Chapter 13

State (s): Oregon and Idaho

Recovery Unit Name: Hells Canyon Complex

Region 1
U S Fish and Wildlife Service
Portland, Oregon

DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recover and/or protect the species. Recovery plans are prepared by the U.S. Fish and Wildlife Service and, in this case, with the assistance of recovery unit teams, State and Tribal agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views or the official positions or indicate the approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. Recovery plans represent the official position of the U.S. Fish and Wildlife Service *only* after they have been signed by the Director or Regional Director as *approved*. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

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HELLS CANYON COMPLEX RECOVERY UNIT
CHAPTER OF THE BULL TROUT RECOVERY PLAN

EXECUTIVE SUMMARY

CURRENT SPECIES STATUS

The U.S. Fish and Wildlife Service issued a final rule listing the Columbia River and Klamath River populations of bull trout (*Salvelinus confluentus*) as a threatened species under the Endangered Species Act on June 10, 1998 (63 FR 31647). The Hells Canyon Complex Recovery Unit includes basins in Idaho and Oregon draining into the Snake River and its associated reservoirs from below the confluence of the Weiser River downstream to Hells Canyon Dam. This recovery unit contains three Snake River reservoirs; Hells Canyon, Oxbow, and Brownlee. Major watersheds are the Pine Creek, Powder River, and Burnt River drainages in Oregon, and the Indian Creek and Wildhorse River drainages in Idaho.

HABITAT REQUIREMENTS AND LIMITING FACTORS

A detailed discussion of bull trout biology and habitat requirements is provided in Chapter 1 of this recovery plan. The limiting factors discussed here are specific to the Hells Canyon Complex Recovery Unit Chapter. Currently, habitat fragmentation and degradation are likely the most limiting factors for bull trout throughout the Hells Canyon Complex Recovery Unit. In the Snake River, large dams of the Hells Canyon Complex lack fish passage and have isolated bull trout among three basins, the Pine Creek and Indian Creek watersheds, Wildhorse River, and Powder River. Dams, irrigation diversions, and road crossings have formed impassable barriers to fish movement within the basins, further fragmenting habitats and isolating bull trout. Land management activities that degrade aquatic and riparian habitats by altering stream flows and riparian vegetation, such as water diversions, past and current mining operations, timber harvest and road construction, and improper grazing practices, have negatively affected bull trout in several areas of the recovery unit. Bull trout are also subject to negative interactions with nonnative brook trout in streams where the species occur together.

RECOVERY GOALS AND OBJECTIVES

The goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining, complex interacting groups of bull trout distributed across the species native range, so that the species can be delisted**. To achieve this goal the following objectives have been identified for bull trout in the Hells Canyon Complex Recovery Unit:

- Maintain current distributions of bull trout and restore distributions in previously occupied areas within the Hells Canyon Complex Recovery Unit.
- Maintain stable or increasing trends in adult bull trout abundance.
- Restore and maintain suitable habitat conditions for all life history stages and forms.
- Conserve genetic diversity and provide opportunity for genetic exchange.

RECOVERY CRITERIA

Recovery criteria for the Hells Canyon Complex Recovery Unit are established to assess whether actions are resulting in the recovery of bull trout in the basin. The criteria developed for bull trout recovery address quantitative measurements of bull trout distribution and population characteristics on a recovery unit basis.

1. **Maintain current distribution of bull trout in the 17 local populations identified, and expand distribution by establishing bull trout local populations in three areas identified as potential spawning and rearing habitat**. The number of existing local populations and areas identified as containing potential spawning and rearing habitat by core area are: Pine-Indian-Wildhorse Core Area, 7 existing local populations and 2 areas with potential spawning and rearing habitat; and Powder River core area, 10 existing local populations and 1 area with potential spawning and rearing habitat

(see Table 6). Achieving criterion 1 entails: (1) maintaining existing local populations; (2) implementing activities intended to evaluate the feasibility of establishing additional bull trout local populations in potential spawning and rearing habitat, and (3) encouraging the establishment of additional bull trout local populations in potential spawning and rearing habitat in both core areas of the recovery unit (*e.g.,* by implementing recovery tasks to provide accesses to the areas and restoring habitat). Establishing additional local populations will contribute to achieving criteria 2 and 3, and increase the likelihood of achieving the recovery goal for the Hells Canyon Complex Recovery Unit.

2. **Estimated abundance of adult bull trout is at least 5,000 individuals in the Hells Canyon Complex Recovery Unit**. The recovered abundance of adult bull trout for the recovery unit was estimated based on professional judgement of the recovery unit team in consideration of surveyed fish densities, habitats, and potential fish production after threats have been addressed to allow expansion of distribution within existing local populations and establishment of additional local populations in the three areas with potential spawning and rearing habitat. The recovered abundance of adult bull trout should be evenly distributed between the two core areas.

3. **Adult bull trout exhibit stable or increasing trends in abundance in the Hells Canyon Complex Recovery Unit**. The intent of this criterion is that adult bull trout in core areas presently below their recovered abundance exhibit increasing trends, whereas bull trout in core areas that may be at their recovered abundance exhibit stable trends.

4. **Specific barriers inhibiting bull trout movement in the Hells Canyon Complex Recovery Unit have been addressed**. Many barriers to bull trout movement and migration exist within the recovery unit, and this recovery plan recommends several tasks to identify, assess, and reduce barriers to bull trout passage. Although

achieving criteria 1 through 3 is expected to depend on providing passage at barriers (including barriers due to physical obstructions, unsuitable habitat, and water quality) throughout the recovery unit, the intent of criterion 4 is to note specific barriers to address or tasks that must be performed to achieve recovery (*i.e.,* barriers evaluated and appropriately addressed if found to be feasible). Specific barriers to address that are required to achieve this criterion are Oxbow Dam in the Pine-Indian-Wildhorse Core Area, and Thief Valley Dam, Mason Dam, and Wolf Creek Dam in the Powder River Core Area (see task 1.2.4). Achieving criterion 4 also entails implementing additional tasks addressing barriers created by such factors as irrigation diversions, stream dewatering, and road crossings (*i.e.,* tasks 1.2.2, 1.2.3, and 1.2.6) sufficiently to achieve criteria 1 through 3. Tasks intended to assess the feasibility of providing passage should be conducted with coordinated review during implementation with the U.S. Fish and Wildlife Service.

ACTIONS NEEDED

Recovery for bull trout will entail reducing threats to the long-term persistence of populations and their habitats, ensuring the security of multiple interacting groups of bull trout, and providing habitat and access to conditions that allow for the expression of various life history forms. Seven categories of actions needed are discussed in Chapter 1; tasks specific to this recovery unit are provided in this chapter.

ESTIMATED COST OF RECOVERY

The total cost of bull trout recovery in the Hells Canyon Complex Recovery Unit is estimated at $9 million spread over a 25-year period. This estimate does not include costs associated with some activities (*e.g.,* capital improvements for fish passage and protection) for which determination of the feasibility and design options are the outcomes of recommended tasks in this chapter, nor does this estimate include costs associated with tasks that are normal agency responsibilities under existing authorities. Total costs include estimates of expenditures by local, Tribal,

State and Federal governments and by private business and individuals. These costs are attributed to bull trout conservation, but other aquatic species will also benefit. Successful recovery of bull trout in the Hells Canyon Complex Recovery Unit is contingent on removing barriers, improving habitat conditions, providing fish passage, and removal of nonnative species that are adversely affecting bull trout.

ESTIMATED DATE OF RECOVERY

Time required to achieve recovery depends on bull trout status, factors affecting bull trout, implementation and effectiveness of recovery tasks, and responses to recovery tasks. A tremendous amount of work will be required to restore impaired habitat, reconnect habitat, and eliminate threats from nonnative species. In the Hells Canyon Complex Recovery Unit, bull trout currently have a wide distribution, but exist in relatively low abundance in several areas. Three to five bull trout generations (15 to 25 years), or possibly longer, may be necessary before identified threats to the species can be significantly reduced and bull trout can be considered eligible for delisting.

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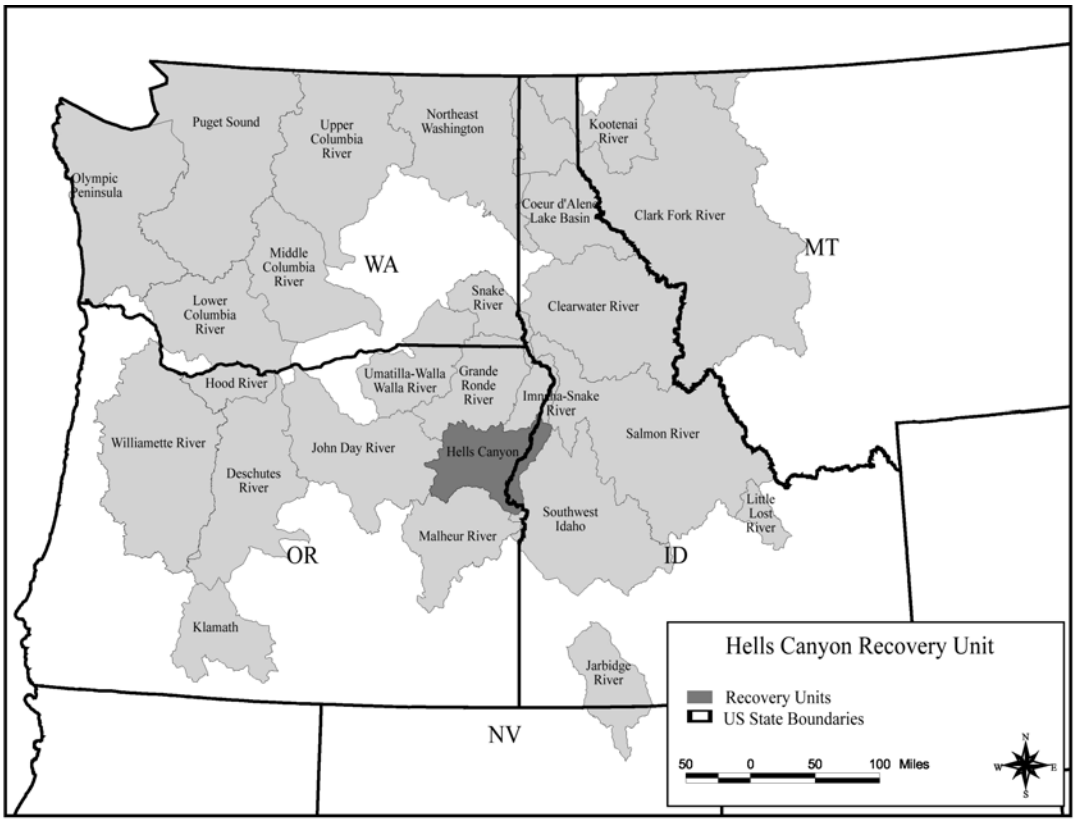
INTRODUCTION

Recovery Unit Designation

The Hells Canyon Complex Recovery Unit is 1 of 22 recovery units designated for bull trout in the Columbia River basin (Figure 1). The Hells Canyon Complex Recovery Unit includes basins in Idaho and Oregon, draining into the Snake River and its associated reservoirs from below the confluence of the Weiser River downstream to Hells Canyon Dam. This recovery unit contains three Snake River reservoirs, Hells Canyon, Oxbow, and Brownlee. Major watersheds are the Pine Creek, Powder River, and Burnt River drainages in Oregon, and the Indian Creek and Wildhorse River drainages in Idaho. Inclusion of bull trout in the Oregon tributaries (*i.e.,* Pine Creek and Powder River) in one recovery unit is based in part on a single gene conservation unit (*i.e.,* roughly the major drainages in Oregon inhabited by bull trout) recognized by the

Figure 1. Bull trout recovery units in the United States. The Hells Canyon Complex Recovery Unit is highlighted.



Oregon Department of Fish and Wildlife (Kostow 1995), which is supported by the genetic analysis conducted by Spruell and Allendorf (1997). Although the genetic composition of bull trout in the two tributaries in Idaho has not been extensively studied, the streams were included in the recovery unit due to their close proximity to the tributaries in Oregon containing bull trout, and the likelihood that bull trout from all tributaries were able to interact historically. Administratively, the Oregon Department of Fish and Wildlife established a working group to develop bull trout conservation strategies in Pine Creek, and the streams in Idaho were included in the Hells Canyon Key Watersheds in the Idaho Bull Trout Conservation Plan (Grunder 1999).

Geographic Description

The Hells Canyon Recovery Unit encompasses three 4th-field hydrologic units of the U.S. Geologic Survey. The Brownlee Reservoir hydrologic unit (hydrologic unit code (HUC)--1705201) includes the Snake River, Hells Canyon Complex of three reservoirs, and all tributaries in Idaho and Oregon from just downstream of the Weiser River confluence to Hells Canyon Dam, excluding the Burnt River and Powder River basins in Oregon. This hydrologic unit consists of 334,120 hectares (825,600 acres). The Burnt River hydrologic unit (HUC--1705202) includes the entire Burnt River basin, and consists of 282,319 hectares (697,600 acres). The Powder River hydrologic unit (HUC--1705203) includes the entire Powder River basin, and consists of 445,494 hectares (1,100,800 acres).

The Snake River flows in a generally south to north direction, and forms the boundary between Idaho and Oregon within the Hells Canyon Complex Recovery Unit. The recovery unit consists of 168 kilometers (104 miles) of the Snake River, of which most of the length is within the Hells Canyon Complex of reservoirs. Tributaries in which bull trout occur or may occur flow into the three Snake River reservoirs (Table 1). Elevations within the Hells Canyon Complex Recovery Unit range from about 2,133 to 2,438 meters (7,000 to 8,000 feet) in the Wallowa Mountains and Blue Mountains in Oregon (Buchanan *et al.* 1997) and from 2,255 meters (7,400 feet) in the Seven Devils Mountains in Idaho (Grunder 1999), to 122 meters (400 feet) at Hells Canyon Dam (Saul *et al.* 2001).

Table 1. Approximate river distances of major physical features within the Hells Canyon Complex Recovery Unit upstream of the Snake River confluence with the Columbia River.

Feature	River kilometer	River mile
Hells Canyon Dam	398	247.6
Pine Creek confluence	434	269.7
Indian Creek confluence	436	271.0
Oxbow Dam	439	272.8
Wildhorse River confluence	455	282.8
Brownlee Dam	459	285.3
Powder River confluence	476	295.8
Burnt River confluence	527	327.5
Brownlee Reservoir[1]	552	343.1
Weiser River confluence	566	351.6

[1] Upstream extent of Brownlee Reservoir.

The Hells Canyon Complex Recovery Unit is largely rural with much of the lands in Federal ownership. In the Pine Creek, Powder River, and Burnt River watersheds, combined, about half of the area is federally owned (Nowak 2001), whereas the remainder is private. The majority of lands in the Indian Creek and Wildhorse River watersheds of Idaho are federally owned (Grunder 1999). About 90 percent of the area in Indian Creek is administered by the Payette National Forest, and over half of the area in the Wildhorse River watershed is administered by the Payette National Forest and Bureau of Land Management. However, a substantial amount of private land occurs along Bear Creek, a tributary of Wildhorse River. Portions of the headwaters for Pine Creek (Norway Creek, Middle Fork Pine Creek, and West Fork Pine Creek) and the Powder River (Eagle Creek, East Fork Eagle Creek, and West Eagle Creek) occur in the Eagle Cap Wilderness Area (Nowak 2001). Reaches of the Powder River, North Powder River, and Eagle Creek, totaling 72 kilometers (44.7 miles), are designated as Wild and Scenic. Downstream portions of the recovery unit occur in the Hells Canyon Wilderness Area and Hells Canyon National Recreation Area.

The overall climate of the Hells Canyon Complex Recovery Unit is temperate continental, which consists of light precipitation, low relative humidity, rapid evaporation, abundant sunshine, and wide temperature and annual precipitation fluctuations (Nowak 2001). Mean temperatures at the lower elevations are typically 26.7 to 32.2 degrees Celsius (70 to 80 degrees Fahrenheit) in summer, and above -1.1 degrees Celsius (30 degrees Fahrenheit) during winter (Saul *et al.* 2001). Precipitation is highly seasonal with short, intense thunderstorms during summer and longer, milder storms delivering the majority of the annual precipitation during winter. Mean annual precipitation is 330 millimeters (13 inches) in the Hells Canyon area and 1,753 millimeters (69 inches) in the headwaters of Pine Creek. Some areas (*e.g.,* portions of the Powder River basin) are subject to rain-on-snow events, which reduce snow pack and may cause localized flooding.

Geology of the Hells Canyon Complex Recovery Unit consists primarily of granitic batholith formations and volcanic basalt (Saul *et al.* 2001; Nowak 2001). These and some metamorphic formations have produced soils low in clay with high erodible potential (*e.g.,* in the Powder River basin). The basalt deposits in Hells Canyon area are prone to landslides and mass wasting. Lava flows dammed the Snake River in Hells Canyon about 13 million years ago forming Lake Idaho. River flow breached the lava flow; and flows and the Bonneville flood increased downcutting in tributary canyons and distributed sediments. Vegetation within the recovery unit includes mixed conifer forests and Ponderosa pine (*Pinus ponderosa*) in forested areas, and shrub and grassland communities elsewhere.

Fish Species. Anadromous fishes (*e.g.,* chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*O. nerka*), steelhead (*O. mykiss*), and Pacific lamprey (*Lampetra tridentata*)) historically occurred in areas of the Hells Canyon Complex Recovery Unit (Saul *et al.* 2001; Stovall 2001). These species primarily migrated through the Snake River from the Pacific Ocean to spawning habitats located in tributaries either within the Hells Canyon Complex Recovery Unit or upstream (*e.g.,*the Powder River basin and the Payette River basin, respectively). Construction of impassable dams, first within the Snake River tributary basins (*e.g.,* Thief Valley Dam in the North Powder River, which was constructed in 1931) (Nowak 2001) and later in the Snake River (*i.e.,* the Hells Canyon Complex of three dams, which was

completed from 1959 through 1967) (Saul *et al.* 2001), eliminated natural runs of anadromous fishes in the recovery unit. The loss of these runs and associated nutrients derived from their carcasses is thought to have negatively affected resident fishes by reducing overall watershed productivity (Nowak 2001; Saul *et al.* 2001; Stovall 2001).

Forty-one fish species are known to have occurred, or may presently occur in the Hells Canyon Complex Recovery Unit (Table 2) (Chandler and Richter 2001; Nowak 2001; Saul *et al.* 2001). Thirty-two of these were documented in the Powder River basin (Nowak 2001). Because the remaining nine taxa were reported in the portion of the Snake River and select tributaries from C.J. Strike Dam downstream to Hells Canyon Dam (Saul *et al.* 2001), they may occur in the Hells Canyon Complex Recovery Unit. Of the 41 species, almost half (19) are native, with redband trout (*Oncorhynchus mykiss*), bull trout, and mountain whitefish (*Prosopium williamsoni*) representing the primary native salmonids. Introduced salmonids include brook trout (*S. fontinalis*), lake trout (*S. namaychush)*, and brown trout *(Salmo trutta*). Lake trout occur in a few high mountain lakes in the Powder River basin, and bull trout-brook trout hybrids have been collected in various locations (*e.g.,* Clear Creek in the Pine Creek basin of Oregon (Buchanan *et al.* 1997) and Indian Creek, which drains from Idaho into Hells Canyon Reservoir (Chandler and Richter 2001)). Most of the other introduced species are game fish (*e.g.,* black crappie (*Pomoxis nigromaculatus*), largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), and bluegill (*Lepomis macrochirus*)) provide angling opportunities in the Hells Canyon Complex reservoirs, as well as ponds and lakes.

Table 2. Species, origin, and habitats of fishes known or likely to occur in the Hells Canyon Complex Recovery Unit. (after Chandler and Richter 2001; Nowak 2001; Saul *et al.* 2001)

Common name	Scientific name	Origin	Habitats[1]
Banded killifish[2]	*Fundulus diaphanus*	native	NR
Black crappie	*Pomoxis nigromaculatus*	introduced	SR, L, P, LG
Bluegill	*Lepomis macrochirus*	introduced	SR, L, P, LG
Bridgelip sucker	*Catostomus columbianus*	native	SR, WS
Brook Trout[3]	*Salvelinus fontinalis*	introduced	SR, WS
Brown trout	*Salmo trutta*	introduced	HCR
Bull trout[3]	*Salvelinus confluentus*	native	R, T
Bullhead, black[2]	*Ameiurus melas*	introduced	SR
Bullhead, brown	*Ameiurus nebulosus*	introduced	SR, L, P, LG
Bullhead, yellow[2]	*Ameriurus natalis*	introduced	NR
Channel catfish	*Ictalurus punctatus*	introduced	SR, L, P, LG

Table 2. Species, origin, and habitats of fishes known or likely to occur in the Hells Canyon Complex Recovery Unit. (after Chandler and Richter 2001; Nowak 2001; Saul *et al.* 2001)

Common name	Scientific name	Origin	Habitats[1]
Chiselmouth	*Acrocheilus alutaceus*	native	SR, T, WS
Common carp	*Cyprinus carpio*	introduced	SR, LG
Cutthroat trout[2]	*Oncorhynchus clarki*	native	NR
Dace[2]	*Rhinichthys spp.*	native	SR
Flathead minnow[2]	*Pimephales promelas*	introduced	SR, T
Flathead catfish	*Pylodictus olivaris*	introduced	SR, L, P, LG
Lake trout	*Salvelinus namaycush*	introduced	HL[4]
Largemouth bass	*Micropterus salmoides*	introduced	SR, L, P, LG
Largescale sucker	*Catostomus macrocheilus*	native	SR, T, WS
Longnose dace	*Rhinichthys cataractae*	native	SR, T, WS
Mottled sculpin	*Cottus bairdi*	native	T
Mountain sucker	*Catostomus platyrhychus*	native	WS
Mountain whitefish	*Prosopium williamsoni*	native	SR, T
Northern pikeminnow	*Ptychocheilus oregonensis*	native	SR, T
Oriental weatherfish[2]	*Misqurnus angullicaudatus*	introduced	D
Paiute sculpin	*Cottus beldingi*	native	T
Peamouth	*Mylocheilus caurinus*	native	SR, WS
Pumpkinseed	*Lepomis gibbosus*	introduced	SR, T, L, P, LG
Redband trout[5]	*Oncorhynchus mykiss*	native	SR, T, WS
Redside shiner	*Richardsonius balteatus*	native	SR, T, WS
Shorthead sculpin	*Cottus confusus*	native	T
Smallmouth bass	*Micropterus dolomieui*	introduced	SR, T, L, P, LG
Speckled dace	*Rhinichthys osculus*	native	SR, T, WS
Tadpole madtom[2]	*Noturus gyrinus*	introduced	SR
Torrent sculpin	*Cottus rhotheus*	native	SR, T
Tui chub [2]	*Gila bicolor*	introduced	NR
Warmouth	*Lepomis gulosus*	introduced	SR, T, L, P, LG
White crappie	*Pomoxis annularis*	introduced	SR, T, L, P, LG
White sturgeon	*Acipenser transmontanus*	native	SR, HCR
Yellow perch	*Perca flavescens*	introduced	SR, L, P, LG

[1] D-ditches, HCR-Hells Canyon Complex reservoirs, L-lakes, LG-low gradient streams, NR-not reported, P-ponds, SR-Snake River mainstem, T-Snake River tributaries, WS-widespread.

[2] May inhabit Snake River areas upstream of recovery unit.

[3] Includes bull trout-brook trout hybrids.

[4] Found in only a few high elevation lakes.

[5] Includes hatchery rainbow trout.

DISTRIBUTION AND ABUNDANCE

Status of Bull Trout at the Time of Listing

In the final listing rule (63 FR 31647) the U.S. Fish and Wildlife Service identified four bull trout subpopulations in the Pine Creek watershed (Meadow Creek-Clear Creek, upper Pine Creek, East Pine Creek, and Elk Creek) and three in the Powder River basin (Powder River upstream of Mason Dam, North Powder River, and Big Muddy Creek) (U.S. Fish and Wildlife Service (USFWS) 1998). Subpopulations were not identified for bull trout inhabiting Snake River tributaries in Idaho in the listing rule. Subpopulations were isolated by impassable dams and unsuitable habitat. Although subpopulations were an appropriate unit upon which to base the 1998 listing decision, the recovery plan has revised the biological terminology to better reflect the current understanding of bull trout life history and conservation biology theory. Therefore, subpopulation terms will not be used in this chapter.

Current Distribution and Abundance

Federal and State resource agencies and the Idaho Power Company have documented the occurrence of bull trout in portions of the Hells Canyon Complex Recovery Unit (*e.g.,* Buchanan *et al.* 1997; Grunder 1999; Chandler, J.A., *in litt.* 2000; Chandler *et al.* 2001). Distributional data for bull trout in the recovery unit comes primarily from presence-absence surveys and basin-wide surveys using techniques such as electrofishing, radio telemetry, spawning ground surveys, snorkeling, and traps. Comprehensive data on bull trout abundance through time in the recovery unit does not exist.

Hells Canyon Reservoir is the downstream reservoir in the Hells Canyon hydroelectric complex, lying between Hells Canyon Dam and Oxbow Dam (Table 1), and forms the lower- most portion of the Hells Canyon Complex Recovery Unit. Bull trout occur in Hells Canyon Reservoir (Chandler, *in litt.* 2000) and two tributaries to the reservoir, the Pine Creek basin in Oregon (Buchanan *et al.* 1997) and Indian Creek basin in Idaho (Grunder 1999). The confluence of Indian Creek is within the Oxbow Dam bypass, a 3.7 kilometer (2.3 mile) reach of original river channel between Oxbow Dam

and the point of water discharged from the Oxbow Dam Powerhouse (Idaho Power Company 1999). Oxbow Dam bypass is a relatively shallow backwater area maintained with a minimum flow of 2.8 cubic meters per second (100 cubic feet per second).

During 1993 through 1999, Idaho Power Company collected a total of 13 bull trout and 4 bull trout-brook trout hybrids upstream of Hells Canyon Dam in the reservoir and Indian Creek, using a downstream migrant weir near its confluence (Chandler, *in litt.* 2000). Two bull trout, one collected near Hells Canyon Dam and the other in Oxbow Dam bypass, were implanted with radio tags and subsequently located at least 8 kilometers (5 miles) upstream in Pine Creek during the spring and summer. Locations observed for one individual within Pine Creek included North Pine Creek and a tributary, Lake Fork Creek.

In the Pine Creek basin, bull trout occur in: upper Pine Creek, which includes West Fork Pine Creek, Middle Fork Pine Creek, and East Fork Pine Creek; Clear Creek; which includes upper Clear Creek, Trail Creek, and Meadow Creek; East Pine Creek; and Elk Creek, which includes the entire length of Elk Creek, Big Elk Creek, Aspen Creek, and Cabin Creek (Buchanan *et al.* 1997). Although bull trout were noted in a creel report from Lake Fork Creek in 1965, extensive sampling of the stream since 1990 collected brook trout, but did not detect bull trout (other than the bull trout observed there during the study by Idaho Power Company). The length distribution of bull trout surveyed from various streams in the Pine Creek basin during 1994 (Buchanan *et al.* 1997), and the limited pre- and post-spawning movements exhibited by radio-tagged fish (Chandler *et al.* 2001) suggest that most bull trout in the basin are resident fish. However, the movement of radio-tagged bull trout from Hells Canyon Reservoir to Pine Creek suggest that migratory fish persist in the basin.

Bull trout abundance was estimated for four streams in the Pine Creek basin by the U.S. Forest Service in 1994 (Table 3) (Buchanan *et al.* 1997). Maximum estimated abundance for bull trout was less than 400 individuals for each stream. Several index sites have been established in bull trout spawning and rearing habitat to conduct redd counts (Fedora and Walters, *in litt.* 2001). In the eight streams where survey sites exist, the actual number of redds observed ranged from 0 to 43 per site during 1998

through 2000, which is equivalent to 0 to 37.3 redds per kilometer (0 to 60.0 redds per mile) of stream length (Table 4).

Table 3. Bull trout population estimates for subwatersheds within the Pine Creek basin based on surveys conducted by U.S. Forest Service in 1994. (From Buchanan *et al.* 1997)

Subwatershed	Sample size	Minimum population estimate[1]	Maximum population estimate[2]
North Pine Creek	98	123	368
East Pine Creek	60	75	225
Clear Creek	98	123	368
Upper Pine Creek	92	115	345
Total for basin	348	435	1,305

[1] Number of fish times 1.25 (factor developed by Kim Jones, Oregon Department of Fish and Wildlife, based on available habitat and assumption that single pass technique captures 80 percent of population).
[2] Minimum estimate times 3.

Table 4. Densities of bull trout redds (number per mile) at index sites sampled in the Pine Creek and Powder River basins, Oregon, during 1998 through 2000 (number of definite redds observed). (Fedora and Walters, *in litt.* 2001)

Site	Stream length sampled (mile)	Year		
		1998	1999	2000
		Pine Creek basin		
0Pine Creek 1	1.20	9.2 (11)	5.8 (7)	5.0 (6)
Pine Creek 2	1.00	13.0 (13)	9.0 (9)	9.0 (9)
East Fork Pine Creek 1	1.20[1]	7.5 (9)	5.8 (7)	7.1 (5)
East Fork Pine Creek 2	0.80	43.7 (35)	18.7 (15)	na
Trail Creek	0.75	na	1.3 (1)	na

Table 4. Densities of bull trout redds (number per mile) at index sites sampled in the Pine Creek and Powder River basins, Oregon, during 1998 through 2000 (number of definite redds observed). (Fedora and Walters, *in litt.* 2001)

Site	Stream length sampled (mile)	Year		
		1998	1999	2000
Meadow Creek	0.75	57.3 (43)	1.3 (1)	25.3 (19)
Clear Creek	1.30	14.6 (19)	3.1 (4)	5.4 (7)
East Pine 1	0.65	60.0 (39)	7.7 (5)	1.5 (1)
East Pine 2[2]	0.50	na	na	10.0 (5)
Elk Creek 1	1.00	10.0 (10)	1.0 (1)	6.0 (6)
Elk Creek 2	0.50	6.0 (3)	0 (0)	na
Elk Creek 3	0.50	20.0 (10)	10.0 (5)	na
Elk Creek 4	0.40	0 (0)	0 (0)	na
Aspen Creek	0.70	15.7 (11)	5.7 (4)	4.3 (3)
Powder River basin				
Anthony Creek[2]	3.40	na	0.3 (1)	na
Lake Creek[2]	2.00	na	0.5 (1)	na
Wolf Creek[2]	2.00	na	1.5 (3)	na

[1] 0.7 mile surveyed in 2000.
[2] Reconnaissance or exploratory surveys.

In Indian Creek, bull trout have been repeatedly observed in the headwaters near Bluejacket Mine and the upstream headwaters, including Camp Creek, since 1979, (Grunder 1999; Nelson 2001). Although population estimates have not been made in

the Indian Creek basin, a U.S. Forest Service habitat survey crew observed 60 bull trout in Camp Creek (Nelson 2001). The U.S. Forest Service and Idaho Department of Fish and Game personnel estimated bull trout density in a reach of Indian Creek adjacent to Bluejacket Mine by electrofishing in 1998 (Grunder 1999). Bull trout density was 2.4 fish per 100 square meters (0.2 fish per 100 square feet). Based on 27 individuals, mean total length was 170 millimeters (range 103 to 219 millimeters; mean 7.0 inches, range 4.0 to 8.6 inches) suggesting that these were resident bull trout. However, bull trout were collected at a downstream migrant weir operated during fall 1998 and 1999 near the confluence of Indian Creek (Chandler and Richter 2001). One brook trout and 10 bull trout-brook trout hybrids (210 to 280 millimeters; 8.3 to 11.0 inches) were collected in 1998. One brook trout, three bull trout-brook trout hybrids, and two bull trout (220 and 270 millimeters; 8.7 and 10.6 inches) were collected in 1999, suggesting that migratory bull trout may occur in Indian Creek.

In Wildhorse River, bull trout occur in two tributaries, Bear Creek and Crooked River (Grunder 1999). Eleven bull trout were collected in upper Bear Creek during 1999, at sites above 1,600 meters (5,250 feet) in elevation (Williams and Veach 1999) and upstream of a physical barrier (R. Nelson, Payette National Forest, pers. comm. 2002). Brook trout and a bull trout-brook trout hybrid were also collected at these sites, and a hybrid was collected at a site 1,350 meters (4,430 feet) in elevation during 2000 (Williams 2001). Twenty-seven bull trout were collected at five of six sites sampled in Crooked River during 2000. Brook trout occurred at the majority of the sites and bull trout-brook trout hybrids were present at three sites. Neither bull trout nor bull trout-brook trout hybrids were captured at a downstream migrant trap operated near the confluence of Wildhorse River in 1998 (Chandler and Richter 2001).

In the Powder River basin, bull trout occur in tributaries of the Powder River upstream of Mason Dam (Silver Creek, Little Cracker Creek, and Lake Creek), tributaries of the Powder River between Mason Dam and the North Powder River confluence (Salmon Creek, Pine Creek, Rock Creek, and Big Muddy Creek), and the upper North Powder River and some tributaries (Anthony Creek, North Fork Anthony Creek, Indian Creek, and Wolf Creek) (Buchanan *et al.* 1997). For tributaries of the lower Powder River (*i.e.,* downstream of Thief Valley Dam), oral histories from residents indicate that bull trout occurred in Big Creek and were common in Eagle Creek during the 1940's and 1950's (Gildemeister 1992). However, we have no recent

reports of bull trout in Big Creek. There are creel reports from 1965 and angler reports during the mid-1980's of bull trout in Eagle Creek, but extensive surveys in 1991 and 1994 did not detect bull trout (Buchanan *et al.* 1997). The only report of bull trout in Brownlee Reservoir was a 305-millimeter (12 inch) individual captured by net during 1959 after the reservoir had filled (Buchanan *et al.* 1997).

Bull trout redd counts and density estimates have been performed in some tributaries of the Powder River basin, primarily as components of investigations of bull trout-brook trout interactions and spawning ground surveys. Bull trout densities were estimated in five tributaries of the upper Powder River and North Powder River in 1996 during an investigation of bull trout-brook trout distribution, abundance, and interactions (Bellerud *et al.* 1997). Mean densities of bull trout were 1.0 to 9.5 individuals per 100 meters (330 feet) of stream length (Table 5). In an 8.6-kilometer reach (5.3 miles) of Silver Creek, spawning surveys were conducted to investigate the use of redds counts as an estimate of adult bull trout abundance. Multiple redd counts were conducted annually in September and October 1996 through 1999 (Bellerude *et al.* 1997; Hemmingsen *et al.* 2001a, 2001b, 2001c). The total number of redds observed per year in the study was 7 to 36 redds (Figure 2). In 1999, snorkel and electrofishing surveys were conducted in Silver Creek to determine bull trout age structure, size-at-maturity, and adult abundance (Hemmingsen *et al.* 2001c). All bull trout 150 millimeters (5.9 inches) and greater in fork length were mature; about a third below this value to 130 millimeters (5.1 inches) were mature. A total of 885 bull trout with 150 millimeters (5.1 inches) fork length and greater were estimated to occur in Silver Creek. Redd counts were also conducted in three streams during reconnaissance-level surveys in 1998 (Table 4). All bull trout inhabiting the Powder River basin are thought to be resident fish.

Figure 2. Number of bull trout redds observed annually in Silver Creek, Powder River basin, Oregon. (After Hemmingsen *et al.* 2001c).

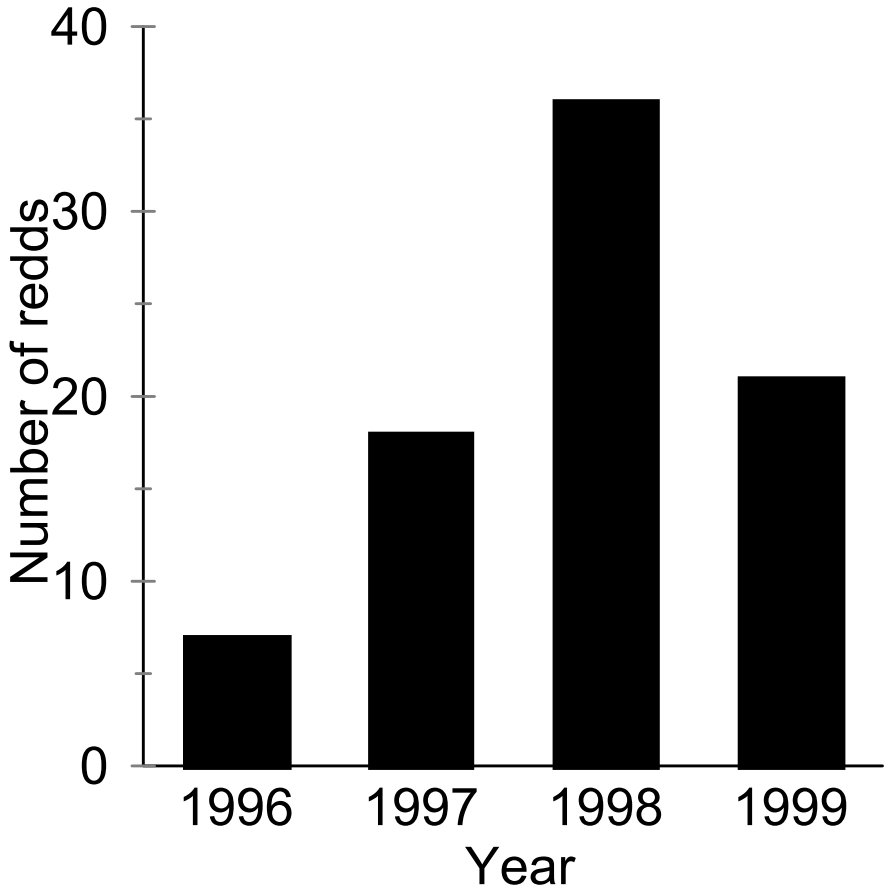


Table 5. Stream length (kilometers) and density (number per 100 meters) of bull trout (Bt) and brook trout (Bkt) collected in three zones within streams in the Powder River basin: bull trout zone (bull trout present, brook trout absence), bull trout-brook trout zone (both species present), and brook trout zone (bull trout absence, brook trout present). Density estimates were based on mean numbers of fish sampled at multiple 100-meter sites in each stream using single-pass electrofishing surveys. (After Bellerude *et al.* 1997; na–not available; English units for stream length (miles) and fish density (number per 100 feet) are given in parentheses)

	Bull trout zone		Bull trout-brook trout zone			Brook trout zone		Total stream length
Stream	Length	Density	Length	Bt density	Bkt density	Length	Density	
N. Fork Anthony Creek[1]	4.0 (2.5)	7.8 (2.4)	0.5 (0.3)	2.0 (0.6)	4.0 (1.2)	0.75 (0.5)	2.5 (0.8)	8.2 (5.1)
Indian Creek[2]	2.5 (1.6)	9.0 (2.7)	0.75 (0.5)	9.5 (2.9)	1.5 (0.5)	2.4 (1.5)	1.5 (0.5)	7.0 (4.3)
Lake Creek	2.5 (1.6)	4.7 (1.4)	na	na	na	1.0 (0.6)	1.5 (0.5)	7.5 (4.7)
Little Cracker Creek	0.5 (0.3)	1.0 (0.3)	0.5 (0.3)	2.0 (0.6)	3.0 (0.9)	na	na	3.0 (1.9)
upper N. Powder River[3]	1.0 (0.6)	5.3 (1.6)	1.5 (0.9)	1.0 (0.6)	34.7 (10.6)	7.5[4] (4.7)	34.3 (10.5)	upper reaches sampled

[1] Density of bull trout-brook trout hybrids were estimated at 1.0 fish per 100 meters (0.6 fish per 100 feet) in a 4.0-kilometer reach (0.6 mile). Two bull trout redds were observed in a 4.0-kilometer reach (2.5 miles) during spawning survey on September 25, 1996.
[2] No bull trout redds were observed in a 1.0-kilometer reach (0.6 mile) during spawning survey on September 26, 1996.
[3] Density of bull trout-brook trout hybrids was estimated at 1.8 fish per 100 meters (0.5 fish per 100 feet) in a 2.0-kilometer reach (1.2 miles).
[4] Brook trout zone may continue downstream.

REASONS FOR DECLINE

Habitat fragmentation and degradation are likely the most limiting factors for bull trout throughout the Hells Canyon Complex Recovery Unit. In the Snake River, large dams of the Hells Canyon Complex lack fish passage and have isolated bull trout among three basins, the Pine Creek and Indian Creek watersheds, Wildhorse River, and Powder River. Dams, irrigation diversions, and road crossings have formed impassable barriers to fish movement within the basins, further fragmenting habitats and isolating bull trout. Land management activities that degrade aquatic and riparian habitats by altering stream flows and riparian vegetation, such as water diversions, past and current mining operations, timber harvest and road construction, and improper grazing practices, have negatively affected bull trout in several areas of the recovery unit. Bull trout are also subject to negative interactions with nonnative brook trout in streams where the species occur together. The following factors contributing to the decline of bull trout in the coterminous United States are discussed relative to bull trout in the Hells Canyon Complex Recovery Unit.

Dams

The Hells Canyon Complex (*i.e.,* three dams and associated reservoirs) occupies a 154-kilometer (95.5-mile) reach of the Snake River. Construction of the three dams was completed over an 8-year period by Idaho Power Company. The complex provides power generation, flood control, and recreational opportunities for the region (Idaho Department of Environmental Quality and Oregon Department of Environmental Quality 2001; Saul *et al.* 2001). The dams are fish passage barriers and eliminated access by natural runs of anadromous fishes (*e.g.,* chinook salmon and steelhead) to the recovery unit, first in the upper portion of the recovery unit (including Powder River and Burnt River) with completion of Brownlee Dam in 1959, then the middle portion (including Wildhorse River) with completion of Oxbow Dam in 1961, and then in the lower portion (including Pine Creek and Indian Creek) with completion of Hells Canyon Dam in 1967. The loss of these runs and associated nutrients derived from their carcasses is thought to have negatively affected resident fishes through reducing overall watershed productivity (Nowak 2001; Saul *et al.* 2001; Stovall 2001). The

Hells Canyon Complex of dams also restrict movement of migratory bull trout within the Snake River and among tributaries, isolating tributaries and possibly contributing to the elimination of migratory bull trout in some streams (Grunder 1999).

Numerous dams exist in Snake River tributaries within the Hells Canyon Complex Recovery Unit. Because their primary function is storage and delivery of irrigation water, for example Unity Dam in the Burnt River is a U.S. Bureau of Reclamation facility operated by an irrigation district for irrigation water supply (U.S. Bureau of Reclamation 1998), they are discussed in the "Agricultural Practices" section of this chapter. However, dams for flood control and municipal water supply also occur in the Powder River basin.

Thief Valley Dam and Mason Dam were constructed by the U.S. Bureau of Reclamation on the Powder River in 1932 and 1968, respectively, for irrigation water supply and flood control (USBR 1998). Both dams are impassible fish barriers and are operated by irrigation districts. Thief Valley Dam restricted access of migratory fish to the lower 113 kilometers (70 miles) of the Powder River basin, where Eagle Creek is the primary tributary in which bull trout occurred (Nowak 2001). Mason Dam isolates bull trout in the upper Powder River (*i.e.,* Silver Creek, Little Cracker Creek, and Lake Creek) from bull trout in downstream tributaries of the Powder River above Thief Valley Dam (*i.e.,* Salmon Creek, Pine Creek, Rock Creek, and Big Muddy Creek), and the upper North Powder River.

Streams along the front of the Elkhorn Mountains provide a municipal water supply for Baker City, Oregon (U.S. Forest Service and Bureau of Land Management 1999). Diversions and water intake structures are located in several streams, including Salmon Creek, a stream inhabited by bull trout. These structures are upstream fish passage barriers. Another stream with bull trout, Rock Creek, has an impassible dam at a site where water is diverted for a hydroelectric project.

Forest Management Practices

Forested areas within the Hells Canyon Complex Recovery Unit have been subject to several management activities associated with timber harvest. These activities include timber harvesting and reforestation, road construction, fire suppression, and other practices. These practices can negatively affect bull trout habitats by increasing sedimentation rates, stream bank and channel instability, and water temperatures; decreasing recruitment of woody debris, canopy shading, and habitat complexity; and altering the hydrologic regime. High sedimentation rates may reduce pool depth and cause channels to become unstable and braid throughout bull trout habitats, and may reduce egg and larval survival in spawning and rearing habitat.

Roads exist throughout much of the public and private lands in the Hells Canyon Complex Recovery Unit and provide access for several activities, including timber harvest. The primary negative effects that can occur from road construction and timber harvest, combined, on bull trout habitats are increases in sedimentation, fish passage barriers, and habitat degradation (*e.g.,* reduced recruitment of woody debris, filling of pools, increased stream bank and channel instability, and decreased riparian canopy cover). Several habitat features important to bull trout (*e.g.,* levels of fine sediment, large woody debris, large pools, and channel conditions) recently were not adequately functioning for bull trout in tributary watersheds to the Powder River within the Wallowa-Whitman National Forest. Factors influencing these habitat features include high road densities, passage barriers, and degraded riparian areas (USFS 1999; USFS and BLM 1999). For example, extensive timber harvest on patented lands in the headwaters of Silver Creek (upper Powder River basin) has contributed high levels of sediment to occupied bull trout habitat downstream (Anderson 1995b; USFS 1999). Similar effects are likely in other streams in the basin. Mean road densities in the Pine Creek and Powder River basins are typically 0.8 to 2.7 kilometers per square kilometer (1.3 to 4.3 miles per square mile) (Fedora *et al.* 1998; USFS 1999; USFS and BLM 1999). Roads within the Hells Canyon Complex Recovery Unit make numerous stream crossings that can be barriers to bull trout passage. The effects on passage in this context are discussed under the section "Transportation Networks" in this recovery unit chapter.

The Indian Creek and Wildhorse River basins have been intensively managed for timber harvest and livestock grazing (Nelson 2001). In Indian Creek, timber harvest has occurred primarily in the mid and upper reaches of the basin where road densities are relatively high, whereas timber harvest in the Wildhorse River basin has occurred in the three primary tributaries, Bear Creek, Lick Creek, and Crooked River (Grunder 1999). Both basins exhibit habitat conditions that can be attributed to the effects of timber harvest and roads (*e.g.,* watershed disturbance, road density, and potential changes in hydrologic regime). Overall road densities within the two basins are 0.9 kilometer per square kilometer (1.4 mile per square mile) in the Indian Creek basin, and 3.1 kilometer per square kilometer (5.0 mile per square mile) in the lower Bear Creek and Lick Creek portions of the Wildhorse River basin (Nelson 1998, 2001).

Livestock Grazing

Improperly managed livestock grazing degrades bull trout habitat by removing riparian vegetation, destabilizing streambanks, increasing soil erosion, and altering water quality. These effects reduce overhead cover, increase summer water temperatures, and increase sediment in spawning and rearing habitats. A large portion of public and private land within the Hells Canyon Complex Recovery Unit is subject to livestock grazing (Anderson 1995a, b, c, d; Grunder 1999; Nowak 2001; Saul *et al.* 2001).

In the Powder River basin, the causes of most water quality problems are related to legacy (*i.e.,* activities conducted in the past but whose effects presently continue to affect habitats) effects of forestry, grazing, and mining (Nowak 2001). About 66 percent of the basin is considered rangelands with livestock and crop production occurring on the majority of this area. Of the remaining 33 percent of the Powder River basin, grazing is the primary use on about 80 percent of the area. Overgrazing in riparian areas has caused declines in riparian vegetation and increases in bank erosion that have negatively affected aquatic habitats. Habitats degraded from overgrazing are also present in the Pine Creek basin. For example, upland areas are recovering from overgrazing in the East Fork Pine Creek, and headcuts and gullies from continued use

of riparian areas in Boulder Creek have degraded habitats in the creek and downstream in Pine Creek (Anderson 1995a).

Livestock grazing occurs in both the Indian Creek and Wildhorse River basins (Nelson 2001). Some areas exhibit habitat degradation that may be influenced by livestock grazing. For example, damaged stream banks and riparian vegetation due to cattle have been noted near Lafferty Campground on the Crooked River (Wildhorse River basin) and most of its tributaries. Grazing in conjunction with timber harvest is thought to be responsible for degraded habitats (*i.e.,* unstable stream banks) in lower Bear Creek and Lick Creek.

Agricultural Practices

Irrigated agriculture and ranching are the primary agricultural activities within the Hells Canyon Complex Recovery Unit. Numerous water diversions, ditches, and reservoirs have been constructed to supply water for these activities (*e.g.,* production of hay and pasture). Many of these structures and their operation have negatively affected bull trout and bull trout habitats by creating impassible barriers to fish movement, entraining fish into unscreened ditches, and dewatering streams, which creates unsuitable habitat conditions (*e.g.,* elevated water temperatures, inadequate habitat quantity and quality). Passage barriers and habitat degradation due to agricultural practices are considered major factors adversely affecting bull trout in the recovery unit.

In the Pine Creek basin, there are 12 reservoirs (*i.e.,* those with capacity of at least 1,168 cubic meters (5 acre-feet) for irrigation storage) and 88 points of water diversion for irrigation throughout the basin, as reported by the U.S. Forest Service (USFS 1998) and the Powder Basin Watershed Council (PBWC 2000). Dams forming all the reservoirs lack upstream fish passage, and although some reservoirs are located upstream of the limits of bull trout distribution, others are barriers to fish movement. The delivery of water stored in reservoirs may be sufficiently raising water temperatures downstream so that bull trout distribution is affected (Anderson 1995c). Out of all points of water diversion in the basin, only 2 diversion points have fish

screens (USFS 1998). Unscreened diversions are present in bull trout spawning and rearing habitats in Meadow Creek and Aspen Creek, whereas a screen was recently installed on a diversion in Clear Creek. Irrigation diversions contribute to the complete dewatering of some stream reaches within the basin during low flow periods (Anderson 1995a).

In the Powder River basin, there are 46 reservoirs (*i.e.,* those with capacity of at least 12,336 cubic meters (10 acre-feet) for irrigation storage) and numerous ditches and points of water diversion for irrigation throughout the basin, as reported by Nowak (2001). The two largest reservoirs are Phillips Reservoir formed by Mason Dam and Thief Valley Reservoir, which have total storage capacities of 140.6 million cubic meters (114,000 acre-feet) and 16.4 million cubic meters (13,300 acre-feet), respectively, and are operated for irrigation storage and flood control (USBR 1998). These dams, and those forming the remaining reservoirs, lack upstream fish passage and have contributed to isolating bull trout and bull trout habitat. For example, Wolf Creek Reservoir and Pilcher Creek Reservoir both are formed by impassable barriers to fish movement within the Wolf Creek watershed, and are filled with water from the drainage as well as water diverted from other headwater streams (*e.g.,* Anthony Creek) that have bull trout (Anderson 1995c; USFS and BLM 1999). For ditches and points of diversion, some are active and others are no longer in use; there is presently no inventory of irrigation infrastructure, structures, and facilities for the basin (Nowak 2001). Most diversions likely contribute to degradation of habitats potentially available to bull trout and are unscreened, which may directly cause bull trout mortalities.

Reservoirs and irrigation diversions may have contributed to the decline, and perhaps extirpation, of bull trout in Eagle Creek, a tributary to the lower Powder River where bull trout were last observed in the mid 1980's. Dams have been constructed on five headwater lakes in the watershed to store irrigation water (Anderson 1995d). Although water delivery from the lakes locally augments stream flow, the water is diverted at at various unscreened locations, resulting in reaches that may be completely dewatered at times.

In the Indian Creek and Wildhorse River basins, there are no reservoirs and only a few water diversions. Water diversions for domestic use exist at springs in upper Indian Creek and Crooked River watersheds, and are not thought to negatively affect bull trout (Grunder 1999; Nelson 2001). In the lower Bear Creek-Lick Creek portion of Wildhorse River, a ditch on U.S. Forest Service land diverts water. A ranch apparently uses water delivered by the ditch and two individuals have applied for an easement, consisting of 1.12 cubic meters per second (3.05 cubic feet per second) of water (Nelson 2001). Although the diversion was not considered to affect bull trout because they have not been observed in the area and a substantial waterfall in Bear Creek near its confluence with the Crooked River isolates bull trout upstream (Nelson 2001), effects of the water diversion on bull trout that may potentially use the lower portion of Bear Creek is not known. Two diversions in the Crooked River watershed have potentially affected bull trout. One is on private land that dewaters a reach during late summer where bull trout have been observed downstream, and the other is unscreened and diverts an unknown quantity of water from a reach where bull trout occur.

Transportation Networks

A network of roads has been constructed in the Hells Canyon Complex Recovery Unit to provide transportation routes and access for such activities as timber harvest, mining, and water development facilities. Roads may degrade bull trout habitats in several ways, by increasing erosion and sedimentation, creating passage barriers, and reducing riparian vegetation (see Chapter 1). For example, a poorly located and eroding road in the headwaters of Meadow Creek, a tributary of Clear Creek in the Pine Creek basin, has been responsible for high levels of sediment in a reach that bull trout presently occupy (Fedora *et al.* 1998). Moreover, portions of a main access road following Clear Creek lies within the creek's riparian area and floodplain, potentially degrading habitats by restricting floodplain and riparian processes (*e.g.,* flow dynamics and riparian vegetation recruitment). With the relatively high densities of roads throughout the Hells Canyon Complex Recovery Unit, consisting of means of 0.8 to 3.1 kilometers per
square kilometer (1.3 to 5.0 miles per square mile) in each major basin, negative effects of roads on aquatic and riparian habitats are likely widespread in the recovery unit.

Improperly constructed stream crossings may act as barriers to bull trout movement either constantly or under certain conditions, which prevents bull trout access to suitable habitats and increases isolation of bull trout populations. Although a comprehensive survey and assessment of fish passage barriers at road crossings has not been conducted throughout the Hells Canyon Complex Recovery Unit, barriers may be relatively common. For instance, Fedora (1999) evaluated fish migration barriers on National Forest lands in the Pine Creek basin, and identified 6 within known occupied habitat, primarily in the Meadow Creek watershed, and 16 in other streams or reaches downstream of occupied habitat. Full or partial barriers to bull trout movement exist in the Indian Creek (Forest Road 105) and Wildhorse River (Forest Road 130 in upper Bear Creek) basins, and may be restricting the distribution of brook trout (Nelson 2001). Surveys of fish passage barriers at road crossings have been recommended for the Powder River basin (USFS 1999; USFS and BLM 1999). In the Oregon portion of the Hells Canyon Complex Recovery Unit, fish passage problems were noted at culverts on State- and County-owned roads in the Pine Creek (at least 18 culverts), Powder River (at least 86 culverts), and Burnt River (at least 38 culverts) basins (Mirati 1999).

Undersize culverts (*i.e.,* those that can not adequately pass a 100-year flow event) at road crossings may act as fish passage barriers, as well as degrade aquatic habitats downstream if they fail under high flows. Forty-six of 53 culverts surveyed in the Clear Creek watershed were considered undersize, suggesting that the entire Pine Creek basin may contain about 300 undersized culverts on National Forest roads if the Clear Creek watershed is representative of the entire Pine Creek basin (USFS 1998). The prevalence of undersize culverts throughout the Hells Canyon Complex Recovery Unit is not presently known.

Mining

Extensive mining activities (*e.g.,* placer, lode, and dredge operations) were historically conducted and continue in the Hells Canyon Complex Recovery Unit. Degradation of aquatic and riparian habitats important for bull trout caused by mining include removal of riparian vegetation, stream channelization, sedimentation, and input

of potentially toxic substances. Most mining activities in the recovery unit have occurred in the Pine Creek and Powder River basins.

In the Pine Creek basin, most mining activities have been concentrated in the Cornucopia Mining District, which is located in upper Pine Creek (USFS 1998). Placer mining was conducted along an 8-kilometer (5-mile) reach in which the stream channel and riparian areas have been highly disturbed (Fedora *et al.* 1998), greatly altering the natural channel form and reducing riparian vegetation. Tailings on the banks in Pine Creek and East Fork Pine Creek are considered hazardous waste by the Oregon Department of Environmental Quality, and it is unknown whether toxic materials are leaching from the tailing piles and affecting fishes currently residing in the area (PBWC 2000).

In the Powder River basin, there are reaches in nearly all streams in the upper Powder River drainage (*i.e.,* upstream of Mason Dam) that contain signs of past mining activities (USFS 1999). The most prominent area is a 9.4-kilometer (6-mile) reach of the upper Powder River near the community of Sumpter that was dredged, resulting in a 567-hectare (1,400-acre) expanse of tailings (Nowak 2001). The channels of this reach of the Powder River and Cracker Creek have been straightened, and meadow areas and riparian vegetation have been destroyed. Areas on tributaries farther upstream (*e.g.,* Cracker Creek, Little Cracker Creek, and Silver Creek) have been patented. In other areas of the Powder River basin, mining activities are ongoing in Salmon Creek and Wolf Creek (USFS and BLM 1999), and mining operations and their access roads are delivering sediments to portions of Eagle Creek (Anderson 1995d). Negative effects due to contaminants are presently unknown.

There are no active mines in the Indian Creek and Wildhorse River basins (Grunder 1999). However, three abandoned mines exist in the upper Indian Creek drainage, and it is not known whether they have affected or continue to affect bull trout and bull trout habitats. Substrate embeddedness was higher at an upstream versus a downstream site (41.3 versus 18.3 percent) in Indian Creek, which may be related to the granitic local geology of the upper site and the influence of historical mining (see references in Nelson 2001).

Residential Development and Urbanization

Although the Hells Canyon Complex Recovery Unit is largely rural, urban and residential areas typically exist at the lower elevations of the major basins. The five most populated communities in the recovery unit during 2000 were: Baker City (population of 9,880), North Powder (490), Haines (425), and Sumpter (175) in the Powder River basin, and Halfway (340) in the Pine Creek basin (Baker City, *in litt.* 2002). Effects of residential development and urbanization of the lower elevation portions of the basins may include stream channelization; loss of riparian vegetation and floodplain processes; and increases in nutrient and pesticide loading, sediment delivery, and water temperatures. The portions of the basins subject to these effects are currently, or were historically, used by bull trout as foraging, migrating, and overwintering habitat.

Residential development and urbanization is occurring in some portions of the recovery unit within or in relatively close proximity to spawning and rearing habitat. Examples in the Powder River basin include the community of Sumpter adjacent to Cracker Creek, a residence on Salmon Creek, and recreational residences on Anthony Creek. New residential housing has been constructed in Sumpter, and some development in Anthony Creek has occurred within riparian areas.

In the Indian Creek and Wildhorse River basins, there are two unincorporated communities, Cuprum near Indian Creek and Bear on Bear Creek in the Wildhorse River basin (Grunder 1999). There are also large private inholdings within the Payette National Forest in the headwaters and near the mouth of Crooked River, and along the corridor of Wildhorse River. Although residences and private lands are primarily downstream of most areas currently occupied by bull trout, there are potential negative effects to aquatic and riparian habitats from septic tank leaks, hazardous material spills, and fires. Summer home residents may increase the risk of inadvertent harvest of bull trout in headwater streams.

Fisheries Management

Brook trout have been widely introduced and are established in several areas throughout the Hells Canyon Complex Recovery Unit (Buchanan *et al.* 1997; Grunder 1999; Chandler and Richter 2001; Nelson 2001), which has contributed to the decline of bull trout. In the Pine Creek basin, brook trout were stocked in mountain lakes during the 1930's and have become established in the Clear Creek watershed, where bull trout-brook trout hybrids have been observed (Buchanan *et al.* 1997). Brook trout are widely distributed in the Powder River basin, and have been observed in several streams presently or historically occupied by bull trout. For example, brook trout occur with bull trout in reaches of such streams as North Fork Anthony Creek, Indian Creek, Little Cracker Creek, and upper North Powder River, and bull trout-brook trout hybrids have been observed in some of these reaches (Bellerud *et al.* 1997). Brook trout are also established in the Eagle Creek watershed, where bull trout have not been observed in several years. In the Idaho portions of the recovery unit, brook trout are widely distributed and locally abundant in the Indian Creek and Wildhorse River basins, and bull trout-brook trout hybrids have been observed in both basins (Grunder 1999; Chandler and Richter 2001; Nelson 2001).

Other fishes that may negatively interact with bull trout have been introduced in the Hells Canyon Complex Recovery Unit (see Table 2). Salmonids such as lake trout were introduced in some mountain lakes within the Powder River basin (Buchanan *et al.* 1997), however, they have not been observed elsewhere in the basin. Rainbow trout are currently planted in Phillips Lake and Cracker Creek. About 8,000 legal-sized and about 100,000 fingerling rainbow trout are annually planted. It is uncertain whether stocked rainbow trout negatively interact with bull trout, however, stocked fish may provide a source of prey to bull trout. Fish such as yellow perch and walleye were both introduced in Phillips Reservoir sometime in the 1980's, and the abundance of yellow perch may be negatively affecting other species. Effects of introduced fishes on the potential of bull trout ultimately using Phillips Reservoir is not known.

Some reaches of the Powder River have been treated with fish toxicants to remove nongame fishes (Buchanan *et al.* 1997). Chemicals were used in headwater tributaries and the main river from Sumpter downstream to Mason Dam, and from Mason Dam to Thief Valley Reservoir, during 1967 to control nongame fishes. Phillips

Reservoir was treated during this time as well as at other times. Eagle Creek was also treated to remove nongame fishes in 1967, and whitefish, rainbow trout, bull trout, and brook trout were noted throughout the upper watershed (Buchanan *et al.* 1997). The effects of this management practice on bull trout is not known.

Isolation and Habitat Fragmentation

The combined effects of the previously discussed factors contributing to the decline of bull trout (*e.g.,* dams, forestry management practices, livestock grazing, agricultural practices, transportation networks, mining, and residential development and urbanization) has led to the degradation and fragmentation of bull trout habitats in the Hells Canyon Complex Recovery Unit. Habitat fragmentation has resulted in isolated groups of bull trout that once had access to a greater diversity of resources than presently available (*e.g.,* amount and quality of habitat, prey abundance) and opportunities to interact among groups. Degradation of habitats has contributed to the isolation of bull trout and further reduced available resources.

The Hells Canyon Complex of three dams in the Snake River lacks two-way fish passage, which has isolated bull trout among the three reservoirs or their tributaries. Migratory bull trout occur in Hells Canyon Reservoir and likely use spawning and rearing habitat in the Pine Creek basin and may use the Indian Creek basin. Bull trout occur in tributaries of the remaining two reservoirs, Wildhorse River draining into Oxbow Reservoir and the Powder River draining into Brownlee Reservoir. Because of impassible barriers to fish movement within tributaries (*e.g.,* Thief Valley Dam and Mason Dam in the Powder River basin) and no observations of migratory bull trout within the reservoirs, bull trout in the recovery unit upstream of Oxbow Dam are thought to be resident fish. Hells Canyon Complex has also eliminated anadromous fish from the recovery unit, which has likely reduced the overall productivity of the watersheds upstream of Hells Canyon Dam.

Habitats within basins presently occupied by bull trout have been further fragmented by seasonal or complete barriers to fish movement caused by small dams, irrigation diversions, and road crossings. These habitats have also been degraded by

land management activities (*e.g.,* forestry practices, mining, livestock grazing, and transportation networks), which have reduced bull trout distribution. For instance, passage barriers and overall degradation of aquatic and riparian habitat conditions from land management activities in the Powder River basin is thought to have eliminated migratory fish, resulting in resident bull trout occurring primarily in the headwaters of the upper Powder River and North Powder River (USFS 1999; USFS and BLM 1999). Throughout the Hells Canyon Complex Recovery Unit, resident bull trout occur in several streams that are also inhabited by brook trout, which exacerbates the negative effects of habitat degradation on bull trout.

Poor water quality associated with habitat degradation has likely contributed to isolation and fragmentation of bull trout habitats in the Hells Canyon Complex Recovery Unit. Under the Federal Clean Water Act, states or the U.S. Environmental Protection Agency designate water bodies that are failing water quality standards (*i.e.,* not achieving their beneficial use) as water quality limited under section 303(d) and are required to develop management plans. These waters are reported every other year on the 303(d) list. In 1998, a total of 37 water bodies within the recovery unit appeared on the 303(d) lists for Idaho and Oregon combined (Appendix 1; IDEQ 1998; ODEQ 1998). The three reservoirs making up the Hells Canyon Complex were included primarily due to exceeding limits for water temperature, sediment, nutrients, and mercury. Water spilled from Brownlee Dam entrains air that has also resulted in supersaturated concentrations of total dissolved gases in Oxbow Reservoir and Hells Canyon Reservoir, which may cause gas bubble trauma in fishes, including bull trout. The effects of dissoved gas levels on bull trout and their distribution in the two reservoirs (*e.g.,* apparent absence in Oxbow Reservoir) is not known. Within Snake River tributaries originating in Oregon, 8, 13, and 13 waterbodies were listed in the Pine Creek, Powder River, and Burnt River basins, respectively. The most common pollutant for the three basins was water temperature. Although water quality limited stream segments occur throughout the basins, some include reaches coinciding with the current distribution of bull trout and have likely contributed to their decline.

ONGOING RECOVERY UNIT CONSERVATION MEASURES

Efforts to recover bull trout and other native species are ongoing in the Hells Canyon Complex Recovery Unit, with a high level of cooperation among natural resource management entities on various projects. For example, conducting spawning surveys within the recovery unit has been a cooperative effort between Federal and State agencies. Groups responsible for assessing the status of bull trout, identifying information needs, and developing conservation strategies exist in both the Idaho and Oregon portions of the recovery unit (*i.e.,* the Southwest Basin Native Fish Watershed Advisory Group in Idaho and the Pine Creek-Powder River Bull Trout Working Group in Oregon). The following discussion provides examples of completed and ongoing conservation activities conducted by these groups, their members, and others.

For proposed Federal activities occurring in the Hells Canyon Complex Recovery Unit, Federal agencies (*e.g.,* the Bureau of Land Management, Bureau of Reclamation, Federal Energy Regulatory Commission, U.S. Forest Service) are consulting with the U.S. Fish and Wildlife Service pursuant to section 7 of the Endangered Species Act. During consultations, potential effects of proposed activities on bull trout and their habitats are evaluated, and the activities may be modified to reduce or eliminate negative effects on bull trout. Federal activities often include conservation measures beneficial to bull trout, such as reducing sediment delivery to streams by closing, removing, or altering forest roads; changing grazing practices; providing fish passage by replacing improperly constructed culverts; and conducting fish and habitat surveys (*e.g.,* USFS 1999; Nelson 2001). For example, the Payette National Forest has been conducting surveys to determine the distribution of bull trout on Federal lands, which resulted in documenting bull trout in Bear Creek and Crooked River in 1998 (Nelson, *in litt.* 2002).

The Natural Resources Conservation Service and the Farm Services Agency administer several programs that provide technical and/or financial assistance to private landowners to address natural resource problems. Resource management systems are developed with landowners to address soil, water, air, plant, and animal resource concerns. Programs available to private landowners include the Conservation Reserve

Program, Environmental Quality Incentives Program, Wetland Reserve Program, and Wildlife Habitat Incentives Program. Resource management systems developed with landowners identify practices that will reduce soil erosion and sediment delivery to streams, restore riparian and wetland functions and values, reduce water consumption on irrigated agricultural lands, and reduce nutrient and pesticide pollution in water bodies. Typical practices employed include riparian forest buffers, fencing, use exclusion, irrigation water management, nutrient and pesticide management, prescribed grazing and livestock watering facilities. Within the Hells Canyon Complex Recovery Unit, the Natural Resources Conservation Service is involved with the Powder Basin Watershed Council in screening water diversions in the Pine Creek and Eagle Creek watersheds.

Ongoing studies are underway by Idaho Power Company in cooperation with the Bureau of Land Management, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, and U.S. Forest Service to investigate bull trout distribution, movement, and life history in Hells Canyon and Oxbow reservoirs and their tributaries (*i.e.,* Pine Creek, Indian Creek, and Wildhorse River). For example, radio telemetry has been used to investigate pre- and post-spawning movements, which also generated preliminary mortality rates, and weirs have been used to investigate downstream migration of bull trout in tributaries (Chandler and Richter 2001; Chandler *et al.* 2001).

The Idaho Department of Fish and Game has implemented ongoing conservation measures to benefit bull trout. Bull trout harvest has been prohibited State wide since 1996. Planting hatchery rainbow trout in the Indian Creek and Wildhorse River basins was discontinued in the 1980's due to potential effects on native redband trout, which has likely benefitted bull trout by eliminating the potential of disease transmission and reducing angler-related mortality to bull trout (Grunder 1999). Idaho Department of Fish and Game manages bull trout in the two basins according to a Five Year Fish Action Plan that emphasizes preservation of bull trout. The agency was also instrumental in the technical group that developed the Hells Canyon Group Key Watersheds Bull Trout Problem Assessment (Grunder 1999) for the Southwest Basin Native Fish Watershed Advisory Group under Idaho's bull trout conservation plan.

The Oregon Department of Fish and Wildlife has taken several actions to address the conservation and recovery of bull trout since 1990. More restrictive harvest regulations were implemented beginning in 1990; by 1994 the harvest of bull trout was prohibited throughout the State with the sole exception of Lake Billy Chinook in central Oregon. In addition to establishing the Pine Creek-Powder River Bull Trout Working Group to develop bull trout conservation strategies, the agency has discontinued stocking brook trout in areas of the recovery unit where they may affect bull trout, implemented angler outreach and education efforts about bull trout (*e.g.,* placing bull trout identification posters at campgrounds and trail heads), and surveyed culverts on State and County roads in the recovery unit for fish passage problems. A Fish Passage Task Force was recently created. The agency has applied for instream water rights in the Pine Creek and Powder River basins, but because the basins are over-allocated, the rights granted to date are junior to most existing rights. The agency is also conducting research to examine life history, genetics, habitat needs, and limiting factors for bull trout in cooperation with the U.S. Forest Service Pacific Northwest Research Station (see Bellerude *et al.* 1997; Hemmingsen *et al.* 2001a, 2001b, 2001c). The project was initiated in 1995 with funding from the Fish and Wildlife program of the Northwest Power Planning Council, and has included several areas within the Hells Canyon Complex Recovery Unit.

As part of the Pacific Northwest Electric Power Planning and Conservation Act of 1980, the Bonneville Power Administration has the responsibility to protect, mitigate and enhance fish and wildlife resources affected by operation of Federal hydroelectric projects in the Columbia River and its tributaries. The Northwest Power Planning Council develops and implements the Columbia River Basin Fish and Wildlife Program with the Bonneville Power Administration, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and the Federal Energy Regulatory Commission. Coordination of the Northwest Power Planning Council's recommendations is done, in part, through the development of subbasin summaries that identify status of fish and wildlife resources, limiting factors, and recommended actions for the protection, mitigation, and enhancement of fish and wildlife resources. Draft subbasin summaries have been complete for the Powder River basin (Nowak 2001) and the Lower Middle Snake River

basin (Saul *et al.* 2001), which together encompasses the Hells Canyon Complex Recovery Unit.

Under sections 303 and 304 of the Federal Clean Water Act, states or the U.S. Environmental Protection Agency set water quality standards, which combine designated beneficial uses and criteria established to protect uses. States or the Environmental Protection Agency designate water bodies that are failing water quality standards as water quality limited under section 303(d) and are required to develop management plans. Management plans include Total Maximum Daily Loads with implementation plans that define site-specific actions and time lines for meeting water quality goals. The Idaho Department of Environmental Quality and Oregon Department of Environmental Quality released a draft Total Maximum Daily Load for multiple constituents in the Hells Canyon reach of the Snake River for public comment in December 2001 (IDEQ and ODEQ 2001).

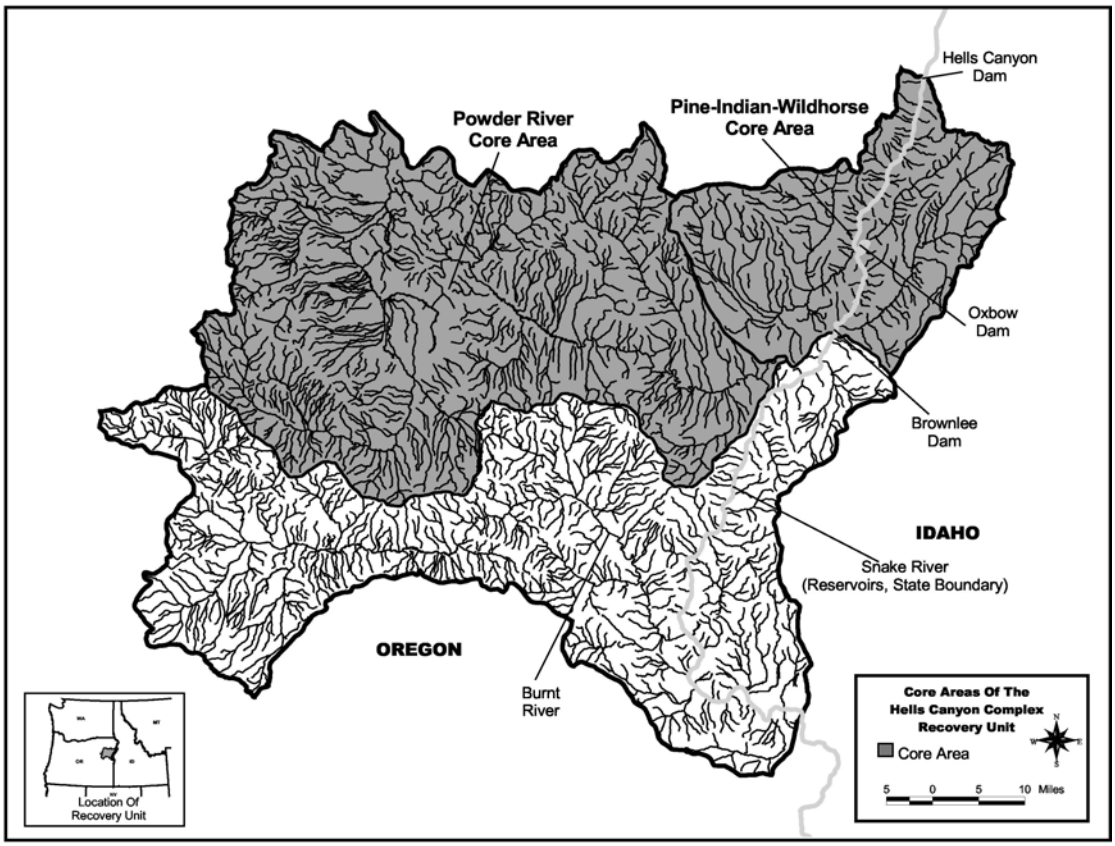
STRATEGY FOR RECOVERY

A core area represents the closest approximation of a biologically functioning unit. The combination of core habitat (*i.e.*, habitat that could supply all the necessary elements for the long-term security of bull trout including both spawning and rearing as well as foraging, migrating, and overwintering) and a core population (*i.e.*, bull trout inhabiting a core habitat) constitutes the basic core area upon which to gauge recovery within a recovery unit. Within a core area, many local populations may exist.

Bull trout currently occupy areas associated with each of the three Snake River reservoirs in the Hells Canyon Complex Recovery Unit (Figure 3). For Hells Canyon Reservoir, bull trout occur in the reservoir and two tributary basins, Pine Creek and Indian Creek. For Oxbow Reservoir, bull trout occur in at least two streams (*i.e.,* Bear Creek and Crooked River) within Wildhorse River, a tributary basin to the reservoir. For Brownlee Reservoir, bull trout occur in various streams within the Powder River basin, a tributary to the reservoir. Migratory bull trout occur in Hells Canyon Reservoir and likely spawn in the Pine Creek basin and perhaps the Indian Creek basin. Bull trout inhabiting the Wildhorse River and Powder River River basins are likely resident fish.

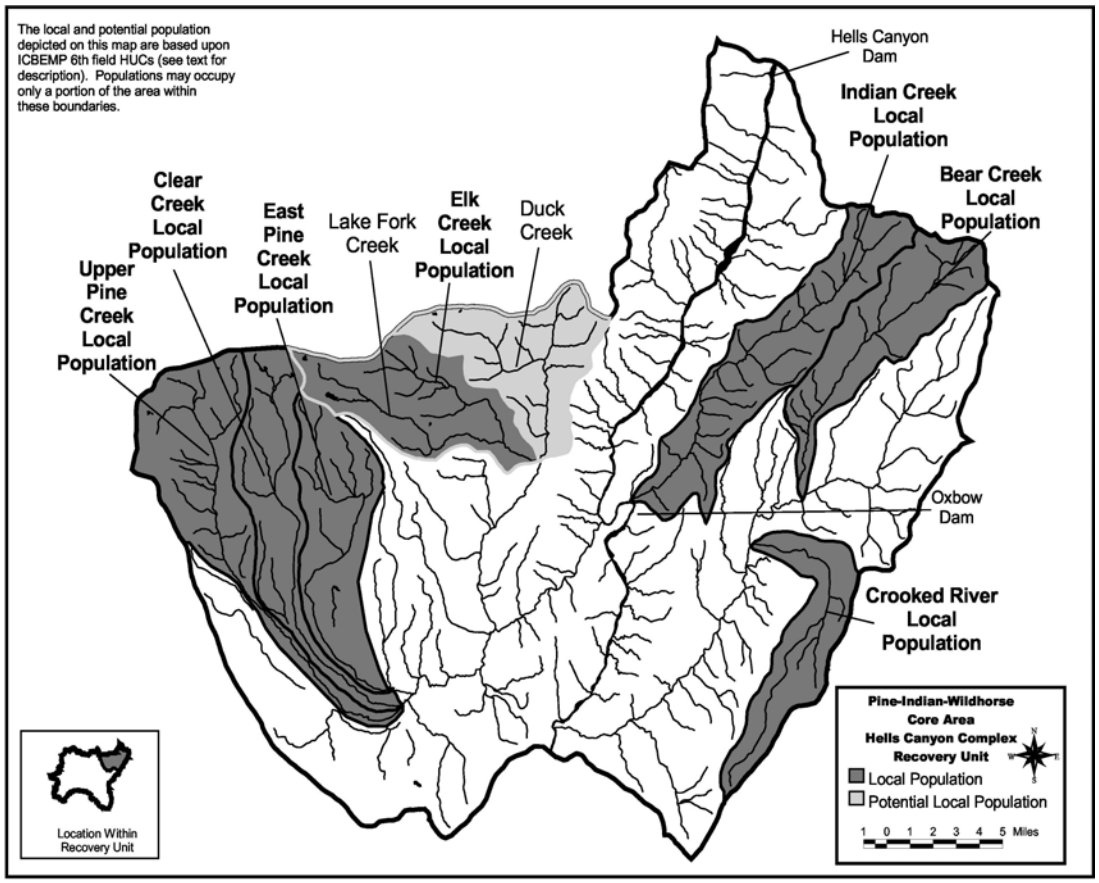
The Hells Canyon Complex Recovery Unit Team has identified two core areas within the recovery unit. The Pine-Indian-Wildhorse Core Aarea encompasses Hells Canyon Reservoir, Oxbow Reservoir, and their tributaries, namely Pine Creek, Indian Creek, and Wildhorse River (Figure 4). A total of seven local populations and two unoccupied areas with potential spawning and rearing habitat (*i.e.,* presently unoccupied areas that may be able to support a local population) was identified in the Pine-Indian-Wildhorse Core Area (Table 6). The Powder River core area encompasses the Powder River basin upstream from the confluence with Brownlee Reservoir (Figure 5). A total of 10 local populations and 1 unoccupied area with potential spawning and rearing habitat was identified in the Powder River Core Area (Table 6).

Figure 3. The Hells Canyon Complex Recovery Unit showing the locations of the Pine-Indian-Wildhorse and Powder River bull trout core areas.



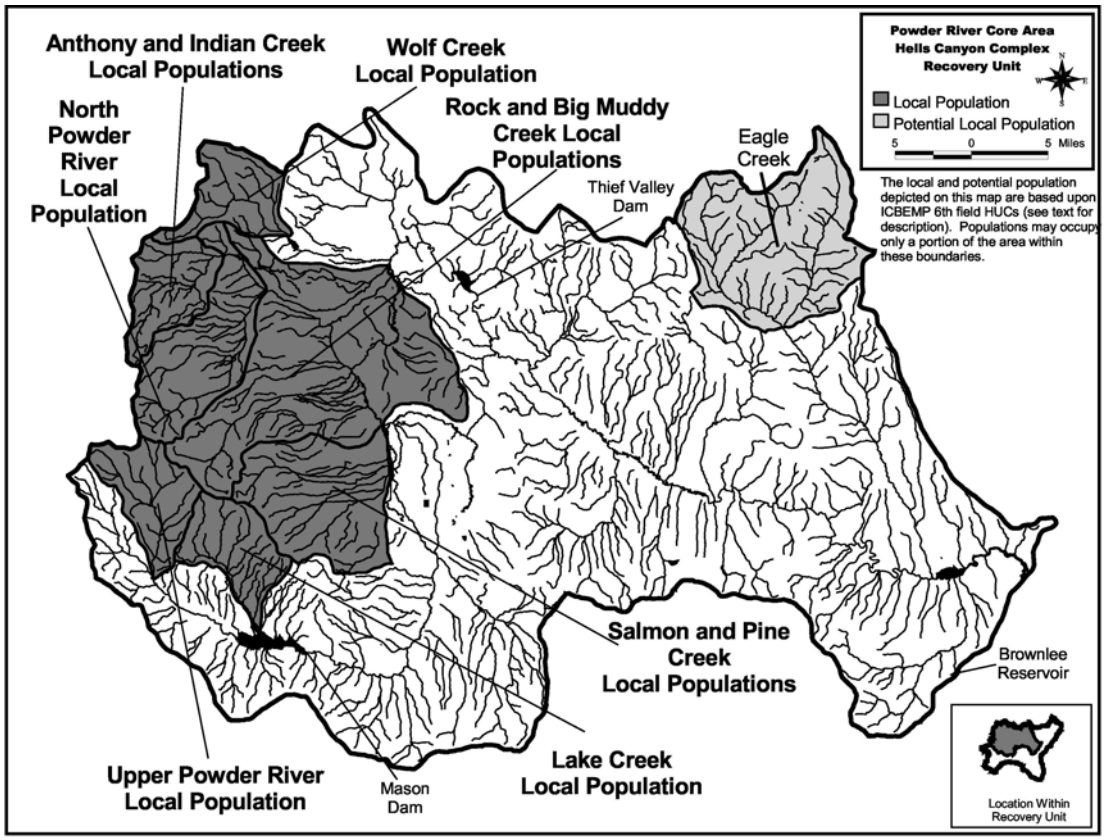
Brownlee Reservoir and the Burnt River basin are included in the Hells Canyon Complex Recovery Unit, but are not presently considered core areas or portions of core areas. Due to uncertainty about the potential roles of the two areas in bull trout recovery, the Hells Canyon Complex Recovery Unit Team identified that gaining a better understanding of the potential for Brownlee Reservoir and the Burnt River basin to contribute to bull trout recovery as a research need. Although bull trout may have been extirpated in Eagle Creek, a tributary to the lower Powder River, it is considered an area that can potentially support a local population (*i.e.,* potential local population). The ability of Brownlee Reservoir to provide foraging, migrating, and overwintering habitat, at least seasonally, for bull trout in Eagle Creek would greatly influence the recovery potential of the local population.

Figure 4. The Pine-Indian-Wildhorse Core Area showing the locations of bull trout local populations and areas with potential spawning and rearing habitat (see Table 6).



Bull trout have not been observed in the Burnt River basin. However, the basin has not been intensively surveyed specifically to investigate the presence of bull trout. Because bull trout occur in basins adjacent to the Burnt River basin and the Burnt River basin historically supported anadromous salmonids, it is plausible that bull trout may have or presently do occur in some portions of the basin. Moreover, habitat suitable for bull trout may exist in headwater tributaries of the Burnt River. Determining bull trout presence and the potential of the Burnt River basin to support bull trout is a primary research need.

Figure 5. The Powder River Core Area showing the locations of bull trout local populations and the area with potential spawning and rearing habitat (see Table 6).



Recovery Goals and Objectives

The goal for the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining complex, interacting groups of bull trout distributed throughout the species' native range, so that it can be delisted**. To achieve this goal the following objectives have been identified for bull trout in the Hells Canyon Complex Recovery Unit:

- Maintain the current distribution of bull trout and restore distribution in previously occupied areas within the Hells Canyon Complex Recovery Unit.

Table 6. Bull trout core areas, local populations, and currently unoccupied potential spawning and rearing habitat in the Hells Canyon Complex Recovery Unit, Idaho and Oregon.

Core area	Local populations	Potential spawning and rearing habitat[1]
Pine-Indian-Wildhorse (Includes Hells Canyon and Oxbow reservoirs, Pine Creek (Oregon), and Indian Creek and Wildhorse River (Idaho) basins.)	1. Indian Creek (Idaho) 2. Bear Creek 3. Crooked River 4. Upper Pine Creek (including West Fork Pine Creek, Middle Fork Pine Creek, and East Fork Pine Creek) 5. Clear Creek (including Trail Creek and Meadow Creek) 6. East Pine Creek 7. Elk Creek (including Aspen Creek, Big Elk Creek, and Cabin Creek)	Lake Fork Creek Duck Creek
Powder River (Includes the Powder River basin downstream to the confluence with Brownlee Reservoir)	1. Lake Creek 2. Upper Powder River (Silver Creek and Little Cracker Creek) 3. Rock Creek[2] 4. Big Muddy Creek[2] 5. Salmon Creek 6. Pine Creek 7. North Powder River 8. Anthony Creek (including North Anthony Creek) 9. Indian Creek (Oregon) 10. Wolf Creek	Eagle Creek

[1] Potential spawning and rearing habitat are areas that are presently unoccupied, but may be able to provide spawning and rearing habitat for bull trout. Listed streams are based on discussions with the Recovery Unit Team.
[2] Rock Creek and Big Muddy Creek may form a single local population if connectivity is established in the future.

- Maintain stable or increasing trends in bull trout abundance.

- Restore and maintain suitable habitat conditions for all life history stages and forms.

- Conserve genetic diversity and provide opportunity for genetic exchange.

The current and recovered status of bull trout in the recovery unit were evaluated based on four population elements. These elements were derived from the best scientific information available concerning bull trout population dynamics and habitat requirements (Rieman and McIntyre 1993; Rieman and Allendorf 2001). The four elements were: 1) number of local populations, 2) adult abundance (defined as the number of spawning fish present in a core area in a given year), 3) productivity, or the reproductive rate of the population (as measured by population trend and variability), and 4) connectivity (as represented by the migratory life history form and functional habitat). For each element, the Hells Canyon Complex Recovery Unit Team classified bull trout into relative risk categories based on the best available data and the professional judgment of the team.

This approach to developing recovery criteria acknowledges that the status of populations in some core areas may remain short of ideals described by conservation biology theory. Some core areas may be limited by natural attributes or by patch size and may always remain at a relatively high risk of extinction. Because of limited data within the Hells Canyon Complex Recovery Unit, the recovery unit team relied heavily on the professional judgment of its members.

Local Populations. Metapopulation theory is an important consideration in bull trout recovery. A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994) (see Chapter 1). Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events. In part, distribution of local populations in such a manner is an indicator of a functioning core area. Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas

with fewer than 5 local populations are at increased risk; core areas with between 5 and 10 local populations are at intermediate risk; and core areas with more than 10 interconnected local populations are at diminished risk.

Currently the Pine-Indian-Wildhorse Core Area has seven local populations including: Indian Creek, Bear Creek, Crooked River, upper Pine Creek (including West Fork Pine Creek, Middle Fork Pine Creek, and East Fork Pine Creek), Clear Creek (including Trail Creek and Meadow Creek), East Pine Creek, and Elk Creek (including Aspen Creek, Big Elk Creek, and Cabin Creek). Based on this information, the Pine-Indian-Wildhorse Core Area is considered at intermediate risk from stochastic events. The Powder River Core Area currently contains 10 local populations including: upper Powder River (Silver Creek and Little Cracker Creek), Lake Creek, Pine Creek, Salmon Creek, Rock Creek, Big Muddy Creek, North Powder River, Anthony Creek (including North Fork Anthony Creek), Indian Creek, Wolf Creek and is also considered at intermediate risk.

Adult Abundance. The recovered abundance levels in the Hells Canyon Complex Recovery Unit were determined by considering theoretical estimates of effective population size, historical census information, and the professional judgment of recovery team members. In general, effective population size is a theoretical concept that allows us to predict potential future losses of genetic variation within a population due to small population sizes and genetic drift (see Chapter 1). For the purpose of recovery planning, effective population size is the number of adult bull trout that successfully spawn annually. Based on standardized theoretical equations (Crow and Kimura 1970), guidelines have been established for maintaining minimum effective population sizes for conservation purposes. Effective population sizes of greater than 50 adults are necessary to prevent inbreeding depression and a potential decrease in viability or reproductive fitness of a population (Franklin 1980). To minimize the loss of genetic variation due to genetic drift and to maintain constant genetic variance within a population, an effective population size of at least 500 is recommended (Franklin 1980; Soule 1980; Lande 1988). Effective population sizes required to maintain long-term genetic variation that can serve as a reservoir for future adaptations in response to

natural selection and changing environmental conditions are discussed in Chapter 1 of the recovery plan.

For bull trout, Rieman and Allendorf (2001) estimated that a minimum number of 50 to 100 spawners per year was needed to minimize potential inbreeding effects within local populations. Furthermore, a population size between 500 and 1,000 adults in a core area is needed to minimize the deleterious effects of genetic variation due to drift.

For the purposes of bull trout recovery planning, abundance levels were conservatively evaluated at the local population and core area levels. Local populations containing fewer than 100 spawning adults per year were classified as at risk from inbreeding depression. Bull trout core areas containing fewer than 1,000 spawning adults per year were classified as at risk from genetic drift.

Accurate adult abundance estimates for bull trout in the recovery unit were not available, and consequently, local populations could not be evaluated relative to the risk of inbreeding. However, given that current local populations exist at low abundance levels, the Recovery Team recommends that genetic risks from inbreeding be monitored closely. The Hells Canyon Complex Recovery Unit Team currently estimates that each core area (Pine-Indian-Wildhorse and Powder River) currently contains less that 500 adult fish per year. Based on the aforementioned guidance, these core areas are currently at risk from genetic drift.

Productivity. A stable or increasing population is a key criterion for recovery under the requirements of the Endangered Species Act. Measures of the trend of a population (the tendency to increase, decrease, or remain stable) include population growth rate or productivity. Estimates of population growth rate (*i.e.* productivity over the entire life cycle) that indicate a population is consistently failing to replace itself also indicate an increased extinction risk. Therefore, the reproductive rate should indicate the population is replacing itself, or growing.

Since estimates of the total population size are rarely available, the productivity or population growth rate is usually estimated from temporal trends in indices of abundance at a particular life stage. For example, redd counts are often used as an index of a spawning adult population. The direction and magnitude of a trend in the index can be used as a surrogate for the growth rate of the entire population. For instance, a downward trend in an abundance indicator may signal the need for increased protection, regardless of the actual size of the population. A population that is below recovered abundance levels, but that is moving toward recovery, would be expected to exhibit an increasing trend in the indicator.

The population growth rate is an indicator of probability of extinction. This probability cannot be measured directly, but it can be estimated as the consequence of the population growth rate and the variability in that rate. For a population to be considered viable, its natural productivity should be sufficient for the population to replace itself from generation to generation. Evaluations of population status will also have to take into account uncertainty in estimates of population growth rate or productivity. For a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time.

Connectivity. The presence of the migratory life history form within the Hells Canyon Complex Recovery Unit was used as an indicator of the functional connectivity of the recovery unit. If the migratory life form was absent, or if the migratory form is present but local populations lack connectivity, the core area was considered to be at increased risk. If the migratory life form persists in at least some local populations, with partial ability to connect with other local populations, the core area was judged to be at intermediate risk. Finally, if the migratory life form was present in all or nearly all local populations, and had the ability to connect with other local populations, the core area was considered to be at diminished risk. Currently, in both core areas the migratory life form persists in at least some local populations with partial ability to connect with other local populations, and as such are considered to be at intermediate risk.

Recovery Criteria

Recovery criteria for bull trout in the Hells Canyon Complex Recovery Unit are the following:

5. **Maintain current distribution of bull trout in the 17 local populations identified, and expand distribution by establishing bull trout local populations in 3 areas identified as potential spawning and rearing habitat**. The number of existing local populations and areas identified as containing potential spawning and rearing habitat by core area are: Pine-Indian-Wildhorse Core Area, 7 existing local populations and 2 areas with potential spawning and rearing habitat; and Powder River Core Area, 10 existing local populations and 1 area with potential spawning and rearing habitat (Table 6). Achieving criterion 1 entails: (1) maintaining existing local populations; (2) implementing activities intended to evaluate the feasibility of establishing additional bull trout local populations in potential spawning and rearing habitat, and (3) encouraging the establishment of additional bull trout local populations in potential spawning and rearing habitat in both core areas of the recovery unit (*e.g.*, by implementing recovery tasks to provide accesses to the areas and restoring habitat). Establishing additional local populations will contribute to achieving criteria 2 and 3, and increase the likelihood of achieving the recovery goal for the Hells Canyon Complex Recovery Unit.

6. **Estimated abundance of adult bull trout is at least 5,000 individuals in the Hells Canyon Complex Recovery Unit.** The recovered abundance of adult bull trout for the recovery unit was estimated based on professional judgement of the Recovery Unit Team in consideration of surveyed fish densities, habitats, and potential fish production after threats have been addressed to allow expansion of distribution within existing local populations and establishment of additional local populations in the three areas with potential spawning and rearing habitat. The recovered abundance of adult bull trout should be evenly distributed between the two core areas and would protect the core area from the deleterious effects of genetic drift.

7. **Adult bull trout exhibit a stable or increasing trend for at least two generations at or above the recovered abundance level within the Pine-Indian-Wildhorse and Powder River core areas**. The development of a standardized monitoring and evaluation program which would accurately describe trends in bull trout abundance is identified as a priority research need. As part of the overall recovery effort, the U.S. Fish and Wildlife Service will take the lead in addressing this research need by forming a multi-agency technical team to develop protocols to evaluate trends in bull trout populations.

4. **Specific barriers inhibiting bull trout movement in the Hells Canyon Complex Recovery Unit have been addressed.** Many barriers to bull trout movement and migration exist within the recovery unit, and this recovery plan recommends several tasks to identify, assess, and reduce barriers to bull trout passage. Although achieving criteria 1 through 3 is expected to depend on providing passage at barriers (including barriers due to physical obstructions, unsuitable habitat, and water quality) throughout the recovery unit, the intent of criterion 4 is to note specific barriers to address or tasks that must be performed to achieve recovery (*i.e.*, barriers evaluated and appropriately addressed if found to be feasible). Specific barriers to address that are required to achieve this criterion are Oxbow Dam in the Pine-Indian-Wildhorse Core Area, and Thief Valley Dam, Mason Dam, and Wolf Creek Dam in the Powder River Core Area (see task 1.2.4). Achieving criterion 4 also entails implementing additional tasks addressing barriers created by such factors as irrigation diversions, stream dewatering, and road crossings (*i.e.*, tasks 1.2.2, 1.2.3, and 1.2.6) sufficiently to achieve criteria 1 through 3. Tasks intended to assess the feasibility of providing passage should be conducted with coordinated review during implementation with the U.S. Fish and Wildlife Service.

Recovery criteria for the Hells Canyon Complex Recovery Unit were established to assess whether recovery actions are resulting in the recovery of bull trout. The Hells Canyon Complex Recovery Unit Team expects that the recovery process will be dynamic and will be refined as more information becomes available. While removal of

bull trout as a species under the Endangered Species Act (*i.e.*, delisting) can only occur for the entity that was listed (Columbia River Distinct Population Segment), the criteria listed above will be used to determine when the Hells Canyon Complex Recovery Unit is fully contributing to recovery of the population segment.

Artificial Propagation

The Hells Canyon Complex Recovery Unit Team has identified that reaching a recovered condition within 25 years could require the use of artificial propagation. Artificial propagation could involve the transfer of bull trout into unoccupied habitat within the historic range (ODFW 1997). In addition, artificial propagation could involve the use of Federal or state hatcheries to assist in recovery efforts (MBTSG 1996). The Hells Canyon Complex Recovery Team recommends that studies be initiated to determine the effectiveness and feasibility of using artificial propagation in bull trout recovery.

Any artificial propagation program instituted in the Hells Canyon Complex Recovery Unit must follow the joint policy of the Fish and Wildlife Service and the National Marine Fisheries Service regarding controlled propagation of listed species (65 FR 56916). The overall guidance of the policy is that every effort should be made to recover a species in the wild before implementing a controlled propagation program. If necessary, an appropriate plan would need to be approved that considers the effects of transplantation on other species as well as the donor bull trout populations. Transplanting listed species must be authorized by the U.S. Fish and Wildlife Service and meet applicable State fish-handling and disease policies.

While artificial propagation has played an important role in the recovery of other listed fish species, where possible, the overall recovery strategy for bull trout in the Hells Canyon Complex Recovery Unit will emphasize the removal of threats and habitat restoration. Recovery should emphasize identifying and correcting threats affecting bull trout and bull trout habitats. Artificial propagation programs should not be implemented unless reasons for decline have been addressed.

ACTIONS NEEDED

Recovery Measures Narrative

In this chapter and all other chapters of the bull trout recovery plan, the recovery measures narrative consists of a hierarchical listing of actions that follows a standard template. The first-tier entries are identical in all chapters and represent general recovery tasks under which specific (*e.g.*, third-tier) tasks appear when appropriate. Second-tier entries also represent general recovery tasks under which specific tasks appear. Second-tier tasks that do not include specific third-tier actions are usually programmatic activities that are applicable across the species' range; they appear in *italic type*. These tasks may or may not have third-tier tasks associated with them; see Chapter 1 for more explanation. Some second-tier tasks may not be sufficiently developed to apply to the recovery unit at this time; they appear in *a shaded italic type (as seen here)*. These tasks are included to preserve consistency in numbering tasks among recovery unit chapters and intended to assist in generating information during the comment period for the draft recovery plan, a period when additional tasks may be developed. Third-tier entries are tasks specific to the Hells Canyon Complex Recovery Unit. They appear in the implementation schedule that follows this section and are identified by three numerals separated by periods.

The Hells Canyon Complex Recovery Unit Chapter should be updated or revised as recovery tasks are accomplished, environmental conditions change, or monitoring results or other new information becomes available. Revisions to the Hells Canyon Complex Recovery Unit Chapter will likely focus on priority streams or stream segments within core areas where restoration activities occurred, and habitat or bull trout populations have shown a positive response. The Hells Canyon Complex Recovery Unit Team should meet annually to review annual monitoring reports and summaries, and make recommendations to the U.S. Fish and Wildlife Service.

1 Protect, restore, and maintain suitable habitat conditions for bull trout.

1.1 Maintain or improve water quality in bull trout core areas or potential core habitat.

1.1.1 Reduce sediment production from roads and other sources (*e.g.,* mines, over-grazed areas) known to be contributing sediment to streams. Roads and other sources of sediment delivery to streams have been identified in a number of assessments in the Pine-Indian-Wildhorse Core Area and Powder River Core Area (*e.g.,* assessments conducted by the Powder River Basin Watershed Council, U.S. Forest Service, and Southwest Basin Native Fish Watershed Advisory Group). Activities such as removing unnecessary roads, stabilizing road crossings, relocating roads out of sensitive riparian areas, and altering grazing practices should be used to reduce sediment delivery to streams.

1.1.2 Assess sediment production from roads and potential sources in areas that have not been evaluated and implement actions to reduce sediment production if appropriate. Some areas in the Hells Canyon Complex Recovery Unit (*i.e.,* those not addressed in existing assessments) have not been assessed for sediment production. These areas should be assessed and appropriate corrective actions implemented.

1.1.3 Assess mine sites for potential negative effects on bull trout and bull trout habitats and rehabilitate sites determined to be problems. Two abandoned mines (Alaska and Bluejacket mines) cover a relatively large area in the headwaters of Indian Creek, and a recently rehabilitated mine (Copper Coin Mine) also occurs in the basin. These and numerous other historically and currently active mining sites throughout the Hells Canyon Complex may be negatively affecting bull trout through sedimentation, acidic discharge, and toxic discharge originating from tailings and other

waste products. Mining sites should be evaluated and corrected, if necessary.

1.1.4 Assess and attempt to mitigate negative effects of nonpoint sources of pollution on bull trout and bull trout habitats. Many land management practices (*e.g.,* forestry, agriculture, mining, and residential development and urbanization) produce nonpoint sources of pollution potentially affecting bull trout and bull trout habitats (*e.g.,* by negatively affecting water temperature, dissolved oxygen, and pH). The effects of nonpoint sources of pollution should be assessed and mitigated.

1.1.5 Assess the presence of residual concentrations of fish toxicants in sediments. Fish toxicants were used to remove nongame fishes in some areas of the recovery unit. The effects of the practice on bull trout are unknown. However, depending on the chemicals used, residual concentrations may remain in sediments and potentially affect aquatic systems for varying periods of time after application of the chemicals. The presence of the chemicals in sediments should be investigated so that the long-term effects on bull trout can be assessed and remedies developed, if appropriate.

1.2 Identify barriers or sites of entrainment for bull trout and implement tasks to provide passage and eliminate entrainment.

1.2.1 Identify water diversion structures and ditches affecting bull trout and implement actions to reduce negative effects. Numerous water diversions and ditches exist in the Hells Canyon Complex Recovery Unit, notably in the Pine Creek and Powder River basins, as well as some in the Crooked River watershed in the Wildhorse River basin, that have not been evaluated for their effects on bull trout (*e.g.,* as passage barriers and sites of entrainment). Diversions and ditches should be inventoried,

evaluated for effects on bull trout, and actions implemented to prevent negative effects on bull trout.

1.2.2 Provide fish passage at water diversions known to be fish passage barriers. Numerous relatively small water diversion structures are known barriers to bull trout movement. These structures should be removed or appropriate fish passage structures installed on them. Examples of areas where water diversion structures are known to be fish passage barriers include the North Powder River, Powder River, and the Anthony Creek and North Anthony Creek watersheds.

1.2.3 Identify dewatered areas where insufficient stream flow creates passage barriers, and develop and implement actions to provide fish passage. Reduced stream flows from water diversions create fish passage barriers (*e.g.,* through either complete drying of streams or contributing to unsuitable habitat conditions) in numerous areas of the Hells Canyon Complex Recovery Unit, especially in the Powder River basin. These areas should be assessed relative to instream flow needs of bull trout, and opportunities to eliminate passage barriers developed and pursued (*e.g.,* through changes in reservoir operations, and purchase or lease of existing water rights).

1.2.4 Investigate and implement methods to provide two-way fish passage at Oxbow Dam, Thief Valley Dam, Mason Dam, and Wolf Creek Dam. Two-way fish passage is necessary at Oxbow Dam to establish connectivity of bull trout local populations in the Wildhorse River basin with other local populations with the Pine-Indian-Wildhorse Core Area. Passage at the other three dams is necessary to establish connectivity among bull trout local populations in the upper Powder River basin and other areas of

the Powder River basin, as well as to encourage establishing bull trout in the Eagle Creek watershed.

1.2.5 Inventory and assess road crossings to identify fish passage barriers and implement actions to provide passage where appropriate. Although road crossings that inhibit fish passage have been inventoried and assessed in some areas or the Hells Canyon Complex Recovery Unit, especially at culverts, a comprehensive survey has not been conducted in all areas (*e.g.,* public and private lands in the Indian Creek and Wildhorse River basins). A survey should be conducted to identify fish passage barriers at road crossings and develop a program to provide passage where necessary (*e.g.*, through placement of appropriate size and properly functioning culverts).

1.2.6 Provide fish passage at road crossings that have been identified as fish passage barriers. Assessments conducted on State- and County-owned roads and some public lands in the Pine Creek and Powder River basins have identified road crossings that are barriers to fish passage (see specific sites in Fedora (1998) and Mirati (1999)). Actions to provide fish passage at these sites should be implemented.

1.3 Identify impaired stream channel and riparian areas and implement tasks to restore their functions.

1.3.1 Restore shade and canopy cover provided by riparian vegetation along select stream reaches where riparian habitats have been degraded. Various land management activities have degraded riparian habitats by removing vegetation, which has reduced the amount of shade and canopy cover of some stream reaches. Examples of streams where revegetating select reaches would improve both aquatic and riparian habitats to benefit bull trout

include the mainstem Powder River above Haines, North Powder River below Anthony Creek, Pine Valley, Indian Creek (Idaho) and Wildhorse River, as well as mainstem stream reaches that may provide overwintering areas for bull trout. Programs involved in riparian restoration projects include the U.S. Fish and Wildlife Service Partners for Fish and Wildlife, Oregon Department of Fish and Wildlife Restoration and Enhancement Program, and the Natural Resources Conservation Service Conservation Reserve Program.

1.3.2 Reduce degradation of aquatic and riparian habitats caused by livestock grazing. Overgrazing has degraded aquatic and riparian habitats through such activities as removal of riparian vegetation, and increases in sedimentation and stream bank instability. Examples of areas where habitats have been degraded include certain reaches of Pine Creek, Clear Creek, Elk Creek, East Pine Creek, Meadow Creek, Indian Creek (Idaho), Wildhorse River, and all stream reaches in the Pine Creek basin and upper Powder River basin occupied by bull trout. In some areas, actions to reduce negative effects of grazing have been implemented, but only along select reaches. For example, the U.S. Forest Service portion of Meadow Creek has been fenced but the meadow, which is on private land, has not. Recommended actions include proven approaches such as fencing, changes in timing and use of riparian pastures, off-site watering, and salting.

1.3.3 Adjust grazing practices to prevent negative effects on streambanks and riparian areas affecting bull trout habitats. Grazing allotments on the Payette National Forest have established riparian management objectives, which were developed in consultation with the U.S. Fish and Wildlife Service. Practices should be adjusted if annual monitoring of the allotments indicates that objectives are not being achieved. The

Idaho Soil Conservation Commission and Natural Resources Conservation Service can provide private livestock producers with technical assistance for grazing in riparian areas on private lands.

1.3.4 Identify and implement actions to restore stream and riparian habitats that have been degraded. The effects of stream channelization, agricultural and urban development, and mining have degraded habitats by confining and straightening streams, reducing recruitment of large woody debris, and reducing riparian vegetation. Examples of areas affected by channelization for agricultural and urban development include the Powder River Valley and lower reaches of streams along the Elkhorn Mountain front (*e.g.,* Big Muddy Creek, Rock Creek, Pine Creek, and Salmon Creek), and areas affected by mining include Cracker Creek and the Powder River upstream of Phillips Reservoir. Actions should address improving riparian vegetation and recruitment of woody debris in streams, and encouraging the restoration of characteristics of natural stream channels.

1.3.5 Improve degraded aquatic and riparian habitats in the Indian Creek and Wildhorse River watersheds. Habitats in the two basins have been degraded from timber harvest and road construction and maintenance, resulting in relatively moderate to high road densities, especially in bull trout spawning and rearing habitat. Actions to mitigate for the effects of roads and improve habitats include such activities as reducing road density, relocating roads, road closures, and road reconstruction.

1.4 Operate dams to minimize negative effects on bull trout in reservoirs and downstream.

1.4.1 Evaluate effects of reservoir operations on bull trout and implement operational changes to prevent negative effects and benefit bull trout if necessary. Reservoir operations (*e.g.,* water level manipulations, release schedule and method) may affect bull trout and bull trout habitat within a reservoir as well as in downstream areas (*e.g.,* through entrainment, thermal regimes, downstream flows). The effects of reservoir operations on bull trout and bull trout habitat should be evaluated and, if necessary, altered to prevent negative effects and benefit bull trout. Numerous reservoirs exist throughout the Hells Canyon Recovery Unit (*e.g.,* the three Snake River reservoirs of the Hells Canyon Complex, and Thief Valley Reservoir and Phillips Reservoir in the Powder River basin). Regulatory authorities (*e.g.,* Endangered Species Act consultations, Federal Energy Regulatory Commission licenses, and State license) vary with the ownership and uses of the reservoirs.

1.4.2 Reduce levels of dissolved gases in water released from Brownlee Reservoir. Entrainment of gases in water released from some reservoirs result in supersaturated levels of total dissolved gases in water downstream, which can induce gas bubble trauma in fish. High levels of total dissolved gases have been observed in water spilled from Brownlee Reservoir with supersaturated conditions extending downstream in both Oxbow Reservoir and Hells Canyon Reservoir. These gas levels may negatively affect the health of bull trout in the Pine-Indian-Wildhorse Core Area. Operational and structural modifications should be implemented at Brownlee Dam to reduce dissolved gases. In addition, operations at Oxbow Dam and Hells Canyon Dam should be assessed to determine whether they contribute to elevated dissolved gas levels downstream.

1.5 Identify upland conditions negatively affecting bull trout habitats and implement tasks to restore appropriate functions.

1.5.1 Evaluate potential effects of degraded upland areas on stream and riparian habitats and implement actions to restore historic vegetation and processes where appropriate. Some land management practices (*e.g.,* grazing and timber management) have degraded upland areas or produced conditions that have, or have the potential to, negatively affect stream and riparian habitats. These areas should be evaluated and actions to restore historic vegetation and processes (*e.g.,* fire regime) should be implemented to benefit bull trout and bull trout habitat.

2 Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.

2.1 Develop, implement, and enforce public and private fish stocking policies to reduce stocking of nonnative fishes that affect bull trout.

2.2 *Evaluate enforcement policies for preventing illegal transport and introduction of nonnative fishes.*

2.3 Provide information to the public about ecosystem impacts of introducing nonnative fishes.

2.4 *Evaluate biological, economic, and social effects of control of nonnative fishes.*

2.5 Implement control of nonnative fishes where found to be feasible and appropriate.

2.5.1 Evaluate the presence of introduced fishes in bull trout core habitat and their potential interactions with bull trout, and develop

and implement a plan to reduce potential negative effects. Several species of fish have been introduced in the Hells Canyon Complex Recovery Unit and may negatively interact with bull trout (*e.g.,* through hybridization, competition, and predation). The distribution of these species throughout the recovery unit and their potential effects on bull trout need to be evaluated so that an action plan to address the effects can be developed and implemented. Higher priority should be placed on investigations of brook trout, hatchery rainbow trout, largemouth bass, and smallmouth bass.

2.6 Develop tasks to reduce negative effects of nonnative taxa on bull trout.

2.6.1 Implement coordinated efforts among resource agencies to remove or suppress brook trout in the Indian Creek and Wildhorse River basins if determined to be feasible. Brook trout are the most common introduced salmonid in the Indian Creek and Wildhorse River watersheds. Bull trout-brook trout hybrids have been observed and are likely negatively affecting bull trout.

3 Establish fisheries management goals and objectives compatible with bull trout recovery, and implement practices to achieve goals.

3.1 Develop and implement State and Tribal native fish management plans integrating adaptive research.

3.1.1 Incorporate bull trout recovery actions into fish and habitat management plans relevant to the Hells Canyon Complex Recovery Unit. Management plans affecting the Hells Canyon Complex Recovery Unit have been developed by various entities (*e.g.,* State and Federal agencies, Tribes, industry groups, and watershed councils). Bull trout recovery should be incorporated into these management plans and assistance in implementing bull

trout recovery strategies requested from all parties involved in the plans.

3.1.2 Coordinate bull trout recovery monitoring with activities conducted under management plans and adaptively integrate the results of research into management plans and programs. Several aspects of the Hells Canyon Complex Recovery Unit (*e.g.,* physical habitat attributes, biological variables, water quality features) are monitored under various management plans. Monitoring activities pertinent to bull trout should be coordinated among plans and incorporate results from research. Examples of plans or programs with monitoring components include U.S. Forest Service management plans and the Oregon Plan for Salmon and Watersheds monitoring program.

3.1.3 Restore the historic prey base for bull trout by reestablishing viable populations of anadromous fish. The Hells Canyon Complex and other dams have eliminated anadromous fish from the recovery unit. Juvenile anadromous fish were likely an important prey source for bull trout in the recovery unit, and their absence has likely reduced the overall productivity of the watersheds upstream of Hells Canyon Dam. Although stocked species may provide a prey source to bull trout, reestablishing viable runs of anadromous fish would increase overall productivity of the recovery unit and increase the prey base available to bull trout. Coordination with task 1.2.4 is required, and passage at Hells Canyon Dam and Brownlee Dam should be addressed.

3.2 Evaluate and prevent overharvest and incidental angling mortality of bull trout.

3.2.1 Develop, implement, and evaluate angling regulations intended to minimize incidental mortality of bull trout. Although harvesting bull trout is prohibited in both the Idaho and Oregon portions of the Hells Canyon Complex Recovery Unit, studies in other areas within the range of bull trout have documented incidental harvest due primarily to anglers' inability to accurately identify bull trout. Regulations using such restrictions as closed areas where bull trout may be susceptible to angling during certain times should be implemented in conjunction with continuing efforts to improve anglers' knowledge of regulations and fish identification (*i.e.,* signs and educational materials). Compliance with these regulations should be evaluated at target areas (*e.g.,* popular access areas where bull trout occur and small, isolated populations), and regulations modified, if appropriate, for improvements.

3.3 Evaluate potential effects of introduced fishes and associated sport fisheries on bull trout recovery and implement tasks to minimize negative effects on bull trout.

3.3.1 Evaluate the effects of fish stocking and the fishery on bull trout in Cracker Creek and Phillips Reservoir. About 8,000 legal-size and 100,000 fingerling rainbow trout are annually planted in Cracker Creek and Phillips Reservoir. Potential effects of stocked rainbow trout and angling for them on bull trout in the Cracker Creek watershed should be assessed and remedied, if necessary. Although bull trout are not presently known to occur in Phillips Reservoir, they may expand their distribution to the reservoir during recovery. The possible influence that stocked rainbow trout and the fishery has on the present and potential distribution of bull trout in the reservoir and upstream should be investigated.

3.4 *Evaluate effects of existing and proposed sport fishing regulations on bull trout.*

4 Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.

4.1 Incorporate conservation of genetic and phenotypic attributes of bull trout into recovery and management plans.

4.1.1 Collect samples for genetic analysis to contribute to establishing a program to understand the genetic baseline and monitor genetic changes throughout the range of bull trout (see Chapter 1 narrative).

4.2 Maintain existing opportunities for gene flow among bull trout populations.

4.2.1 Prevent the establishment of barriers that may inhibit the movement of bull trout within the Hells Canyon Complex Recovery Unit. Activities that result in structural barriers or unsuitable habitat conditions should be modified or prohibited.

4.3 Develop genetic management plans and guidelines for appropriate use of transplantation and artificial propagation.

4.3.1 Develop protocols for and evaluate the feasibility of reintroducing bull trout into apparent historic or suitable habitat within the Hells Canyon Complex Recovery Unit. Transplanting bull trout in suitable unoccupied habitat may be necessary to achieve recovery at some time in the future. The feasibility of transplanting bull trout within the recovery unit needs to be assessed and appropriate protocols for specific areas need to be developed and evaluated. Protocols should address such issues as monitoring,

criteria for evaluating results, State and Federal guidelines for public process, donor stocks, disease factors, effects on other native species, and genetic concerns. Areas to consider as potential sites for transplanting bull trout include Eagle Creek and Fruit Creek, both in the Powder River basin.

5 Conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.

5.1 *Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.*

5.2 Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks.

5.2.1 <u>Evaluate historic and current conditions of all habitat types in each watershed within the Hells Canyon Recovery Unit</u>. The evaluation will generate information useful for developing additional site-specific recovery tasks. For instance, the evaluation may identify site-specific threats to bull trout in currently occupied and possibly unoccupied areas for which recovery tasks should be developed and implemented. Evaluations have been performed in select portions of the recovery unit (*i.e.,* contained in biological and watershed assessments primarily conducted by natural resource agencies for public lands).

5.2.2 <u>Review findings of continuing studies conducted by Idaho Power Company and others to develop additional recovery tasks for bull trout and other native fishes</u>. As part of Federal Energy Regulatory Commission relicensing efforts, Idaho Power Company is studying fish habitat and populations in the Hell

Canyon Complex reservoirs, key tributaries, and the mainstem Snake River below Hells Canyon Dam. These data, in addition to those generated by resources agencies, should be used to develop and refine recovery tasks in the Hells Canyon Complex Recovery Unit.

5.3 *Conduct evaluations of the adequacy and effectiveness of current and past best management practices in maintaining or achieving habitat conditions conducive to bull trout recovery*.

5.4 Evaluate effects of diseases and parasites on bull trout, and develop and implement strategies to minimize negative effects.

5.5 Develop and conduct research and monitoring studies to improve information concerning the distribution and status of bull trout.

5.5.1 <u>Evaluate the ability of Brownlee Reservoir to provide foraging, migrating, and overwintering habitat for bull trout</u>. Establishing a local population in Eagle Creek is considered essential for recovery of bull trout in the Powder River Core Area; bull trout occurred in Eagle Creek during the past and establishing a local population there would contribute to achieving recovery criteria 2 and 3. Because Eagle Creek is a tributary to the lower Powder River, migratory bull trout that may become established in it could seasonally use Brownlee Reservoir as foraging, migrating, and overwintering habitat. Evaluating the ability of Brownlee Reservoir to provide bull trout habitat is the first step in developing recovery tasks that may lead to increasing the recovery potential of an Eagle Creek local population and the Powder River Core Area.

5.5.2 <u>Conduct a comprehensive survey to evaluate bull trout presence and potentially suitable habitat in the Burnt River basin</u>.

Although bull trout have not been observed in the Burnt River basin, the basin has not been intensively surveyed specifically to investigate the presence of bull trout. Because bull trout occur in basins adjacent to the Burnt River basin and the Burnt River basin historically supported anadromous salmonids, it is plausible that bull trout presently occur or historically occurred in some portions of the basin. Habitat suitable for bull trout may exist in headwater tributaries of the Burnt River. Determining bull trout presence and the potential of the Burnt River basin to support bull trout is a primary research need.

5.5.3 Conduct studies of bull trout distribution, abundance, and life history characteristics in the Wildhorse River watershed and continue studies in the Indian Creek watershed. Bull trout presence in the upper Wildhorse River basin has only recently been documented and appears to be limited to two tributaries, Bear Creek and Crooked River. Bull trout in Indian Creek were thought to consist only of resident fish in the upper portion of the watershed; however, relatively large bull trout leaving the stream were recently collected in a weir in the lower portion of the stream, suggesting that migratory fish may occur in the drainage. Expanding ongoing studies in these basins will improve our understanding of bull trout there and contribute information to developing additional recovery tasks.

5.5.4 Conduct regular surveys in areas where bull trout status is unknown and those identified as having potential spawning and rearing habitat. Insufficient information is available to confidently describe the status (*e.g.,* abundance, distribution) and life history characteristics of bull trout in some areas of the Hells Canyon Complex Recovery Unit. Regular surveys should be conducted in these areas, as well as in areas considered as having potential spawning and rearing habitat, to generate information on

bull trout status and the establishment of additional local populations.

5.5.5 Develop a process to disseminate all information collected within the Hells Canyon Complex Recovery Unit. Several agencies and groups are generating information on various aspects of the recovery unit. A process to provide the information to interested parties is necessary to ensure that the data are distributed in a timely manner to improve coordination. The process should include reviewing and updating databases for bull trout distribution records.

5.6 Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.

6 Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitats.

6.1 Use partnerships and collaborative processes to protect, maintain, and restore functioning core areas for bull trout.

6.1.1 Support collaborative efforts by local watershed groups to implement site- specific protection and restoration activities to benefit bull trout. Various local watershed groups occur within the Hells Canyon Complex Recovery Unit and are involved in activities affecting bull trout conservation (*e.g.,* completing watershed assessments and implementing recommendations in assessments). Collaborative approaches (*e.g.,* conservation agreements, habitat conservation plans, easements, land purchases and leases from willing sellers) should be pursued with the groups and landowners to protect and improve bull trout habitat.

6.1.2 Continue cooperative efforts between states and among government agencies to implement recovery actions. The Hells Canyon Complex Recovery Unit occupies portions of both Idaho and Oregon. Agencies in both states should coordinate activities in implementing recovery tasks to improve efficiency (*e.g.,* common data collection methods, evaluation of responses to recovery tasks).

6.1.3 Develop educational materials on bull trout and their habitat needs. Educational materials addressing bull trout habitat and activities affecting it (*e.g.,* watershed form and function, riparian and side channel restoration, large wood placement, marking storm drains in urban areas) would contribute to informing landowners and the public at large about bull trout and recovery tasks.

6.2 *Use existing Federal authorities to conserve and restore bull trout.*

6.3 Evaluate enforcement of existing Federal, State, and Tribal habitat protection standards and regulations and evaluate their effectiveness for bull trout conservation.

7 Assess the implementation of bull trout recovery by recovery units, and revise recovery unit plans based on evaluations.

7.1 Convene annual meetings of each recovery unit team to review progress on recovery plan implementation.

7.1.1 Develop a participation plan to support implementation of recovery tasks in the Hells Canyon Complex Recovery Unit. A plan formalizing the participation of all interested parties in recovery of bull trout in the Hells Canyon Complex Recovery Unit should be developed. The plan should address such issues as

assessing appropriate changes in the recovery plan, task implementation and priority, and treatment of new information.

7.2 Assess effectiveness of recovery efforts.

7.3 *Revise scope of recovery as suggested by new information.*

IMPLEMENTATION SCHEDULE

The implementation schedule that follows describes recovery task priorities, task numbers, task descriptions, duration of tasks, potential or participating responsible parties, total cost estimate and estimates for the next 5 years, if available, and comments. These tasks, when accomplished, will lead to recovery of bull trout in the Hells Canyon Complex Recovery Unit. Costs estimates are not provided for tasks which are normal agency responsibility under existing authorities.

Parties with authority, responsibility, or expressed interest to implement a specific recovery task are identified in the Implementation Schedule. Listing a responsible party does not imply that prior approval has been given or require that party to participate or expend any funds. However, willing participants may be able to increase their funding opportunities by demonstrating that their budget submission or funding request is for a recovery task identified in an approved recovery plan, and is therefore part of a coordinated effort to recover bull trout. In addition, section 7(a)(1) of the Endangered Species Act directs all Federal agencies to use their authorities to further the purposes of the Endangered Species Act by implementing programs for the conservation of threatened or endangered species.

The following are definitions to column headings in the Implementation Schedule:

Priority Number: All priority 1 tasks are listed first, followed by priority 2 and priority 3 tasks.

Priority 1: All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: All actions that must be taken to prevent a significant decline in species population, habitat quality, or some other significant negative effect short of extinction.

Priority 3: All other actions necessary to provide for full recovery (or reclassification) of the species.

Task Number and Task Description: Recovery tasks are numbered as in the recovery outline. Refer to the action narrative for task descriptions.

Task Duration: Expected number of years to complete the corresponding task. Study designs can incorporate more than one task, which when combined, may reduce the time needed for task completion.

Responsible or Participating Party: The following organizations are those with responsibility or capability to fund, authorize, or carry out the corresponding recovery task. Lead agencies are indicated in bold type. Additional identified agencies or parties are considered cooperators in conservation efforts. Identified parties include:

BLM	Bureau of Land Management
counties	Counties within the recovery unit
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDT	Idaho Department of Transportation
IPC	Idaho Power Company
NMFS	National Marine Fisheries Services
NRCS	Natural Resources Conservation Service
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODF	Oregon Department of Forestry
ODOT	Oregon Department of Transportation
COE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation

USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
operators	water diversion and reservoir operators
councils	watershed councils
districts	water irrigation districts or companies

Cost Estimates: Cost estimates are rough approximations and provided only for general guidance. Total costs are estimated for the duration of the task, are itemized annually for the next five years, and include estimates of expenditures by local, Tribal, State and Federal governments and private business and individuals.

An asterisk (*) in the total cost column indicates ongoing tasks that are currently being implemented as part of normal agency responsibilities under existing authorities. Because these tasks are not being done specifically or solely for bull trout conservation, they are not included in the cost estimates. Some of these efforts may be occurring at reduced funding levels and/or in only a small portion of the watershed.

Double asterisk (**) in the total cost column indicates that estimated costs for these tasks are not determinable at this time. Input is requested to help develop reasonable cost estimates for these tasks.

Triple asterisk (***) indicates costs are combined with or embedded within other related tasks.

Implementation schedule for the Bull Trout Recovery Plan: Hells Canyon Complex Recovery Unit, Idaho and Oregon											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.1.1	Reduce sediment production from roads and other sources (*e.g.,* mines, over-grazed areas) known to be contributing sediment to streams.	25	**counties**, IDEQ, **IDT**, ODEQ, ODF, **ODOT**, **USFS**	***						Ongoing[1]. Coordinate with task 1.1.2.
1	1.1.2	Assess sediment production from roads and potential sources in areas that have not been evaluated and implement actions to reduce sediment production if appropriate.	6	**counties,** IDEQ, **IDT,** ODEQ, ODF, **ODOT**, **USFS**	*						
1	1.2.1	Identify water diversion structures and ditches affecting bull trout and implement actions to reduce negative effects.	10	councils, districts, **IDFG, ODFW**, operators, USFS,	750	75	75	75	75	75	Cost estimate for identification of sites and design.
1	1.2.2	Provide fish passage at water diversions known to be fish passage barriers.	10	councils, districts, IDFG, NRCS, ODFW, **operators**, USFS,	1,500	150	150	150	150	150	

[1]Ongoing tasks are currently being implemented as part of normal agency responsibilities that may benefit bull trout. Because these actions are not specifically being done to address bull trout conservation, they are not included in the cost estimates. Some of these efforts may be occurring at reduced funding levels and/or in only a small portion of the watershed.

Implementation schedule for the Bull Trout Recovery Plan: Hells Canyon Complex Recovery Unit, Idaho and Oregon											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.2.3	Identify dewatered areas where insufficient stream flow creates passage barriers, and develop and implement actions to provide fish passage.	25	councils, districts, **IDFG,** NRCS, **ODFW,** operators, USBR, USFS,	750	30	30	30	30	30	Cost estimate for identification of sites and development of actions.
1	1.2.4	Investigate and implement methods to provide two-way fish passage at Oxbow Dam, Thief Valley Dam, Mason Dam, and Wolf Creek Dam.	5	COE, FERC, IDFG, **IPC,** ODFW, **USBR,** USFWS	750	150	150	150	150	150	Cost estimate for investigations.
1	1.2.5	Inventory and assess road crossings to identify fish passage barriers and implement actions to provide passage where appropriate.	5	**BLM, counties, IDT, ODOT, USFS**	*						Ongoing.
1	1.2.6	Provide fish passage at road crossings that have been identified as fish passage barriers.	25	**BLM, counties, IDT, ODOT, USFS**	**						Ongoing.
1	2.5.1	Evaluate the presence of introduced fishes in bull trout core habitat and their potential interactions with bull trout, and develop and implement a plan to reduce potential negative effects.	5	**IDFG, ODFW,** USFWS, USFS	300	60	60	60	60	50	Cost and time estimate for evaluation.

Implementation schedule for the Bull Trout Recovery Plan: Hells Canyon Complex Recovery Unit, Idaho and Oregon											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	2.6.1	Implement coordinated efforts among resource agencies to remove or suppress brook trout in the Indian Creek and Wildhorse River basins if determined to be feasible.	25	**IDFG, ODFW,** USFWS, USFS	***						Task dependent on results of task 2.5.1.
2	1.1.3	Assess mine sites for potential negative effects on bull trout and bull trout habitats and rehabilitate sites determined to be problems.	5	**IDEQ, ODEQ,** USFS	250	50	50	50	50	50	Cost estimate for evaluation of sites.
2	1.1.4	Assess and attempt to mitigate negative effects of nonpoint sources of pollution on bull trout and bull trout habitats.	25	**EPA, IDEQ,** landowners, NRCS, ODA, **ODEQ,** USFS	*						Ongoing.
2	1.3.1	Restore shade and canopy cover provided by riparian vegetation along select stream reaches where riparian habitats have been degraded.	25	**BLM**, councils, IDFG, **landowners**, **NRCS,** ODFW, USFWS, **USFS**	500	20	20	20	20	20	Ongoing.
2	1.3.2	Reduce degradation of aquatic and riparian habitats caused by livestock grazing.	25	**BLM**, councils, IDFG, **landowners**, **NRCS,** ODFW, USFWS, **USFS**	500	20	20	20	20	20	Ongoing.
2	1.3.3	Adjust grazing practices to prevent negative effects on streambanks and riparian areas affecting bull trout habitats.	25	**BLM**, councils, IDFG, **landowners**, **NRCS,** ODFW, USFWS, **USFS**	50	20	20	20	20	20	Ongoing.

Implementation schedule for the Bull Trout Recovery Plan: Hells Canyon Complex Recovery Unit, Idaho and Oregon											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.3.4	Identify and implement actions to restore stream and riparian habitats that have been degraded.	25	**BLM**, councils, **IDFG**, **landowners**, **NRCS, ODFW**, USFWS, **USFS**	500	20	20	20	20	20	Cost estimate for identification of sites.
2	1.3.5	Improve degraded aquatic and riparian habitats in the Indian Creek and Wildhorse River watersheds.	25	IDFG, **landowners**, USFWS, **USFS**	*						Ongoing.
2	3.1.2	Coordinate bull trout recovery monitoring with activities conducted under management plans and adaptively integrate the results of research into management plans and programs.	25	**BLM, councils, IDEQ, IDFG, IPC, NMFS, NRCS, ODEQ, ODFW, USBR, USFS**	*						
2	3.1.3	Restore the historic prey base for bull trout by reestablishing viable populations of anadromous fish.	25	FERC, IDFG, **IPC, NMFS**, ODFW, USBR, USFWS	***						Coordinate with tasks 1.2.4.
2	4.1.1	Collect samples for genetic analysis to contribute to establishing a program to understand the genetic baseline and monitor genetic changes throughout the range of bull trout (see Chapter 1 narrative).	25	BLM, IDEQ, IDFG, IPC, ODEQ, ODFW, **USFWS**, USFS	**						See Chapter 1.
2	5.5.4	Conduct regular surveys in areas where bull trout status is unknown and those identified as having potential spawning and rearing habitat.	25	**IDFG, ODFW,** USFS	500	20	20	20	20	20	

Implementation schedule for the Bull Trout Recovery Plan: Hells Canyon Complex Recovery Unit, Idaho and Oregon											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	1.1.5	Assess the presence of residual concentrations of fish toxicants in sediments.	3	**ODEQ**, ODFW	180		60	60	60		
3	1.4.1	Evaluate effects of reservoir operations on bull trout and implement operational changes to prevent negative effects and benefit bull trout if necessary.	5	IDFG, ODFW, **operators, USBR**	250	50	50	50	50	50	Cost estimate for evaluation.
3	1.4.2	Reduce levels of dissolved gases in water released from Brownlee Reservoir.	25	IDEQ, IDFG, **IPC,** ODEQ, ODFW,	**						
3	1.5.1	Evaluate potential effects of degraded upland areas on stream and riparian habitats and implement actions to restore historic vegetation and processes where appropriate.	5	**BLM, councils**, IDEQ, IDFG, **NRCS,** ODEQ, ODFW, **USFS**	250	50	50	50	50	50	Cost estimate for evaluation.
3	3.1.1	Incorporate bull trout recovery actions into fish and habitat management plans relevant to the Hells Canyon Complex Recovery Unit.	25	**BLM, councils, IDEQ, IDFG, IPC, NMFS, NRCS, ODEQ, ODFW, USBR, USFS**	*						
3	3.2.1	Develop, implement, and evaluate angling regulations intended to minimize incidental mortality of bull trout.	25	**IDFG, ODFW**	*						
3	3.3.1	Evaluate the effects of fish stocking and the fishery on bull trout in Cracker Creek and Phillips Reservoir.	3	**ODFW**, USBR, USFS	150		50	50	50		

Implementation schedule for the Bull Trout Recovery Plan: Hells Canyon Complex Recovery Unit, Idaho and Oregon											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	4.3.1	Develop protocols for and evaluate the feasibility of reintroducing bull trout into apparent historic or suitable habitat within the Hells Canyon Complex Recovery Unit.	5	**IDFG, ODFW,** USFWS, USFS	250	50	50	50	50	50	Cost estimate for protocol development.
3	5.2.1	Evaluate historic and current conditions of all habitat types in each watershed within the Hells Canyon Recovery Unit.	10	BLM, councils, **IDFG, ODFW, USFS**	*						
3	5.2.2	Review findings of continuing studies conducted by Idaho Power Company and others to develop additional recovery tasks for bull trout and other native fishes.	25	**IDFG, councils, ODFW, USFWS, USFS**	*						Ongoing.
3	5.5.1	Evaluate the ability of Brownlee Reservoir to provide foraging, migrating, and overwintering habitat for bull trout.	5	FERC, IDFG, **IPC**, ODFW, USFWS	150	30	30	30	30	30	
3	5.5.2	Conduct a comprehensive survey to evaluate bull trout presence and potentially suitable habitat in the Burnt River basin.	5	councils, IPC, **ODFW,** USFS, USBR	200	40	40	40	40	40	
3	5.5.3	Conduct studies of bull trout distribution, abundance, and life history characteristics in the Wildhorse River watershed and continue studies in the Indian Creek watershed.	5	IPC, **IDFG,** USFS, USBR	500	100	100	100	100	100	

Implementation schedule for the Bull Trout Recovery Plan: Hells Canyon Complex Recovery Unit, Idaho and Oregon											
Priority number	Task number	Task description	Task duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	5.5.5	Develop a process to disseminate all data collected within the Hells Canyon Complex Recovery Unit.	25	all parties	*						
3	6.1.1	Support collaborative efforts by local watershed groups to implement site specific protection and restoration activities to benefit bull trout.	25	all parties	*						
3	6.1.2	Continue cooperative efforts between states and among government agencies to implement recovery actions.	25	**Idaho, Oregon, all agencies**	*						
3	6.1.3	Develop educational materials on bull trout and their habitat needs.	5	**IDFG, ODFW,** local, State, and Federal regulatory entities	125	25	25	25	25	25	Ongoing.
3	7.1.1	Develop a participation plan to support implementation of recovery tasks in the Hells Canyon Complex Recovery Unit.	3	all parties	75	25	25	25			Cost estimate for plan development.

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APPENDIX A: Summary of streams, stream reaches, and pollutant, parameter, or criteria for inclusion on the 1998 303(d) lists of Idaho and Oregon for the Hells Canyon Complex Recovery Unit. (Idaho Division of Environmental Quality 1998; Oregon Department of Environmental Quality 1998)

State	Basin or watershed	Boundaries	Pollutant, parameter, or criteria for inclusion
Idaho	Snake River	Brownlee Reservoir	dissolved oxygen, mercury, nutrients, pH, sediment
Idaho	Snake River	Brownlee Dam to Oxbow Dam	nutrients, pesticides, sediment
Idaho	Snake River	Weiser (town) to Brownlee Dam	dissolved oxygen, nutrients, pH, sediment
Oregon	Snake River	Hells Canyon Dam to Oxbow Dam	temperature, toxics (mercury)
Oregon	Snake River	Oxbow Dam to Brownlee Dam	temperature, toxics (mercury)
Oregon	Snake River	Brownlee Dam to Idaho border	temperature, tissue-mercury
Oregon	Pine Creek	Mouth to headwaters	temperature (bull trout)
Oregon	Pine Creek	Mouth to Clear Creek	temperature (rearing)
Oregon	Pine Creek	Clear Creek to Pine Creek, East Fork	temperature (rearing)
Oregon	Pine Creek	Pine Creek, East Fork to headwaters	temperature (bull trout)
Oregon	East Pine Creek	Mouth to Okanogan Creek	temperature (rearing)
Oregon	East Pine Creek	Okanogan Creek to headwaters	temperature (bull trout)
Oregon	East Pine Creek	Trail Creek, mouth to headwaters	temperature (bull trout)
Oregon	Clear Creek	Trinity, mouth to West Fork	temperature (rearing)
Oregon	Powder River	North Fork Anthony Fork of North Powder River, mouth to headwaters	temperature (bull trout)
Oregon	Powder River	California Gulch, mouth to headwaters	temperature (rearing)
Oregon	Powder River	Dean Creek, mouth to headwaters	temperature (rearing)
Oregon	Powder River	Eagle Creek, mouth to East Fork	temperature (rearing)
Oregon	Powder River	West Fork Eagle Creek, mouth to headwaters	temperature (rearing)
Oregon	Powder River	Elk Creek, mouth to Baker City municipal diversion	temperature (rearing)
Oregon	Powder River	East Fork Goose Creek, mouth to Phillips-Ingle ditch	turbidity
Oregon	Powder River	Indian Creek, mouth to headwaters	temperature (bull trout)
Oregon	Powder River	Mouth to Thief Valley Reservoir	bacteria, dissolved oxygen, flow modification, temperature (rearing)

State	Basin or watershed	Boundaries	Pollutant, parameter, or criteria for inclusion
Oregon	Powder River	Thief Valley Reservoir to Sutton Creek	bacteria, temperature (rearing)
Oregon	Powder River	Sutton Creek to National Forest boundary	bacteria
Oregon	North Powder River	Mouth to National Forest boundary	temperature (rearing)
Oregon	Powder River	Silver Creek, mouth to headwaters	temperature (bull trout)
Oregon	Burnt River	Mouth to Clarks Creek	flow modification, temperature (rearing)
Oregon	Burnt River	Clarks Creek to Unity Reservoir	chlorophyll a, flow modification, temperature (rearing)
Oregon	North Fork Burnt River	Mouth to Pete Mann Ditch	flow modification, habitat modification, sedimentations, temperature (rearing)
Oregon	West Fork Burnt River	Mouth to headwaters	habitat modification, sedimentation
Oregon	Burnt River	Camp Creek, mouth to East/West Forks	habitat modification, sedimentation
Oregon	Burnt River	East Camp Creek, mouth to King Creek	temperature (rearing)
Oregon	Burnt River	China Creek, mouth to headwaters	habitat modification, sedimentation, temperature (rearing)
Oregon	Burnt River	Geiser Creek, mouth to headwaters	habitat modification, sedimentation
Oregon	Burnt River	Gimlet Creek, mouth to headwaters	habitat modification, sedimentation
Oregon	Burnt River	Meadow Creek, mouth to headwaters	temperature(bull trout)
Oregon	Burnt River	Patrick Creek, mouth to south end of Patrick Meadows	habitat modification, sedimentation, temperature (rearing)
Oregon	Burnt River	Trout Creek, mouth to headwaters	habitat modification, sedimentation, temperature (rearing)

APPENDIX B: List of Chapters