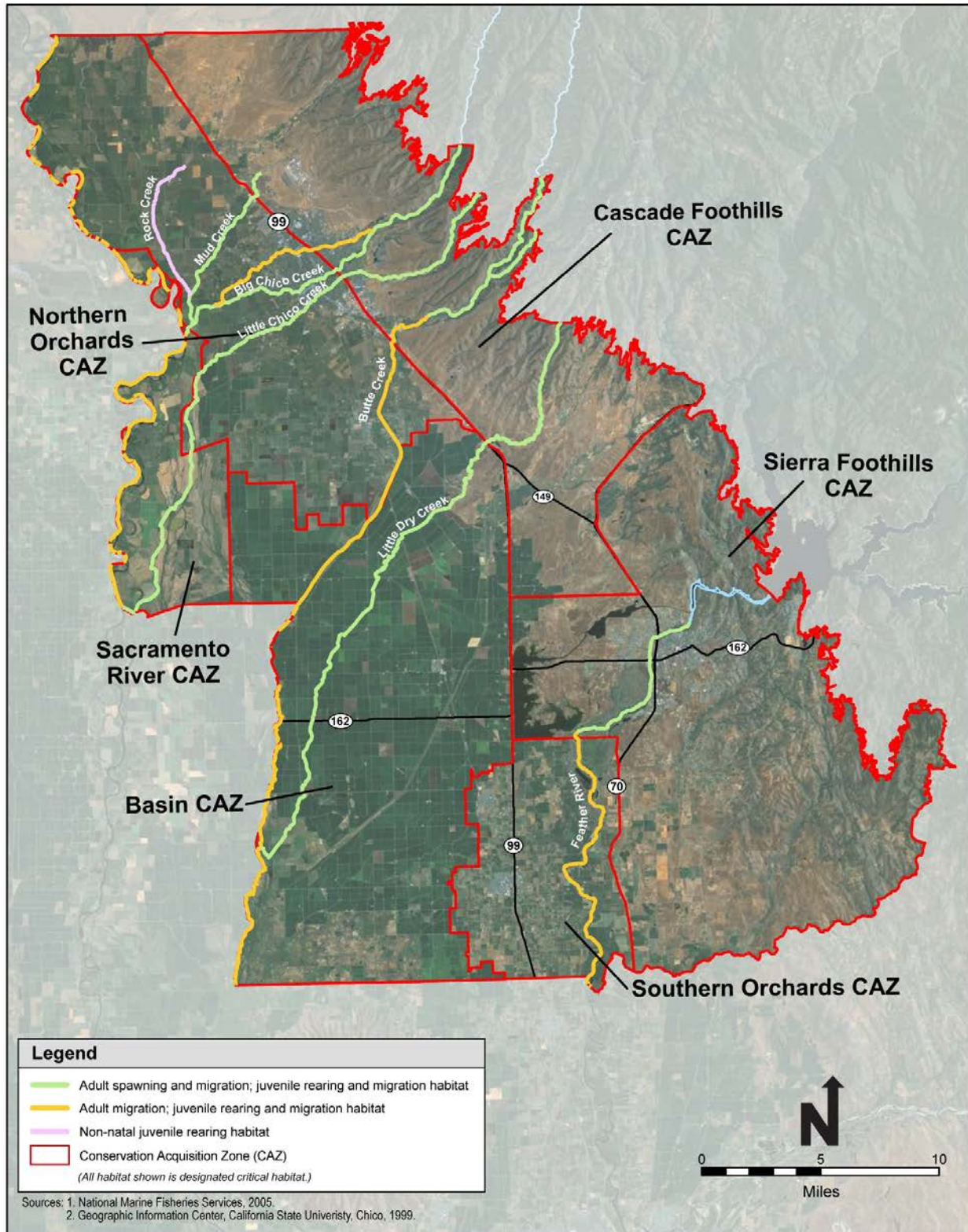
5 **A.17.3 Habitat Requirements and Special Considerations**

6 Optimal habitat for steelhead throughout its range on the Pacific Coast can generally be
7 characterized by clear, cool water with abundant instream cover, well-vegetated stream banks,
8 relatively stable water flow, and a 50:50 pool-to-riffle ratio (Raleigh et al. 1984). Although
9 optimal water temperatures for steelhead are considered to range from 53.8°F to 68°F (12°C to
10 20°C), various sources document southern steelhead as persisting in streams with water
11 temperatures ranging from 58°F to 80°F (14.4°C to 25.5°C) during the summer and early fall
12 months of drought years (Titus et al. 2003). The critical thermal maximum is reported to be up
13 to 85°F (29.4°C) (Lee and Rinne 1980). Maximum water temperature thresholds have been
14 established by NOAA (2009) for spawning and egg incubation at 56°F and for juvenile rearing
15 and juvenile and adult migration at 65°F.

16 In fresh water, steelhead use freshwater habitat for spawning, rearing, and migration (NOAA
17 2000). Essential features of steelhead habitat include adequate substrate, water quality and
18 quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and
19 safe passage conditions. In general, appropriate stream flow, water temperature, and water
20 chemistry (e.g., high dissolved oxygen and low turbidity) are necessary for adult migration to
21 spawning areas and juvenile migration to the ocean. Suitable water depth, velocity, and substrate
22 composition are the primary requirements for spawning, although water temperature and
23 turbidity are also important. Dissolved oxygen, pH, and water temperature all affect survival of
24 incubating embryos. Fine sediment particles (sand and smaller) can settle into the spaces
25 between larger substrate particles (such as gravel and cobbles) in the redd, which reduces water
26 flow and dissolved oxygen concentrations.

27 For juvenile steelhead, living space (defined by water depth and velocity), shelter from predators
28 and adverse environmental conditions, a food supply, and suitable water quality and quantity are
29 necessary for survival and development while in fresh water. Young-of-the-year steelhead use
30 shallow water and constituent habitats whereas larger, older juveniles use deeper water for
31 ontogeny and survival (A. Spina, unpublished data). All age classes, however, may seek cover
32 and cool water in pools during the summer (Nielsen et al. 1994), especially when flow, and
33 consequently space, decline during the summer and fall (Kraft 1972).

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Figure A-17. Central Valley Steelhead Modeled Habitat

1 The five primary constituent elements of freshwater critical habitat for steelhead include the
2 following:

- 3 • Freshwater spawning sites (i.e., providing suitable water temperatures and instream flows
4 for successful spawning in the upstream reaches of the tributary rivers);
- 5 • Freshwater rearing sites (i.e., providing suitable water quality for juvenile rearing,
6 instream flows to support physical habitat, connectivity with floodplains, tidal habitat,
7 channel margin habitat, and other juvenile rearing areas, and providing suitable food
8 resources for juvenile rearing);
- 9 • Freshwater migration corridors (i.e., reducing and avoiding passage barriers and
10 impediments, providing suitable water quality and instream flows to support access and
11 connectivity for migration within the tributary rivers, seasonally inundated floodplains
12 and tidal habitats, and migration pathways through the Delta); and
- 13 • Estuarine areas (i.e., providing unobstructed migration and rearing opportunities, suitable
14 water quality with salinity conditions that support juvenile and adult physiological
15 transitions between freshwater and saltwater, and providing food resources to support
16 juvenile growth and survival) (NOAA 2005a, 2006).

17 **A.17.4 Life History**

18 Steelhead are the anadromous form of rainbow trout, migrating from the Pacific Ocean to
19 upstream rivers and streams to spawning grounds. Adult steelhead enter creeks in the winter
20 (September to March), usually after the first substantial rainfall, and move upstream to suitable
21 spawning areas. Spawning can occur in winter to spring (January through March, or April in
22 some years), generally in riffle areas or the tails of pools. Suitable spawning gravels generally
23 are 0.5 to 3 inches in diameter, are not heavily compacted, and have low amounts of sand or silt
24 in them; however, steelhead can successfully spawn in gravels not meeting these characteristics.
25 Females dig a nest, or redd, in the gravel and deposit their eggs, the males fertilize the eggs, and
26 the female covers the nest with gravel.

27 After eggs hatch (3.5 to 5 weeks), fry emerge from the gravel in 2 to 6 weeks in late May to early
28 June, and disperse throughout the creek, typically occupying shallow areas along stream
29 margins. Juvenile steelhead often move to deeper water as they grow and will remain in
30 freshwater for an average of 2 years before migrating to the ocean (NOAA 1997). Downstream
31 movement of kelts³ generally occurs from January through April. Downstream juvenile
32 migration usually occurs from October to May. Photoperiod, stream flow, and temperature
33 appear to influence emigration timing (Shapovalov and Taft 1954, Bjornn and Reiser 1991,
34 Holubetz and Leth 1997). Juvenile steelhead may spend several weeks in the coastal lagoon or
35 estuary of a stream before entering the ocean. They reside in the ocean for 2 to 3 years before
36 returning to their natal stream to spawn (NOAA 1997), although in wet years steelhead may

³ “Kelt” is the name given to adult salmon and steelhead after they have spawned.

1 return to spawn after only one year in the ocean (Moyle et al. 1995). Adults can spawn more
2 than once, although most do not spawn more than twice (NOAA 1997).

3 **A.17.5 Threats**

4 Steelhead populations have been most significantly impacted by the construction of dams that block
5 access to headwaters of the main stem Sacramento and San Joaquin rivers and all the major
6 tributaries (McEwan and Jackson 1996). The construction of barrier dams along the migratory
7 streams has blocked steelhead passage to many natal tributaries, resulting in the loss of spawning
8 and holding habitat. Compared to historical extent, the spawning and rearing habitat accessible
9 to steelhead has been substantially reduced. Dam-regulated low flow periods and alterations in
10 river flows are other limiting factors for steelhead migration and reproduction. During low
11 flows, fish are unable to reach natal spawning habitat or become disconnected and isolated from
12 flowing water. In dry years, some individuals may be blocked from their streams and forced to
13 remain in main rivers where breeding habitat is marginal.

14 Within Butte County, a major threat to steelhead is the construction of Pacific Gas and Electric's
15 Butte Creek and Centerville head dams in upper Butte Creek, which has eliminated access to the
16 headwaters of the Butte Meadows basin (Brown 1992 cited in McEwan and Jackson 1996). The
17 range of steelhead for spawning is restricted to lower Butte Creek and tributaries. Ten diversion
18 dams are located on lower Butte Creek. These dams have fish ladders, but are known to impede
19 salmon and steelhead migration (McEwan and Jackson 1996). These diversions result in less
20 than adequate flows and blocked passage for steelhead. Mill and Deer creeks and other minor
21 Sacramento River tributaries with passable dams hold the last adequate spawning and rearing
22 habitat available to steelhead in the Central Valley (McEwan and Jackson 1996).

23 Elevated water temperatures are the result of inadequate carryover storage in Shasta and other
24 reservoirs and warm agricultural runoff (McEwan and Jackson 1996). Steelhead require cool
25 water temperatures, and increases in water temperatures negatively impact the rate of survival.
26 Land use activities associated with logging, road construction, urban development, mining,
27 livestock grazing, agriculture, and recreation are causing a decline in quantity and quality of fish
28 habitat by changing streambank and channel morphology, altering water temperatures, degrading
29 water quality, and blocking access to spawning areas (McEwan and Jackson 1996).

30 Artificial propagation of steelhead at multiple Central Valley hatcheries presents threats to the
31 wild steelhead population (NOAA 2009b). A major concern is genetic introgression by hatchery
32 origin fish that spawn naturally and interbreed with wild fish (McEwan and Jackson 1996).
33 Genetic introgression is thought to introduce maladaptive traits to wild stocks that can reduce
34 their survival and fitness (Araki et al. 2007).

1 A.17.6 Relevant Conservation Efforts

2 Several efforts have been established by DFG to conserve and restore steelhead throughout
3 California, including 100 percent marking of hatchery-produced steelhead, zero bag limit for
4 unmarked steelhead, gear restrictions, harvest closures, and size limits.

5 Biological opinions for State Water Project (SWP) and Central Valley Project (CVP) operations
6 (e.g., NMFS 2009a) and other federal projects involving irrigation, water diversion, and fish
7 passage have improved or minimized adverse impacts on steelhead in the Central Valley. In
8 1992, an amendment to the authority of the CVP through the Central Valley Project
9 Improvement Act (CVPIA) was enacted to give protection of fish and wildlife equal priority with
10 other Central Valley Project objectives. From this Act arose several programs that have
11 benefited listed salmonids. The USFWS's Anadromous Fish Restoration Program is engaged in
12 monitoring, education, and restoration projects designed to contribute toward doubling the
13 natural populations of select anadromous fish species residing in the Central Valley, including
14 steelhead. Restoration projects funded through the program include fish passage, fish screening,
15 riparian easement and land acquisition, development of watershed planning groups, instream and
16 riparian habitat improvement, and gravel replenishment.

17 The CALFED Ecosystem Restoration Program (ERP) has conducted restoration actions that
18 include installation of fish screens, modification of barriers to improve fish passage, habitat
19 acquisition, and instream habitat restoration. A major CALFED ERP action currently underway
20 is the Battle Creek Salmon and Steelhead Restoration Project. This project will restore 77
21 kilometers (km) (48 miles) of habitat in Battle Creek to support steelhead and Chinook salmon
22 spawning and juvenile rearing at a cost of more than \$90 million. The project includes removal
23 of five small hydropower diversion dams, construction of new fish screens and ladders on
24 another three dams, and construction of several hydropower facility modifications to ensure
25 continued hydropower operations. This restoration effort is believed to be the largest cold water
26 restoration project to date in North America.

27 Oroville Dam Federal Energy Regulatory Commission (FERC) relicensing efforts on the Feather
28 River have considered instream flows and temperature management for steelhead spawning and
29 juvenile rearing downstream of the dam.

30 The Fish Passage Improvement Project at the Red Bluff Diversion Dam is building a pumping
31 facility to provide reliable water supply for high-valued crops in Tehama, Glenn, Colusa, and
32 northern Yolo counties while providing year-round unimpeded fish passage. Gate closures at the
33 dam have historically interrupted the passage of steelhead and other migratory species.

34 The Bay Delta Conservation Plan is under development to contribute to the recovery of Central
35 Valley steelhead and other fish species. Proposed conservation measures under the plan that
36 would benefit steelhead include restoration of up to 65,000 acres of tidal wetland, 10,000 acres
37 of floodplain, and 10 linear miles of channel margin habitat; reductions in predation;

1 improvements in dissolved oxygen levels in the Stockton Deep Water Ship Channel; reductions
2 in illegal harvest; improvements in fisheries in the Yolo Bypass; and contributions to hatchery
3 and genetic management plans at Central Valley hatcheries.

4 Mitigation under the Delta Fish Agreement has increased the number of wardens enforcing
5 harvest regulations for steelhead and other fish in the Bay-Delta and upstream tributaries by
6 creating the Delta Bay Enhanced Enforcement Program (DBEEP). Initiated in 1994, DBEEP
7 currently consists of nine wardens and a supervisor.

8 Many smaller tributaries to the Sacramento and San Joaquin rivers have local watershed
9 conservancies with master plans to contribute to conservation and recovery of steelhead and
10 other salmonids.

11 **A.17.7 Species Habitat Suitability Model**

12 Steelhead migration, spawning, and rearing habitats are defined as migration, spawning, and
13 rearing habitats delineated by NMFS (2005b) and GIC (1999) (Figure A-17).

14 **Spawning Habitat.** Spawning habitat of Central Valley steelhead exists in multiple waterways
15 throughout the Plan Area. Spawning occurs in the Plan Area throughout Mud Creek, Little
16 Chico Creek, Big Chico Creek, and Little Dry Creek, in Butte Creek upstream of River Mile
17 (RM) 13 to outside the Plan Area, and in the Feather River upstream of the Thermalito Afterbay
18 Outlet to the Fish Diversion Dam.

19 **Adult Migration Habitat.** Adult migration habitat occurs in and downstream of all spawning
20 habitat locations in the Plan Area.

21 **Juvenile Rearing and Migration Habitat.** Juvenile rearing and migration habitat occurs
22 throughout adult spawning and migration habitat. Some nonnatal juvenile steelhead rearing has
23 also been observed in Rock Creek, a tributary to Big Chico Creek.

24 **Assumptions.** Data from NMFS were used for this model because NMFS is the federal agency
25 responsible for managing steelhead and, as such, is considered to be the authority on the
26 distribution of the species and its habitat. Data gaps in the NMFS (2005) GIS database were
27 augmented with information from Chico State University's Geographic Information Center
28 (1999).

29 **A.17.8 Recovery Plan Goals**

30 The Public Draft Recovery Plan for Central Valley salmonids, including steelhead, was released
31 by NMFS on October 19, 2009. Although not final, the overarching goal in the public draft is
32 the removal of, among other listed salmonids, the Central Valley steelhead DPS from the Federal
33 List of Endangered and Threatened Wildlife (NMFS 2009a). Several objectives and related
34 criteria represent the components of the recovery goal, including the establishment of at least two

1 viable populations within each historical diversity group, as well as other measurable biological
2 criteria.

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