8.6 BULL TROUT

8.6.1 STATUS OF THE SPECIES

(Note that terminology related to bull trout population groupings are further defined in Appendix E)

8.6.1.1 Listing Status

The coterminous United States population of the bull trout (Salvelinus confluentus) was listed as threatened on November 1, 1999 (64 FR 58910). The threatened bull trout occurs in the Klamath River Basin of south-central Oregon and in the Jarbidge River in Nevada, in the Willamette River Basin in Oregon, in the Pacific Coast drainages of Washington, including the Puget Sound; throughout major rivers in Idaho, Oregon, Washington, and Montana within the Columbia River Basin, and in the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Cavender 1978; Bond 1992; Brewin and Brewin 1997; Leary and Allendorf 1997).

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation and alterations associated with: dewatering, road construction and maintenance, mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels; and introduced non-native species (64 FR 58910). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

The bull trout was initially listed as three separate Distinct Population Units (DPSs) (63 FR 31647, 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs, plus two other population segments, into one listed taxon and the application of the jeopardy standard under section 7 of the ESA relative to this species (64 FR 58930):

> Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the ESA, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.

8.6.1.2 Current Status and Conservation Needs

As noted above, in recognition of available scientific information relating to their uniqueness and significance, five segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as interim recovery units: (1) Jarbidge River; (2) Klamath River; (3) Columbia River; (4) Coastal-Puget Sound; and (5) St. Mary-Belly River (USFWS 2002c; 2004a, b). Each of these segments is necessary to maintain the bull trout’s distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species’ resilience to changing environmental conditions.

A summary of the current status and conservation needs of the bull trout within these units is provided below. A comprehensive discussion of these topics is found in the FWS's draft Bull Trout Recovery Plan for the bull trout (USFWS 2002b; 2004a,b).

The conservation needs of the bull trout are often generally expressed as the four "Cs": cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminus to local populations. The recovery planning process for the bull trout (USFWS 2002b; 2004a,b) has also identified the following conservation needs: (1) maintenance and restoration multiple, interconnected populations in diverse habitats across the range of each interim recovery unit; (2) preservation of the diversity of life-history strategies; (3) maintenance genetic and phenotypic diversity across the range of each interim recovery unit; and (4) establishment of a positive population trend. Recently, it has also been recognized that bull trout populations need to be protected from catastrophic fires across the range of each interim recovery unit.

Central to the survival and recovery of the bull trout is the maintenance of viable core areas (USFWS 2002b, 2004a, b). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat. Each of the interim recovery units listed above consists of one or more core areas. There are 121 core areas are recognized across the United States range of the bull trout (USFWS 2002b; 2004a, b).

Jarbidge River

This interim recovery unit currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawners, are estimated to occur within the core area. The current condition of the bull trout in this interim recovery unit is attributed to the effects of livestock grazing, roads, angler harvest, timber harvest, and the introduction of non-native fishes (USFWS 2004a). The draft Bull Trout Recovery Plan (USFWS 2004a) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout within the core area; maintain stable or increasing trends in abundance of both resident and migratory bull trout in the core area; restore and maintain suitable habitat conditions for all life history stages and forms; and conserve genetic diversity and increase natural opportunities for genetic exchange between resident and migratory forms of the bull trout. An estimated 270 to 1,000 spawning fish per year are needed to provide for the persistence and viability of the core area and to support both resident and migratory adult bull trout (USFWS 2004a).

Klamath River

This interim recovery unit currently contains 3 core areas and 12 local populations. The current abundance, distribution, and range of the bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of non-native fishes (USFWS 2002c). Bull trout populations in this unit face a high risk of extirpation (USFWS 2002c). The draft Bull Trout Recovery Plan (USFWS 2002c) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout and restore distribution in previously occupied areas; maintain stable or increasing trends in bull trout abundance; restore and maintain suitable habitat conditions for all life history stages and strategies; and conserve genetic diversity and provide the opportunity for genetic exchange among appropriate core area populations. Eight to 15 new local populations and an increase in population size from about 3,250 adults currently to 8,250 adults are needed to provide for the persistence and viability of the 3 core areas (USFWS 2002c).

Columbia River

This interim recovery unit currently contains about 90 core areas and 500 local populations. About 62 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The condition of the bull trout within these core areas varies from poor to good, but generally all have been subject to the combined effects of habitat degradation, fragmentation, fisheries management, and alterations associated with one or more of the following activities: dewatering; road construction and maintenance; mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; poaching and incidental mortality from other targeted fisheries; entrainment into diversion channels; and introduced non-native species. The draft Bull Trout Recovery Plan (USFWS 2002c) identifies the following conservation needs for this unit: maintain or expand the current distribution of the bull trout within core areas; maintain stable or increasing trends in bull trout abundance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange.

Coastal-Puget Sound

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous, adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this unit. This interim recovery unit currently contains 14 core areas and 67 local populations (USFWS 2004b). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this unit. With only a few exceptions, bull trout continue to be present in nearly all major watersheds where they likely occurred historically within this unit. Generally, bull trout distribution has contracted and abundance has declined especially in the southeastern part of the unit. The current condition of the bull trout in this interim recovery unit is attributed to the adverse effects of dams, forest management practices (e.g., timber harvest and associated road building activities), agricultural practices (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, poaching and incidental mortality from other targeted fisheries, and the introduction of non-native species. The draft Bull Trout Recovery Plan (USFWS 2004b) identifies the following conservation needs for this unit: maintain or expand the current distribution of bull trout within existing core areas; increase bull trout abundance to about 16,500 adults across all core areas; and maintain or increase connectivity between local populations within each core area.

St. Mary-Belly River

This interim recovery unit currently contains 6 core areas and 9 local populations (USFWS 2002c). Currently, the bull trout is widely distributed in the St. Mary River drainage and occurs in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2-mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999. This increase was attributed primarily to protection from angler harvest (USFWS 2002c). The current condition of the bull trout in this interim recovery unit is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of non-native fishes (USFWS 2002c). The draft Bull Trout Recovery Plan (USFWS 2002c) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout and restore distribution in previously occupied areas; 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 the opportunity for genetic exchange; and establish good working relations with Canadian interests because local bull trout populations in this unit are comprised mostly of migratory fish, whose habitat is mostly in Canada.

8.6.1.3 Life History

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989, Goetz 1989). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989; Goetz 1989), or saltwater (anadromous) to rear as sub-adults or to live as adults (Cavender 1978; McPhail and Baxter 1996; WDFW 1997c). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime), and both repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982; Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1996).

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require two-way passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and therefore require only one-way passage upstream). Therefore even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Pratt 1985; Goetz 1989). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

8.6.1.4 Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), fish should not be expected to simultaneously occupy all available habitats (Rieman et al.1997).

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993; Gilpin, *in litt.* 1997; Rieman et al. 1997). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed, or stray, to non-natal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates that there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a very long time (Spruell et al. 1999, Rieman and McIntyre 1993).

Cold water temperatures play an important role in determining bull trout habitat, as these fish are primarily found in colder streams (below 59 degrees Fahrenheit), and spawning habitats are generally characterized by temperatures that drop below 48 degrees Fahrenheit in the fall (Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1993).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992; Rieman and McIntyre 1993; Baxter et al. 1997; Rieman et al. 1997). Optimum incubation temperatures for bull trout eggs range from 35 to 39 degrees Fahrenheit whereas optimum water temperatures for rearing range from about 46 to 50 degrees Fahrenheit (McPhail and Murray 1979; Goetz 1989; Buchanan and Gregory 1997). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 46 to 48 degrees Fahrenheit, within a temperature gradient of 46 to 60 degrees Fahrenheit. In a landscape study relating bull trout distribution to maximum water temperatures, Dunham et al. (2003) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 52 to 54 degrees Fahrenheit.

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman et al. 1997). Factors that can influence bull trout ability to survive in warmer rivers include availability and proximity of cold water patches and food productivity (Myrick et al. 2002). In the Little Lost River, Idaho, bull trout have been collected in water having temperatures up to 68 degrees Fahrenheit; however, bull trout made up less than 50 percent of all salmonids when maximum summer water temperature exceeded 59 degrees Fahrenheit and less than 10 percent of all salmonids when temperature exceeded 63 degrees Fahrenheit (Gamett 1999). In the Little Lost River study, most sites that had high densities of bull trout were in an area where primary productivity increased in the streams following a fire (B. Gamett, U. S. Forest Service, Personal Communication, 2002).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Pratt 1992; Thomas 1992; Rich 1996; Sexauer and James 1997; Watson and Hillman 1997). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989; Pratt 1992; Pratt and Huston 1993). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989; Pratt 1992; Rieman and McIntyre 1996). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992). After hatching, juveniles remain in the substrate, and time from egg deposition to emergence of fry may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992; Ratliff and Howell 1992).

Migratory forms of the bull trout appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers, lakes or nearshore marine habitat where foraging opportunities may be enhanced (Frissell 1993; Goetz et al. 2004; Brenkman and Corbett 2005). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams, lakes and marine waters, greater fecundity resulting in increased reproductive potential, and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Rieman and McIntyre 1993; MBTSG 1998; Frissell 1999). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbance makes local habitats temporarily unsuitable, the range of the species is diminished, and the potential for enhanced reproductive capabilities are lost (Rieman and McIntyre 1993).

8.6.1.5 Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. A single optimal foraging strategy is not necessarily a consistent feature in the life of a fish, but this foraging strategy can change from one life stage to another. Fish growth depends on the quantity and quality of food that is eaten (Gerking 1994) and as fish grow their foraging strategy changes as their food changes in quantity, size, or other characteristics. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987; Goetz 1989; Donald and Alger 1993). Adult migratory bull trout feed on various fish species (Leathe and Graham 1982; Fraley and Shepard 1989; Brown 1994; Donald and Alger 1993). Bull trout of all sizes other than fry have been found to eat fish half their length (Beauchamp and Van Tassell 2001). In nearshore marine areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) in the ocean (WDFW 1997c; Goetz et al. 2004).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Optimal foraging theory can be used to describe strategies fish use to choose between alternative sources of food by weighing the benefits and costs of capturing one choice of food over another. For example, prey often occur in concentrated patches of abundance ("patch model"; Gerking 1998). As the predator feeds in one patch, the prey population is reduced, and it becomes more profitable for the predator to seek a new patch rather than continue feeding on the original one. This can be explained in terms of balancing energy acquired versus energy expended. For example, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW 1997c). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman, in litt. 2003; Brenkman and Corbett, in litt. 2003; Goetz, in litt., 2003a,b).

8.6.1.6 Changes in Status of the Coastal-Puget Sound Population Segment

Although the status of bull trout in Coastal-Puget Sound population segment has been improved by certain actions, it continues to be degraded by other actions, and it is likely that the overall status of the bull trout in this population segment has not improved since its listing on November 1, 1999. Improvement has occurred largely through changes in fishing regulations and habitat-restoration projects. Fishing regulations enacted in 1994 either eliminated harvest of bull trout or restricted the amount of harvest allowed, and this likely has had a positive influence on the abundance of bull trout. Improvement in habitat has occurred following restoration projects intended to benefit either bull trout or salmon, although monitoring the effectiveness of these projects seldom occurs. On the other hand, the status of this population segment has been affected by a number of Federal and non-Federal actions, some of which are addressed under section 7 of the ESA. Most of these actions degraded the environmental baseline; all of those addressed through formal consultation under section 7 of the ESA permitted the incidental take of bull trout.

Three recent section 10(a)(1)(B) permits have been issued for Habitat Conservation Plans (HCPs) completed in the Coastal-Puget Sound population segment: 1) the City of Seattle's Cedar River Watershed HCP; 2) the Simpson Timber HCP; and 3) the Tacoma Public Utilities Green River HCP. In addition, the Plum Creek Cascades HCP, the Washington State Department of Natural Resources (WDNR) HCP, and the West Fork Timber HCP (Nisqually River) addressed the Coastal-Puget Sound population segment of bull trout. Following listing, consultation was reinitiated for these HCPs regarding their incidental take permits. These HCPs provide landscape-scale conservation for fish, including bull trout. Many of the covered activities associated with these HCPs will contribute to conserving bull trout over the long-term; however, some covered activities (albeit minimized by the conservation measures) may result in short-term degradation of the baseline. All HCPs permit the incidental take of bull trout.

8.6.1.7 Changes in Status of the Columbia River Population Segment

The overall status of the Columbia River population segment has not changed appreciably since its listing on June 10, 1998. Populations of bull trout and their habitat in this area have been affected by a number of actions addressed under Section 7 of the ESA. Most of these actions resulted in degradation of the environmental baseline of bull trout habitat, and all permitted or analyzed the potential for incidental take of bull trout.

In addition, the Plum Creek Cascades HCP addressed portions of the Columbia River population segment of bull trout. Immediately following listing, consultation was reinitiated regarding addition of the population segment to Plum Creek's incidental take permit.

In general, trends since listing have been improving slightly for many of the factors considered to be threats to bull trout due to implementation of conservation measures described in the draft Bull Trout Recovery Plan (USFWS 2002a). Although we have refined our understanding of some aspects of the bull trout's life history, distribution, and abundance, substantial gaps in our knowledge remain.

8.6.2 ENVIRONMENTAL BASELINE: Bull Trout

8.6.2.1 Status of the Species in the FPHCP Action Area

Regulations implementing the ESA (50 CFR § 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the FPHCP Action Area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the FPHCP Action Area that have undergone section 7 consultation, and the impacts of State and private actions that are contemporaneous with the consultation in progress.

8.6.2.2 Consulted on Effects

The status of bull trout in each population segment is being affected by a number of ongoing activities that have been addressed through previous biological opinions prepared under section 7 of the ESA, including several Habitat Conservation Plans (section 10(a)(1)(B) permits). A number of biological opinions addressing bull trout have been issued for Federal actions within the Coastal-Puget Sound and Columbia River population segments since listing. Many of these biological opinions have permitted the incidental take of bull trout. Habitat Conservation Plans are also discussed in the following section because they have the potential to have large-scale influences over a long period of time. In addition, numerous recovery permits (section 10(a)(1)(A) permits) have been issued to aid the recovery of bull trout in each population segment. Additionally, a discussion of section 7 analyse can be found in each of the core area narratives.

<u>Coastal-Puget Sound Population Segment</u>

Biological Opinions

Since being listed in 1999, the FWS has issued biological opinions that exempted incidental take in the Coastal–Puget Sound population segment. These incidental take exemptions were in the form of harm and harassment, primarily from temporary sediment increases during in-water work, loss or alteration of habitat, and the capturing and handling of fish. None of these projects were determined to result in jeopardy to the bull trout. The combined effects of actions evaluated under these biological opinions have resulted in short-term and long-term adverse effects to bull trout and degradation of bull trout habitat within the population segment.

Habitat Conservation Plans

The West Fork Timber Company (previously Murray Pacific Corporation), Washington Department of Natural Resources, and Plum Creek Timber Company added the Coastal-Puget Sound population segment of bull trout to their ITPs consistent with their respective HCPs and IAs. The West Fork Timber Company's HCP ensures that sufficient amounts of habitat types will be maintained or enhanced for bull trout on their land for a term of 100 years. The Washington Department of Natural Resources' Permit was updated in 1998 to include an exemption for the incidental taking of bull trout associated with their annual road construction and maintenance program and their annual timber management program. The Coastal-Puget Sound population segment of bull trout was added to the Plum Creek Cascades Permit in 2004 for forest-related activities on their lands. The Permit allows for the incidental take of bull trout associated with habitat degradation/loss due to selective and thinning/restoration-oriented silvicultural harvest, stream restoration, and road construction, maintenance, and removal per year. The term of the Plum Creek HCP and Permit is 50 to 100 years.

Three other HCPs have been completed in the Coastal-Puget Sound population segment. The City of Seattle's Cedar River Watershed HCP, completed in April 2000, covers municipal water supply and includes 1) Chester Morse reservoir operations and activities associated with restoration planting; 2) restoration thinning; 3) ecological thinning; 4) instream habitat restoration projects; 5) road removal; 6) road maintenance; and 7) road improvement. This HCP completely encompasses a single core area, the Chester Morse Lake core area. The term of the City of Seattle HCP and incidental take permit is 50 years.

The Green Diamond (formerly Simpson Timber) HCP, completed in October 2000, encompasses 261,575 acres with approximately 354 miles of fish-bearing stream habitat in the Chehalis and Skokomish River drainages in western Washington. Bull trout currently reside in the South Fork Skokomish River watershed, but they also may be found in low numbers within the Wynoochee and Satsop River watersheds (Chehalis River basin). The FWS authorized the incidental take of bull trout as a result of timber harvest and experimental thinning associated with stream habitats over the 50-year permit term. In addition, the FWS authorized incidental take of bull trout associated with habitat adjacent to new road construction, and road remediation. By year 15 of the HCP, effects to bull trout habitat resulting from road remediation should be eliminated.

The Tacoma Public Utilities Green River HCP, completed in July 2001, addresses effects to listed species from the management of 15,000 acres of forest in the upper Green River watershed, including approximately 110 stream miles, and Tacoma's municipal water withdrawal from Green River at river mile 61.0. Bull trout have not been documented to occur in the upper watershed and only a few individuals have been found in the FMO habitat of the lower Green River and Duwamish Waterway (USFWS 2001). In this HCP, we permitted the incidental take of bull trout resulting from water withdrawal activities affecting the middle and lower Green River, even-aged harvest, uneven-aged harvest, and the construction, maintenance, and decommissioning of forest road. The term of the Tacoma HCP and incidental take permit is 50 years.

Scientific Permits

The FWS may also issues recovery permits that would be in effect during the implementation period of this proposed action within the Coastal-Puget Sound population segment. Pursuant to these permits, bull trout may be injured or killed for research purposes. These permits usually are issued for five years and then would need to be renewed, if necessary. Although actual numbers of fish handled or killed due to fish handling procedures have not been recently summarized, based upon past experience we anticipate that the actual number of fish injured or killed will be significantly less than that issued. Prior years (2000-2002) indicate there have typically been no adult mortalities in almost all core areas, except one, South Fork Skokomish. Juvenile mortality is low as well, with only eight individuals lethally sampled across all core areas in three years (2000-2002).

Columbia River Population Segment

Biological Opinions

Since the bull trout listing, the FWS has issued biological opinions that exempted incidental take in the Columbia River population segment. These incidental take exemptions were in the form of harm and harassment, primarily from temporary sediment increases during in-water work, loss or alteration of habitat, and the capturing and handling of fish. None of these projects were determined to result in jeopardy to the bull trout. The combined effects of actions evaluated under these biological opinions have resulted in short-term and long-term adverse effects to bull trout and degradation of bull trout habitat within the Columbia River population segment.

Habitat Conservation Plans

The Plum Creek Timber Company's Permit amendment (USDI 1998d) added the Columbia River population segment of bull trout to their Permit consistent with the HCP and IA. The Permit allows for the incidental take of bull trout associated with habitat degradation/loss due to selective and thinning and silvicultural harvest, stream restoration, and road construction, maintenance, and removal per year. The term of the Plum Creek HCP and Permit is 50 to 100 years.

The Washington Department of Natural Resources' HCP incidental take Permit was updated (USDI 1998c) to allow for incidental take of bull trout in the lower Columbia River downstream from Greenleaf and Hamilton creeks. This Permit update was connected with the same effort discussed in the Coastal-Puget Sound population segment for the annual habitat degradation/loss due to road construction and maintenance and selective and thinning harvest.

Scientific Permits

The FWS may also issues recovery permits that would be in effect during the implementation period of this proposed action within the Columbia River population segment. Pursuant to these permits, bull trout may be injured or killed for research purposes. These permits usually are issued for five years and then would need to be renewed, if necessary. Although the actual numbers of fish handled or killed due to fish handling procedures have not yet been summarized, based upon past experience we anticipate that the actual number of fish injured or killed will be significantly less than that issued.

8.6.2.3 Core Areas

The FPHCP Action Area is comprised of almost the entire Coastal-Puget Sound population segment and that portion of the Columbia River population segment encompassed by the State of Washington. The Coastal-Puget Sound population segment is comprised of two management units: the Olympic Peninsula Management Unit and the Puget Sound Management Unit. A management unit is a subset of a listed entity that is defined by USFWS for administrative and management purposes, usually to manage recovery for a species that is broadly distributed and that may experience a wide range of threats and management authorities across its distribution. In the case of bull trout, the population segment was further subdivided into management units based on several factors, including biological and genetic considerations, political boundaries, and ongoing conservation efforts. Within the Olympic Peninsula Management Unit there are six core areas: the Quinault, Queets, Hoh, Elwha, Dungeness, and Skokomish. All six of these core areas are at least partially within the FPHCP Action Area. The Puget Sound Management Unit consists of eight core areas: Chester Morse Lake, Chilliwack, Lower Skagit, Nooksack, Puyallup, Snohomish/Skykomish, Stillaquamish, and the Upper Skagit. Portions of the FPHCP Action Area are within all of these core areas except Chester Morse Lake. Chester Morse Lake is not included in the description of the environmental baseline within the FPHCP Action Area because the entire watershed where bull trout occur is owned and managed under an approved HCP by the City of Seattle. Core areas consist of habitat that could supply all the necessary elements for every life-stage of bull trout (e.g., spawning, rearing, migration, overwintering, foraging), and have one or more local populations of bull trout. Core areas constitute the basic unit on which to gauge recovery.

That portion of the Columbia River population segment that falls within the boundaries of Washington State is made up of all or portions of nine management units (MUs). These recovery units are in the Lower Columbia River Basin, Middle Columbia River Basin, Upper Columbia River Basin, Northeast Washington River Basin, Umatilla-Walla Walla River Basins, Snake River Basin in Washington, Grande Ronde River Basin, Clark Fork River Basin, and the Coeur d'Alene Lake Basin. The Lower Columbia River Basin MU consists of the Klickitat and Lewis core areas. The Middle Columbia River Basin MU consists of the Yakima core area. The Upper Columbia River Basin MU consists of the Entiat, Wenatchee, and Methow core areas. The Northeast Washington River Basin MU contains the Pend Oreille core area. The Umatilla-Walla Walla River Basin MU (portion in Washington) contains the Walla-Walla and Touchet core areas. The Snake River Basin in Washington MU contains the Tucannon and Asotin Creek core areas. The Grande Ronde River Basin MU (portion in Washington) contains the Grande Ronde core area. The Clark Fork River Basin MU (portion in Washington) contains the Priest Lakes and Pend Oreille Lake core area. The Coeur d'Alene Lake Basin MU contains the Coeur d'Alene Lake Basin core area. Portions of each of these core areas are within the FPHCP Action Area.

Recovery objectives are similar for all core areas and are focused on maintaining current bull trout distributions and restoring distribution in previously occupied areas, maintaining stable or increasing trends in abundance of bull trout, restoring and maintaining suitable habitat for all life-history stages, conserving genetic diversity, and providing opportunity for genetic exchange. This can be achieved by correcting prevailing threats in each core area. In addition, the establishment of fisheries management goals and objectives, research and monitoring programs, adaptive-management approaches, and use of available conservation programs and regulations are recommended to achieve recovery objectives, and monitor progress in reaching recovery goals.

Coastal-Puget Sound Population Segment

Olympic Peninsula Management Unit

Queets Core Area

The Queets Core Area comprises the Queets River, all of its tributaries, and the estuary. The Queets mainstem, except for the lower eight miles, is contained entirely within a narrow corridor of the Olympic National Park. The tributaries flow through the Quinault Indian Reservation, Olympic National Forest, and State and private landholdings.

Fluvial, resident, and anadromous life history forms of bull trout occur in the Queets Core Area.

The status of the bull trout Core Area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

Number and Distribution of Local Populations

One local population has been identified: Queets River and associated tributaries upstream from the confluence with Tshletshy Creek. Bull trout occur in the Queets River up to river mile 46; in the Salmon, Sams, and Clearwater Rivers; and in Matheny Creek. The Queets River mainstem and tributaries are designated as mixed use (i.e., rearing, foraging, migration, overwintering). Spawning occurs in the mainstem river between river miles 45 and 48. With only one local population, bull trout in this Core

Area are considered at increased risk of extirpation and adverse effects from random naturally occurring events (see "Life History").

Adult Abundance

The Queets Core Area probably supports at least 500 but fewer than 1,000 adults. With fewer than 1,000 adults, the bull trout population in this Core Area is considered at increased risk of genetic drift.

Productivity

The bull trout population in the Queets Core Area is considered to be at risk of extirpation until sufficient information is collected to properly assess productivity.

Connectivity

Bull trout occur in the Queets River from the marine waters of the anadromous zone up to the headwater spawning sites. Although there are barriers to movement (e.g., impassable culverts) in some tributaries, there are no barriers to movement in the mainstem Queets River. This migratory corridor is relatively pristine and intact.

Changes in Environmental Conditions and Population Status

Since the bull trout listing, several Federal actions occurring in the Queets Core Area have resulted in harm to, or harassment of, bull trout. These actions include forest management activities and culvert replacements outside of the local population. The culvert replacements are designed to provide long-term benefits to the watershed and bull trout. The more recent forest management activities that are consistent with the Quinault Indian Reservation 10-year Forest Management Plan incorporate riparian buffers and conservation measures designed to reduce adverse effects to bull trout. No section 6 or section 10(a)(1)(A) permits have been issued in the Queets Core Area for effects to bull trout through capture and handling.

The number of non-Federal actions occurring in the Queets Core Area since the bull trout listing is unknown. Activities currently conducted on an infrequent basis, such as emergeny flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

Threats

Threats to bull trout in the Queets Core Area include:

- Past logging and logging-related activities, such as roads, degraded habitat conditions in the Clearwater, Sams, and Salmon Rivers and Matheny Creek.
- Road densities in the Clearwater River basin are high, and roads throughout the Queets Core Area are in need of repair.
- Bull trout are susceptible to incidental mortality associated with fisheries that target salmon and steelhead at the mouth of the Queets River and incidental hooking mortality from recreational fishers.

Skokomish Core Area

The Skokomish Core Area comprises the South Fork Skokomish River, North Fork Skokomish River (above Cushman Dam), Vance Creek, and their tributaries. Mainstem rivers in the area provide important foraging, migration, and overwintering habitat for sub-adult and adult bull trout. Available spawning and early rearing habitat is limited and fragmented. One reservoir in the core area, Lake Cushman, supports a typical adfluvial population.

Fluvial, adfluvial and, possibly, anadromous and resident life history forms of bull trout occur in the Skokomish Core Area.

The status the bull trout core area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

Number and Distribution of Local Populations

Two local populations have been identified: (1) North Fork Skokomish River (including Elk and Slate Creeks); and (2) South Fork Skokomish River (including Church Creek). Bull trout are distributed throughout the Skokomish core area, mainly downstream of barriers to migration in the South Fork Skokomish River and upstream of Cushman Dam in the North Fork Skokomish River. A third potential local population may occur in Brown Creek. With only two known local populations, the bull trout in this core area is at increased risk of local extirpation and adverse effects from random naturally occurring events.

Adult Abundance

The Skokomish Core Area likely supports fewer than 200 adult bull trout. Olympic National Forest estimates 60 adults occupy the South Fork Skokomish (WSCC 2003b). In the North Fork Skokomish River bull trout numbers remained relatively stable from 1990 to 1996. Counts during this period averaged 302 adults, ranging from 250 to 413. More recent counts from 1998 to 2004 indicate a decline to an average of 100 adults, ranging from 89 to 133 (S. Brenkman, Olympic National Park, *in litt.* 2003; S. Brenkman, Personal Communication, 2004). With fewer than 1,000 adults, the bull trout population in this core area is considered at risk of genetic drift. With fewer than 100 adults, the South Fork Skokomish River local population is considered at risk from inbreeding depression.

The bull trout population in this core area is one of the most depressed in the Olympic Peninsula Management Unit. The decline in numbers of adult bull trout in the North Fork Skokomish River and the low number of spawning adults in the South Fork Skokomish River indicate that the bull trout in this core area is at increased risk of extirpation and adverse effects from random naturally occurring events.

Productivity

The Olympic National Forest completed intensive redd surveys in the core area over a 3-year period. In 2000 in the South Fork Skokomish River, 20 redds were located in 5 spawning areas between river mile 19 and river mile 23.4, and 2 reds were located in the lower 0.5 mile of Church Creek. One questionable redd was observed in Brown Creek. There were 18 redds in the South Fork Skokomish River and 2 Church Creek in 2001. In 2002, there were 13 redds in the South Fork Skokomish River and 1 in Church Creek.

The bull trout in the Skokomish Core Area is considered at risk of extirpation until sufficient information is collected to properly assess productivity.

CONNECTIVITY

Migratory bull trout likely are present in the South Fork Skokomish River local population. Bull trout in the North Fork Skokomish River local population occur in Lake Cushman and the river upstream from the reservoir to the confluence of Four Streams in Olympic National Park. Adfluvial bull trout occur in Lake Cushman, the North Fork Skokomish River, and Elk and Slate Creeks. Restoration of the migratory corridor between the two local populations and between the local populations and Hood Canal will be required to allow full expression of the bull trout's migratory life history form.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

The FWS, NMFS, and the EPA assisted the Simpson Timber Company (now Green Diamond Resources) in completing a habitat conservation plan in 2000. The principle area of the HCP overlaps bull trout distribution in the South Fork Skokomish River and the accessible reaches of its major tributaries. The HCP includes management prescriptions designed to address wetlands, unstable slopes, road construction, road maintenance and decommissioning, certain harvest limitations to moderate snowmelt runoff, and riparian buffers that vary from 5 to 65 meters. The HCP also includes provisions for research and monitoring and a scientific committee of stakeholders.

Capture and handling during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Skokomish Core Area.

The number of non-Federal actions occurring in the Skokomish Core Area since the bull trout listing is unknown. Activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

THREATS

Threats to bull trout in the Skokomish Core Area include:

- Past timber harvest and harvest-related activities, such as roads, have degraded habitat conditions, including water quality, in the upper Skokomish River.
- Road densities in the Skokomish River basin represent some of the highest found west of the Cascades Mountains in Washington, and roads throughout the core area are in need of repair.
- Agricultural and livestock practices affect foraging, migration, and overwintering habitat in the lower watershed. Significant effects to the floodplain bull trout habitat, are caused by blocking fish passage, altering stream morphology, and degrading water quality.
- Diversion of water for hydropower production has eliminated connectivity between bull trout habitat upstream from the dams and habitat in the lower North Fork Skokomish River, the mainstem Skokomish River, the South Fork Skokomish River, and Hood Canal.
- The reduction of flows in the North Fork Skokomish River by diversion of water has reduced sediment transport capabilities and caused additional aggradation of the river.
- Incidental mortality of migrating bull trout caused by tribal gill-net fisheries, and recreational and tribal fisheries, poses a threat in the North Fork Skokomish River because of the low numbers of bull trout documented in recent years.
- Rural development in the lower watershed habitat has degraded water quality.

Elwha Core Area

The Elwha Core Area comprises the Elwha River and its tributaries including Boulder, Cat, Prescott, Stony, Hayes Godkin, Buckinghorse, and Delabarre Creeks; Lake Mills and Lake Aldwell; and the estuary of the Elwha River. There is no upstream passage at either the Elwha Dam or Glines Canyon Dam, which fragment the Core Area.

Anadromous, fluvial, adfluvial, and resident life history forms probably occupy the Elwha Core Area, although there is no available information. No spawning sites have been identified above the two dams, and there probably is little habitat suitable for bull trout spawning and incubation downstream from the dams. Elevated stream temperatures due to the two dams likely limit reproducing populations of bull trout in both the lower and middle reaches of the Elwha River.

The status of a bull trout Core Area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Only one local population has been identified in the Elwha Core Area. However, future surveys may identify additional local populations. Although no spawning areas have been identified, the presence of multiple age classes of bull trout in the Elwha River and accessible tributaries upstream from Glines Canyon Dam indicates spawning and juvenile rearing occur in the area. Many of the tributaries have limited accessible habitat. The Little River has been identified as a potential local population, based on the availability of suitable habitat and the likelihood that spawning will occur when the Elwha and Glines Canyon Dams are removed. With only one local population, bull trout in the Elwha Core Area are considered at increased risk of extirpation and adverse effects from random naturally occurring events.

ADULT ABUNDANCE

Bull trout occur in moderately low numbers between the two dams. Both juvenile and adult bull trout have been captured in the upper and middle Elwha River and in Lake Aldwell below Glines Canyon Dam. At the time of listing, bull trout were rare (i.e., one or two fish per year) in the Elwha River below the Elwha dam. Thirty-one bull trout, ranging in size from 250 to 620 millimeters, were documented in this section of the river during snorkel surveys in 2003 (G. Pess, NMFS, *in litt*. 2003).

There is no information on trends in abundance of Elwha River bull trout, and the status of Elwha River bull trout is unknown. Consequently, the bull trout population in the Elwha Core Area is considered at risk of genetic drift.

PRODUCTIVITY

Bull trout in the Elwha Core Area are considered at risk of extirpation until sufficient information is collected to properly assess productivity.

CONNECTIVITY

The Elwha and Glines Canyon Dams in the Elwha River fragment the populations of bull trout in the Elwha Core Area. Restoration of connectivity in the Elwha River will be required to allow full expression of the bull trout's migratory life history form, including anadromy.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Since the bull trout listing, Federal actions occurring in the Elwha River Core Area have resulted in harm to, or harassment of, bull trout. These actions include statewide Federal restoration programs that include riparian restoration, replacement of fish passage barriers, and fish habitat improvement projects; federally funded transportation projects involving repair and protection of roads and bridges; and section 10(a)(1)(B) permits for HCPs addressing forest management practices. Capture and handling during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Elwha Core Area.

The number of non-Federal actions occurring in the Elwha River Core Area since the bull trout listing is unknown. However, because most of the Core Area is in Federal ownership, few non-Federal actions likely have occurred in this Core Area.

THREATS

Threats to bull trout in the Elwha Core Area include:

- Two dams in the Elwha River prevent connectivity, increase injury and mortality of bull trout attempting to navigate through the dams, reduce spawning gravel recruitment, prevent recruitment of fluvially transported sediment to the estuary, affect the beach and eelgrass beds in the estuary, and increase water temperatures below the dams.
- Past logging on private lands in the Elwha Core Area, outside of the Olympic National Park, has affected water quality through the release of fine sediment, which potentially affects bull trout egg incubation success and juvenile rearing.
- Impacts from residential and urban development occur mainly in the lower Elwha River. Dike construction has constricted the channel and severely affected nearshore and estuary habitat and processes.
- Bull trout are susceptible to incidental mortality associated with fisheries that target commercially desirable species such as coho and steelhead.

Dungeness River Core Area

The Dungeness River Core Area comprises the Dungeness and Grey Wolf Rivers, associated tributaries, and estuary. The Dungeness River Core Area is one of two Core Areas in the Olympic Peninsula Management Unit that are connected to the Strait of Juan de Fuca.

Bull trout occur throughout the Dungeness and Gray Wolf Rivers downstream of impassable barriers, which are present on both rivers. They also occur in the Dungeness River estuary and Gold Creek, a Dungeness River tributary. Twenty-five char sampled in the Dungeness River were all bull trout (Spruell and Maxwell 2002). However, 50 char sampled upstream of the barrier at river mile 24 were all Dolly Varden (S. Young, WDFW, *in litt.* 2001).

Fluvial and anadromous life history forms of bull trout occur in the Dungeness River Core Area. Mainstem rivers within the Core Area provide spawning, rearing, foraging, migration, and overwintering habitats.

The status of the bull trout Core Area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Two local populations have been identified: (1) middle Dungeness River up to river mile 24 and tributaries, including Silver, Gold, and Canyon Creeks; and (2) Gray Wolf River to confluence with Cameron, Grand, and Cedar Creeks. With only two local populations, bull trout in this Core Area are considered to be at increased risk of extirpation and adverse effects from random naturally occurring events.

ADULT ABUNDANCE

Little is known about adult abundance in the Dungeness River Core Area, mainly due to lack of survey effort and difficult access to the upper watershed. However, the Dungeness River Core Area probably supports at least 500 but fewer than 1,000 adults. With fewer than 1,000 adults, this population is considered to be at increased risk of genetic drift.

From late August through November 1984, comprehensive redd surveys were conducted in the Gray Wolf and middle Dungeness Rivers. These surveys combined walking surveys with radio telemetry tracking. Eight redds were observed in the middle Dungeness, above the confluence with the Gray Wolf River and below the impassable barrier, and 32 redds were observed in the Gray Wolf River local population area. This probably represents approximately 90 percent of the redds in the two local populations (L. Ogg, USFS, Personal Communication, 2004b). There appear to be two spawning peaks during the year, with large (27- to 30-inch) bull trout observed during the second peak.

PRODUCTIVITY

Bull trout in the Dungeness Core Area are considered at risk of extirpation until sufficient information is collected to properly assess productivity.

CONNECTIVITY

Barriers to fish movement and migration in the Dungeness River Core Area include improperly sized or installed culverts throughout the Core Area. Connectivity between the Dungeness River and its floodplain has been eliminated by diking to prevent flooding. Migration during late summer and early fall can be blocked by reduced flows from water diversions for irrigation in the lower Dungeness watershed. Migration at certain times of the year may be blocked by the WDFW fish hatchery collection rack on the lower Dungeness River. In addition, the hatchery water intake is a complete barrier to upstream fish passage in Canyon Creek. Despite these alterations, migratory bull trout persist in both local populations. Bull trout in this Core Area have diminished risk of extirpation from habitat isolation and fragmentation.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Since the bull trout listing, Federal actions occurring in the Dungeness River Core Area have caused harm to, or harassment of, bull trout. These actions include statewide Federal restoration programs that include riparian restoration, replacement of fish passage barriers, and fish habitat improvement projects; federally funded transportation projects involving repair and protection of roads and bridges; and section 10(a)(1)(B) permits for HCPs addressing forest management practices. Capture and handling during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Dungeness Core Area.

The number of non-Federal actions occurring in the Dungeness River Core Area since the bull trout listing is unknown. Activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

One of the greatest causes of bull trout habitat degradation in the upper Dungeness River watershed is the presence of forest roads in an area having naturally unstable geology and steep slopes. Mass wasting and sediment delivery to streams are common problems. The lower watershed has been permanently modified by timber harvest and development into farming and housing areas. Water rights are over appropriated in the Dungeness River. Consequently, water diversions have altered stream flows, resulting in increased water temperatures, seasonal migration barriers, and false attractions of bull trout to other streams. Stormwater runoff from urban and residential development and agricultural practices also affect water quality. Incidental mortality of bull trout due to tribal and recreational fishing are likely affecting bull trout.

THREATS

Threats to bull trout in the Dungeness River Core Area include:

- Past logging and logging-related activities, such as roads, have degraded habitat conditions (e.g., fisheries, water quality, and connectivity) in the upper watershed, which has a naturally unstable geology with steep slopes that are susceptible to mass wasting.
- Past and current agricultural practices and the over appropriation of water rights negatively affect instream flow, increase water temperatures, and increase sediment deposition in the streambed. Other impacts include blocked migration, decreased juvenile rearing areas, false attractions of bull trout to other streams, transportation of pollutants in irrigation flows, reduced amounts of LWD, and loss of estuarine rearing and foraging habitat.
- Water quality has been degraded by municipal, agricultural, and industrial effluent discharges and development.
- Residential and urban development along the shore that include intertidal filling, bank armoring, and shoreline modifications have caused the loss of extensive eelgrass meadows in the nearshore.
- Bull trout are susceptible to incidental mortality associated with fisheries that target coho and steelhead at the mouth of the Dungeness River for approximately 74 days per year. Although recreational fishing for bull trout has been closed in the Dungeness River Core Area since 1994, incidental catch does occur, particularly during the early portion of the winter steelhead fisheries (NMFS, *in litt*. 2004).
- Predation by eagles and ospreys has caused the mortality of several fish in the Dungeness River (L. Ogg, USFS, Personal Communication, 2004a).

Quinault Core Area

The Quinault Core Area comprises the mainstem Quinault (East Fork) and North Fork Quinault Rivers, associated tributaries, the estuary of the river, and Lake Quinault. Fifty-one percent of the core area lies within the Olympic National Park, 32 percent is owned by the Quinault Indian Nation, and 13 percent is managed by the Olympic National Forest. The remaining 4 percent are private landholdings; Rayonier Timberlands Company is the largest private landowner.

Fluvial, adfluvial, anadromous and, possibly, resident life history forms of bull trout occur in the Quinault Core Area. The Cook Creek watershed provides foraging and overwintering habitat.

The status of the bull trout core area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Two local populations have been identified: (1) North Fork Quinault River and its associated tributaries; and (2) upper mainstem Quinault River, upstream from the confluence with the North Fork Quinault River. These two local populations occur entirely within the Olympic National Park. Although there may be more than two local populations, there is insufficient information at this time to identify additional local populations. Dolly Varden occur with bull trout in the upper mainstem Quinault River. There is no evidence of hybridization or introgression between the two species (Leary and Allendorf 1997).

Bull trout occur from the headwaters to the estuary and in numerous tributaries above the lake. Although spawning sites have not been located in the Quinault Core Area, the presence of multiple age classes of bull trout in both local populations indicates spawning and rearing does occur. With only two local populations, bull trout in this core area are considered at increased risk of extirpation and adverse effects from random naturally occurring events.

ADULT ABUNDANCE

Currently there is insufficient information for a precise estimate of adult bull trout abundance. However, the Quinault Core Area probably supports at least 500 but fewer than 1,000 adults. With fewer than 1,000 adults, this population is considered at increased risk of genetic drift.

PRODUCTIVITY

Bull trout in the Quinault Core Area are considered at risk of extirpation until sufficient information is collected to properly assess productivity.

CONNECTIVITY

Migratory bull trout occur in both local populations in the Quinault Core Area. Adequate connectivity between the two local populations, and throughout the core area, diminishes the risk of extirpation of bull trout in the core area from habitat isolation and fragmentation.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Since the bull trout listing, several Federal actions occurring in the Quinault Core Area have resulted in harm to, or harassment of, bull trout. These actions primarily consist of forest management activities and road repair outside of the local populations. Capture and handling during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Quinault Core Area. The only known Federal action occurring in a local population was a road reconstruction adjacent to the upper mainstem Quinault River. In general, the road repair actions were designed to provide long-term benefits to the watershed and bull trout. The more recent forest management activities that are consistent with the Quinault Indian Reservation 10-year Forest Management Plan incorporate riparian buffers and conservation measures designed to reduce adverse effects to bull trout from timber harvest activities and road construction and maintenance.

The number of non-Federal actions occurring in the Quinault Core Area since the bull trout listing is unknown. Activities conducted on a regular basis, such as emergeny flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

Threats

Threats to bull trout in the Quinault Core Area include:

- Tributaries and rivers outside of the Olympic National Park have been affected by past logging.
- Current and long-term historical impacts from roads and transportation networks affect fisheries, water quality, and connectivity. The core area below Lake Quinault has been modified by extensive road construction and timber harvest activities.
- Bull trout are susceptible to incidental mortality associated with fisheries that target salmon and steelhead at the mouth of the Quinault River and to incidental hooking mortality from recreational anglers.
- Physical reductions of stream channel depths and cover habitat, along with flow regime changes in the mid-to-lower subbasins, have altered migratory corridors.

Hoh River Core Area

The Hoh River Core Area comprises the Hoh and South Fork Hoh Rivers and associated tributaries. Active glaciers at the headwaters of the Hoh River watershed deliver both cold water and "glacial flour" to the mainstem.

Bull trout occur throughout the mainstem Hoh and South Fork Hoh Rivers. However, bull trout were not detected in 17 of 18 tributaries surveyed in the upper Hoh River. A series of cascades at river mile 48.5 in the upper Hoh River may be a barrier to upstream fish passage. There is a potential barrier to upstream fish passage in the South Fork Hoh River at river mile14.

Resident and migratory life history forms of bull trout, including anadromous forms, likely occur in the Hoh River Core Area. Genetic analysis has identified only bull trout (no Dolly Varden) in the Hoh River Core Area (Spruell and Maxwell 2002).

The status of the bull trout core area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

Number and Distribution of Local Populations

Two local populations have been identified: (1) the Hoh River above the confluence with the South Fork Hoh River and (2) the South Fork Hoh River. With only two local populations, the bull trout in this core area is considered at increased risk of extirpation and adverse effects from random naturally occurring events.

Adult Abundance

Historically the Hoh River Core Area likely comprised the largest population of bull trout on the Washington coast (Mongillo 1993). Currently there is insufficient information for a precise estimate of adult bull trout abundance, but the Hoh core area probably supports at least 500 but fewer than 1,000 adults. With fewer than 1,000 adults, this population is considered at increased risk of genetic drift.

PRODUCTIVITY

Bull trout in the Hoh River Core Area are considered at risk of extirpation until sufficient information is collected to properly assess productivity.

CONNECTIVITY

Barriers to fish movement and migration in the Hoh River Core Area include improperly sized or installed culverts in several locations. The mainstem is disconnected from off-channel habitats and adjacent riparian forest by riprap for bank armoring along the Upper Hoh Road. Impassable barriers of cedar spalt debris have formed in coastal rivers and streams in the core area. Holding and rearing areas for adult bull trout during spawning migration, and for juveniles during rearing movements among different stream reaches, are reduced due to reduction of instream large woody debris. Despite these habitat alterations, migratory bull trout persist in the Hoh River Core Area. Recent studies have shown that bull trout in the Hoh River Core Area move into adjacent independent coastal tributaries (Brenkman and Corbett 2003). Bull trout in this core area have diminished risk of extirpation from habitat isolation and fragmentation.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Since the bull trout listing, Federal actions occurring in the Hoh River Core Area have resulted in harm to, or harassment of, bull trout. These actions include statewide Federal restoration programs that include riparian restoration, replacement of fish passage barriers, and fish habitat improvement projects; federally funded transportation projects involving repair and protection of roads and bridges; and section 10(a)(1)(B) permits for HCPs addressing forest management practices. Capture and handling during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Hoh River Core Area.

The number of non-Federal actions occurring in the Hoh River Core Area since the bull trout listing is unknown. Activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

THREATS

Threats to bull trout in the Hoh River Core Area include:

- Past logging and logging-related activities, such as roads, have degraded habitat conditions (e.g., fisheries, water quality, and connectivity) in the lower and middle watershed. Numerous steep slopes are susceptible to mass wasting and channelized landslides. The resulting substantial increase in the number of debris flows has reduced macroinvertebrate populations in the Hoh River. Riparian roads have increased fine sediments and peak flows.
- Other impacts from past logging include reduced amounts of LWD, altered stream morphologies (especially reduced pool area and quality), and loss of riparian vegetation leading to increased water temperatures. Cedar spalts in several tributaries block fish passage, impede water flows, increase water temperature, leach tannins into the water, inhibit plant growth in the riparian area, and form dams that carve stream banks and increase fine sediments.
- Riprap for bank armoring along the Upper Hoh Road has prevented channel migration and formation of new habitats, created unnatural meander patterns, and disconnected the mainstem from off-channel habitats and adjacent riparian forest.
- Fisheries targeting other salmonids cause incidental mortality of bull trout via by-catch and are likely affecting the local populations.

- Black spot disease may be a factor in the decline of bull trout in the Hoh River.

Puget Sound Management Unit

Lower Skagit Core Area

The Lower Skagit Core Area comprises the Skagit basin downstream of Seattle City Light's Diablo Dam, including the mainstem Skagit River and the Cascade, Sauk, Suiattle, White Chuck, and Baker Rivers, and the lake systems above Shannon and Baker Dams.

Bull trout, which occur throughout the Lower Skagit Core Area, include fluvial, adfluvial, resident, and anadromous life-history forms. Resident life-history forms, found in a number of locations in the Core Area, often occur with migratory life-history forms. Adfluvial bull trout occur in Baker and Gorge Lakes. Fluvial bull trout forage and overwinter in the larger pools of the upper portion of the mainstem Skagit River and, to a lesser degree, in the Sauk River (WDFW 1997c; Kraemer, *in litt* 2003).

Many bull trout extensively use the lower estuary and nearshore marine areas for extended rearing and sub-adult and adult foraging. Key spawning and early rearing habitat, found in the upper portion of much of the basin, is generally on federally protected lands, including North Cascades National Park, North Cascades Recreation Area, Glacier Peak Wilderness, and Henry M. Jackson Wilderness Area.

The status of the bull trout Core Area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations, (2) adult abundance, (3) productivity, and (4) connectivity (USFWS 2004b).

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Nineteen local populations were identified initially: (1) Bacon Creek, (2) Baker Lake, (3) Buck Creek, (4) Cascade River, (5) Downey Creek, (6) Forks of Sauk River, (7) Goodell Creek, (8) Illabot Creek, (9) Lime Creek, (10) Lower White Chuck River, (11) Milk Creek, (12) Newhalem Creek, (13) South Fork Cascade River, (14) Straight Creek, (15) Sulphur Creek, (16) Tenas Creek, (17) Upper South Fork Sauk River, (18) Upper Suiattle River, and (19) Upper White Chuck River. Although initially identified as potential local populations, Stetattle Creek and Sulphur Creek (Lake Shannon), each now meets the definition of local population based on subsequent observations of juvenile bull trout and prespawn migratory adult bull trout (R2 Resource Consultants and Puget Sound Energy 2005; J. Shannon, *in litt*. 2004). With 21 local populations, the bull trout in the Lower Skagit Core Area is at diminished risk of extirpation and adverse effects from random naturally occurring events.

ADULT ABUNDANCE

The Lower Skagit Core Area, with a spawning population of migratory bull trout that numbers in the thousands, is probably the largest population in Washington (C. Kraemer, *in litt*. 2001). Consequently, the bull trout population in this Core Area is not considered to be at risk from genetic drift. Fewer than 100 migratory adults and a limited number of resident fish use the Forks of the Sauk River; however, the migratory component appears abundant and is increasing (C. Kraemer, *in litt*. 2003). Fewer than 100 adults probably occur in Tenas Creek, but this local population is presumed to be increasing. The Straight Creek population includes fewer than 100 migratory adults and an unknown number of resident fish (C. Kraemer, *in litt*. 2001), but the migratory component appears stable. The Lime Creek local population probably has fewer than 100 migratory adults, but resident and migratory components are considered abundant. The South Fork Cascade River local population probably has fewer than 100 migratory adults (C. Kraemer, *in litt*. 2001); however, resident and migratory components are considered stable. Adult abundances in Newhalem and Stettatle Creeks and Baker Lake are unknown. The majority of local populations in the Core Area include 100 adults or more. However, some local populations probably have fewer than 100 adults and are considered to be risk from inbreeding depression.

PRODUCTIVITY

Long-term redd counts in the index areas of the Lower Skagit Core Area generally indicate stable to increasing population trends.

CONNECTIVITY

The presence of migratory bull trout in most of the local populations indicates the bull trout in the Lower Skagit Core Area has a diminished risk of extirpation from habitat isolation and fragmentation. However, the lack of connectivity of the Baker Lake system and Stetattle Creek in the Gorge Lake system with other occupied sites in the Core Area is a concern.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Since the bull trout listing, Federal actions occurring in the Lower Skagit Core Area have caused harm to, or harassment of, bull trout. These actions include statewide Federal restoration programs that include riparian restoration, replacement of fish passage at barriers, and fish habitat improvement projects; federally funded transportation projects involving repair and protection of roads and bridges; and section 10(a)(1)(B) permits for HCPs addressing forest management practices. Capture and handling, and indirect mortality, during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Lower Skagit Core Area.

The number of non-Federal actions occurring in the Lower Skagit Core Area since the bull trout listing is unknown. Activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably have negatively affected bull trout.

THREATS

Threats to bull trout in the Lower Skagit Core Area include:

- Gorge and Baker Dams restrict connectivity of the Stetattle Creek and Baker Lake bull trout populations with the majority of other populations in the Core Area.
- Operations of the Lower Baker Dam occasionally have substantially affected water quantity in the lower Baker and Skagit Rivers.
- Agricultural practices, residential development, and the transportation network, with related stream channel and bank modifications, have caused the loss and degradation of foraging, migration, and overwintering habitats in mainstem reaches of the major forks and in a number of the tributaries.
- Marine nearshore foraging habitats have been, and continue to be, affected by agricultural practices and development activities.

Nooksack Core Area

The Nooksack Core Area comprises the Nooksack River and its tributaries, including the North, Middle, and South Fork Nooksack Rivers. Fluvial, anadromous and, possibly, resident life-history forms of bull trout occur in the Nooksack Core Area. Bull trout spawning occurs in the North, Middle, and South Fork Nooksack Rivers and their tributaries. Post-dispersal rearing and sub-adult and adult foraging probably occur throughout accessible reaches below barriers to anadromous fish. Overwintering likely occurs primarily in the lower mainstem reaches of the three forks and in the mainstem Nooksack River.

Bull trout and Dolly Varden co-occur in the Nooksack Core Area, but the level of interaction between the two species and degree of overlap in their distributions is unknown. However, limited genetic analysis and observational data suggest Dolly Varden in this Core Area inhabit stream reaches above barriers to anadromous fish, while bull trout primarily occupy the accessible stream reaches below the barriers.

The status of the bull trout Core Area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

Number and Distribution of Local Populations

Ten local populations have been identified: (1) Lower Canyon Creek, (2) Glacier Creek, (3) Lower Middle Fork Nooksack River, (4) Upper Middle Fork Nooksack River, (5) Lower North Fork Nooksack River, (6) Middle North Fork Nooksack River, (7) Upper North Fork Nooksack River, (8) Lower South Fork Nooksack River, (9) Upper South Fork Nooksack River, and (10) Wanlick Creek. Spawning areas in the local populations apparently are small and dispersed. With 10 local populations, the bull trout in this Core Area are considered to be at intermediate risk of local extirpation and adverse effects from random naturally occurring events.

Adult Abundance

The Nooksack Core Area probably supports fewer than 1,000 adults. Eight of the local populations likely have fewer than 100 adults each, based on the relatively low number of migratory adults observed returning to the Core Area. The Glacier Creek local population has approximately 100 adults, based on incidental redd counts and available spawning habitats. The Upper North Fork Nooksack River local population may support 100 adults, based on the number of persistent, small numbers of spawning adults observed in tributaries and available side channel habitat. The Nooksack Core Area bull trout population is considered to be at risk of genetic drift. Although the deleterious effects of inbreeding are minimized in these two local populations, the other eight local populations with few adults are considered at risk of inbreeding depression.

Productivity

The bull trout in the Nooksack Core Area are considered to be at increased risk of extirpation until sufficient information is collected to properly assess productivity

Connectivity

There is connectivity among most of the local populations, except for the Middle Fork Nooksack River, which has poor fish passage. There are road culvert barriers in several local populations. Consequently, the bull trout in the Nooksack Core Area is considered to be at intermediate risk of extirpation from habitat isolation and fragmentation.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Since the bull trout listing, Federal actions occurring in the Nooksack Core Area have resulted in harm to, or harassment of, bull trout. These actions include statewide Federal restoration programs that include riparian restoration, restoration of fish passage at barriers, and fish habitat improvement projects; federally funded transportation projects involving repair and protection of roads and bridges; and section 10(a)(1)(B) permits for HCPs addressing forest management practices. Capture and handling and indirect mortality during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Nooksack Core Area.

The number of non-Federal actions occurring in the Nooksack Core Area since the bull trout listing is unknown. Activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

THREATS

Threats to bull trout in the Nooksack Core Area include:

- Past logging and logging-related activities, such as roads, have caused the loss or degradation of a number of spawning and rearing areas within local populations, as well as foraging, migration, and overwintering habitats.
- The Bellingham Diversion has significantly reduced, if not precluded, connectivity of the Upper Middle Fork Nooksack River local population with the rest of the Core Area.
- Agricultural practices, residential development, the transportation network and related stream channel and bank modifications have caused the loss and degradation of foraging, migration, and overwintering habitat in mainstem reaches of the major forks of the Nooksack River and in a number of tributaries.
- Marine foraging habitats have been, and continue to be, greatly affected by urbanization along nearshore habitats in Bellingham Bay and the Strait of Georgia.
- The potential for brook trout and brook trout/Dolly Varden hybrids, detected in many parts of the Nooksack Core Area, to increase their distributions is a significant concern.

Puyallup Core Area

The Puyallup Core Area comprises the Puyallup, Mowich, and Carbon Rivers; the White River, which includes the Clearwater, Greenwater, and the West Fork White Rivers; and Huckleberry Creek. Glacial sources in several watersheds drain the north and west sides of Mount Rainier and significantly influence both water and substrate conditions in the mainstem reaches. The location of many of the headwater reaches of the basin in either Mount Rainier National Park or designated wilderness areas (Clearwater Wilderness, Norse Peak Wilderness) provides pristine habitat conditions.

Anadromous and fluvial/resident bull trout local populations occur in the White River and Puyallup River systems. The Puyallup Core Area has the southernmost, anadromous bull trout population in the Puget Sound Management Unit. Consequently, maintaining the bull trout population in this Core Area is critical to maintaining the overall distribution of migratory bull trout in the management unit.

The status of the bull trout Core Area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Five local populations occur in the Puyallup Core Area: (1) upper Puyallup and Mowich Rivers, (2) Carbon River, (3) upper White River, (4) West Fork White River, and (5) Greenwater River. The Clearwater River is identified as a potential local population, but the occurrence of reproduction there is unknown (USFWS 2004b).

Information about the distribution and abundance of bull trout in this Core Area is limited because observations have generally been incidental to other fish survey work. The anadromous life-history form in the Puyallup Core Area probably uses Commencement Bay and other marine nearshore habitats along Puget Sound. Both anadromous and fluvial/resident bull trout local populations occur in the White River and Puyallup River systems.

Spawning occurs in the upper reaches of this basin where higher elevations produce cool temperatures required by bull trout. Based on current survey data, bull trout spawning in this Core Area occurs earlier (September) than typically observed in other Puget Sound Core Areas (Marks et al. 2002). The known spawning areas in local populations are few in number and not widespread.

Rearing likely occurs throughout the upper Puyallup, Mowich, Carbon, upper White, West Fork White, and Greenwater Rivers. However, sampling indicates most rearing is confined to the upper reaches of the basin. The mainstem reaches of the White, Carbon, and Puyallup Rivers probably provide the primary foraging, migration, and overwintering habitat for migratory bull trout.

With fewer than 10 local populations, the Puyallup Core Area is considered to be at intermediate risk of extirpation and adverse effects from random naturally occurring events.

ADULT ABUNDANCE

Abundance estimates are not available for most local populations in the Puyallup Core Area. Fewer than 100 adults probably occur in local populations in the White River system, based on adult counts at the Buckley fish trap. Although these counts may not adequately account for fluvial migrants that might not migrate below the facility, these counts do indicate a few anadromous bull trout return to local populations in the White River system.

PRODUCTIVITY

The bull trout in the Puyallup Core Area is considered to be at increased risk of extirpation until sufficient information is collected to properly assess productivity.

CONNECTIVITY

Migratory bull trout are present in some local populations in the Puyallup Core Area. Although connectivity between the upper Puyallup and Mowich Rivers local populations and other local populations have been improved recently, very low numbers of migratory fish pass at the Buckley Diversion on the White River. The low abundance of migratory life-history forms limits the possibility for genetic exchange and local population reestablishment. Consequently, bull trout in the Puyallup Core Area are considered to be at intermediate risk of extirpation from habitat isolation and fragmentation.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Since the bull trout listing, the FWS has issued biological opinions that exempted incidental take in the Puyallup River Core Area. These incidental take exemptions were in the form of harm and harassment, primarily from temporary sediment increases during in-water work, loss or alteration of habitat, and handling of fish. None of these projects were determined to result in jeopardy to the bull trout. The combined effects of actions evaluated under these Opinions have resulted in short-term and long-term adverse effects to bull trout and degradation of bull trout habitat within the Core Area.

Implementation of section 6 and 10(a)(1)(A) permits have directly affected bull trout. As of May 2005, four juvenile bull trout were reported captured and handled in the Puyallup Core Area.

DNR's HCP (USFWS 1998) allows for the incidental take from associated forest practices and other covered activities of bull trout from the Coastal-Puget Sound population segment and the Columbia River population segment in the lower Columbia River downstream from Greenleaf and Hamilton Creeks.

THREATS

Threats to bull trout in the Puyallup Core Area include:

- Past logging harvest and associated road construction continue to affect bull trout spawning and rearing areas in the upper watershed.
- Agricultural practices continue to affect foraging, migration, and overwintering habitats for bull trout in the lower watershed.
- Dams and diversions have significantly affected migratory bull trout in the Core Area. Until passage was recently restored, the Electron Diversion Dam isolated bull trout in the upper Puyallup and Mowich Rivers for nearly 100 years and drastically reduced the abundance of migratory life-history forms in the Puyallup River. Buckley Diversion and Mud Mountain Dam have significantly affected the White River system in the past by impeding or precluding adult and juvenile migration and degrading foraging, migration, and overwintering habitats in the mainstem. Despite improvements, some of these effects continue, but to a lesser degree.
- Urbanization and residential development and the marine port at Tacoma have significantly reduced habitat complexity and quality in the lower mainstem rivers and associated tributaries and largely eliminated intact nearshore foraging habitats for anadromous bull trout in Commencement Bay.
- The presence of brook trout in many portions of the Puyallup Core Area and their potential to increase in distribution, including Mount Rainer National Park waters, are considered substantial threats to bull trout. Brook trout in the upper Puyallup and Mowich Rivers local populations are of highest concern because of past isolation and the level of habitat degradation.
- Until the early 1990s, bull trout fisheries probably significantly reduced the overall bull trout population. Current legal and illegal fisheries in the Puyallup Core Area may significantly limit recovery of the local population because of low numbers of migratory adults.
- Water quality has been degraded due to municipal and industrial effluent discharges resulting from development, particularly in Commencement Bay.

Snohomish-Skykomish Core Area

The Snohomish-Skykomish Core Area comprises the Snohomish, Skykomish, and Snoqualmie Rivers and their tributaries. Bull trout occur throughout the Snohomish River system downstream of barriers to anadromous fish. Bull trout are not known to occur upstream of Snoqualmie Falls, upstream of Spada Lake on the Sultan River, in the upper forks of the Tolt River, above Deer Falls on the North Fork Skykomish River, or above Alpine Falls on the Tye River.

Fluvial, resident, and anadromous life-history forms of bull trout occur in the Snohomish River/Skykomish Core Area. A large portion of the migratory segment of this population is anadromous. There are no lake systems within the basin that support an adfluvial population. However, anadromous and fluvial forms occasionally forage in a number of lowland lakes connected to mainstem rivers.

The mainstems of the Snohomish, Skykomish, North Skykomish, and South Fork Skykomish Rivers provide important FMO habitat for sub-adult and adult bull trout. The amount of key spawning and early rearing habitat is more limited, in comparison with many other Core Areas, because of the topography of the basin. Rearing bull trout occur throughout most of the accessible reaches of the basin and extensively use the lower estuary, nearshore marine areas, and Puget Sound for extended rearing.

The status of the bull trout Core Area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Four local populations have been identified: (1) North Fork Skykomish River (including Goblin and West Cady Creeks); (2) Troublesome Creek (resident form only); (3) Salmon Creek; and (4) South Fork Skykomish River. With only four local populations, bull trout in this Core Area are considered to be at increased risk of extirpation and adverse effects from random, naturally occurring events.

ADULT ABUNDANCE

The Snohomish-Skykomish Core Area probably supports between 500 and 1,000 adults. However, this Core Area remains at risk of genetic drift. About half of the spawners in the Core Area occur in the North Fork Skykomish local population. This is one of two local populations in the Core Area (the other is South Fork Skykomish River) that support more than 100 adults, which minimizes the deleterious effects of inbreeding. The Troublesome Creek population is mainly a resident population with few migratory fish. Although adult abundance is unknown in this local population, it is probably stable due to intact habitat conditions. The Salmon Creek local population likely has fewer than 100 adults. Although spawning and early rearing habitat in the Salmon Creek area is in good to excellent condition, this local population is considered to be at risk of inbreeding depression because of the low number of adults. Monitoring of the South Fork Skykomish local population indicates increasing numbers of adult migrants. This local population recently exceeded 100 adults and is not considered to be at risk of inbreeding depression (C. Jackson, Washington Department of Fish and Wildlife, Personal Communication, 2004). Fishing is allowed in this system.

PRODUCTIVITY

Long-term redd counts for the North Fork Skykomish local population indicate increasing population trends. Productivity of the Troublesome Creek and Salmon Creek local populations is unknown but presumed stable, as the available spawning and early rearing habitats are considered to be in good to excellent condition. In the South Fork Skykomish local population, new spawning and rearing areas are being colonized, resulting in increasing numbers of spawners. Sampling of the North Fork and South Fork Skykomish local population areas indicates the overall productivity of bull trout in the Snohomish-Skykomish Core Area is increasing.

CONNECTIVITY

Migratory bull trout occur in three of the four local populations in the Snohomish-Skykomish Core Area (North Fork Skykomish, Salmon Creek, and South Fork Skykomish). The lack of connectivity with the Troublesome Creek local population is a natural condition. The connectivity between the other three local populations diminishes the risk of extirpation of the bull trout in the Core Area from habitat isolation and fragmentation.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Since the bull trout listing, Federal actions occurring in the Snohomish-Skykomish Core Area have caused harm to, or harassment of, bull trout. These actions include statewide Federal restoration programs that include riparian restoration, restoration of fish passage at barriers, and fish habitat improvement projects; federally funded transportation projects involving repair and protection of roads and bridges; and section 10(a)(1)(B) permits for HCPs addressing forest management practices. Capture and handling during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Snohomish-Skykomish Core Area.

The number of non-Federal actions occurring in the Snohomish-Skykomish Core Area since the bull trout listing is unknown. However, activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

THREATS

Threats to bull trout in the Snohomish-Skykomish Core Area include:

- Past logging and logging-related activities, such as roads, have degraded habitat conditions in the upper watershed.
- Agricultural and livestock practices, including blocking fish passage, altering stream morphology, and degrading water quality in the lower watershed (FMO habitat), have significantly affected the floodplain and bull trout habitat.
- Illegal harvest or incidental hooking mortality may occur where recreational fishing is allowed by WDFW.
- Water quality has been degraded by municipal and industrial effluent discharges and development.
- Nearshore foraging habitat has been, and continues to be, affected by development activities.

Stillaguamish Core Area

The Stillaguamish Core Area comprises the Stillaguamish River basin, including the North Fork and South Fork Stillaguamish Rivers and their tributaries. Major tributaries to the North Fork Stillaguamish River include the Boulder River and Deer, Little Deer, and Higgins Creeks. Canyon Creek, the only major tributary to the South Fork Stillaguamish River, has minor tributaries including Millardy, Deer, Coal, Palmer, Perry, and Beaver Creeks.

Bull trout occur throughout the Stillaguamish River basin and, in the Stillaguamish Core Area, primarily include anadromous and fluvial life-history forms (USFWS 2004b). There are no known populations in the North Fork Stillaguamish River above the barrier to migration at river mile 37.5 (C. Kraemer, WDFW, *in litt*. 1999). No resident populations have been found above any of the natural migratory barriers on Deer or Higgins Creeks. No exclusively resident populations have been identified in this Core Area, but the South Fork Stillaguamish River population has a strong resident component coexisting with migratory forms.

The South Fork Stillaguamish River upstream of Granite Falls has supported anadromous bull trout since the construction of a fishway in the 1950s. Previously the falls were impassable to anadromous fish. Anecdotal information from fish surveys in the 1920s and 1930s, however, suggest that native char likely were present above Granite Falls prior to construction of the fishway (WDFW 1998).

Spawning habitat is generally limited in the Stillaguamish Core Area, and apparently, only the upper reaches provide adequate spawning conditions. Bull trout spawn in the upper reaches of the accessible portions of the upper North Fork Stillaguamish River and its tributaries, including Deer and Higgins Creeks. There have been no extensive juvenile sampling or evaluation of spawning success in the North Fork Stillaguamish River. Bull trout in the Upper Deer Creek local population spawn in Higgins Creek, and spawning also may occur in upper Little Deer Creek. Bull trout spawn in the Boulder River below the impassible falls at river mile 3. Although unconfirmed, spawning and rearing probably occur in the Squire Creek system, which is similar in size to Boulder River and also influenced by snowmelt. Boulder River may be identified as an additional local population when more distribution information is available.

Spawning areas in the South Fork Stillaguamish River and its tributaries include Canyon Creek and upper South Fork Stillaguamish. Bull trout are known to spawn and rear in Palmer, Perry, and Buck Creeks and the upper South Fork mainstem above Palmer Creek. Recent spawning surveys identified a major spawning area above the Palmer Creek confluence. Between 50 and 100 bull trout spawn in this reach. Electrofishing surveys also documented high densities of juveniles (D. Downen, WDFW, *in litt*. 2003). Spawning and early rearing habitat in the South Fork Stillaguamish River is considered to be in fair condition. Although bull trout spawn in the upper South Fork Stillaguamish River and other tributaries, available habitat is partially limited by gradient and competition with coho salmon. Upstream movement of bull trout from the lower river depends on proper functioning of the fish ladder at Granite Falls. Migratory and resident fish coexist on the spawning grounds.

Bull trout in the Canyon Creek local population use the upper South Fork Stillaguamish River for spawning and rearing. Although there have been isolated and incidental observations of spawning by migratory-size bull trout, electrofishing surveys have been unable to locate any juvenile or resident bull trout from this population. Despite repeated survey efforts, very few bull trout have been located in this population because of the difficulty in locating individuals.

The status of the bull trout Core Area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

Number and Distribution of Local Populations

Four local populations have been identified in the Stillaguamish Core Area: (1) Upper Deer Creek, (2) North Fork Stillaguamish River, (3) South Fork Stillaguamish, and (4) Canyon Creek. The scarcity and spatial isolation of available spawning habitat limits the number of local populations in the Stillaguamish Core Area. With only four local populations, the bull trout in this Core Area is considered to be at increased risk of extirpation and adverse effects from random naturally occurring events.

Adult Abundance

The bull trout population in the Stillaguamish River basin is estimated at fewer than 1,000 adults. In the North Fork Stillaguamish River, as many as 100 adult bull trout have been observed holding near the mouth of the Boulder River. Surveys documented nearly 300 adult char between river miles 21 and 25 during fall 2001; fewer than 100 adults were counted in the remaining sample years between 1996 and 2003 (G. Pess, NMFS, *in litt*. 2003). Other limited snorkel surveys had similar results (M. Downen, Personal Communication, 2003). These staging adult bull trout are assumed to spawn somewhere in the North Fork Stillaguamish River. Adult abundance in the Upper Deer Creek and Canyon Creek local populations is considered low. The Boulder River population probably has fewer than 100 adults. Approximately 50 to 100 adults are present in the South Fork Stillaguamish River, based on conservative estimates from spawning and electrofishing surveys (D. Downen, *in litt*. 2003). Although accurate counts are unavailable, current estimates of adult abundance suggest that Upper Deer Creek and Canuyon Creek local populations have fewer than 100 adults and are considered at risk of inbreeding depression.

Connectivity

Primary foraging, migration, and overwintering areas in the Stillaguamish River basin include the mainstems of the North Fork and South Fork Stillaguamish Rivers and the Stillaguamish River to the estuary. Foraging sub-adults and adults may be found in nearly all reaches of the basin below migratory barriers to the basin. Rearing individuals may use nearly all accessible reaches in higher elevation and coldwater portions of the basin. Anadromous forms in the Stillaguamish Core Area are presumed to use nearshore marine areas in Skagit Bay, Port Susan, and Possession Sound, but may also use areas even farther from their natal basin.

All native char habitat within the Stillaguamish River Basin generally has good connectvity. However, because the local populations are somewhat isolated from one another, maintaining connectivity among them will be critical to support life-hsitory diversity, refounding, and genetic exchange.

Changes in Environmental Conditions and Population Status

Since the bull trout listing, Federal actions occurring in the Stillaguamish Core Area have caused harm to or harassment of bull trout. These actions include five statewide Federal restoration programs that include riparian restoration, restoration of fish passage at barriers, and habitat-improvement projects. In addition, two federally funded transportation projects involving repair and protection of roads and bridges have been completed. One (WDNR) section 10(a)(1)(B) permits has been issued for HCPs that address bull trout in this Core Area.

The number of non-Federal actions occurring in the Stillaguamish Core Area since the bull trout listing is unknown. However, activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

Threats

Threats to bull trout in the Stillaguamish Core Area include:

- Channel widening and a significant reduction in primary pool abundance have seriously degraded habitat conditions in the North Fork and lower South Fork Stillaguamish Rivers.
- Spawning habitats in Deer and Canyon Creeks have been extremely degraded.

- Past logging and logging-related activities, such as roads, have degraded habitat in the Stillaguamish River basin. The loss of riparian cover, slope failures, stream sedimentation, increased stream temperatures, flooding, and loss of LWD have adversely affected bull trout in Deer Creek and in the South Fork Stillaguamish River (WDFW 1997b; USFWS 2004b). Deer and Higgins Creeks currently violate State water-quality standards for temperature.
- Agricultural and residential development have contributed to poor water quality in the lower Stillaguamish River basin. Excessive siltation caused by mud and clay slides on the North Fork Stillaguamish River near Hazel, Washington, and on the South Fork above Robe, contribute to poor water quality (Williams et al. 1975).
- Other limiting factors in the North Fork Stillaguamish River include loss of deep holding pools for adults and low summer flows (USFWS 2004b).
- Low flows and high temperatures during the summer affect holding habitat for anadromous migrants in the mainstem Stillaguamish River, especially in the lower river sloughs that have slow-moving water without significant riparian cover (WDFW 1997b).

Upper Skagit Core Area

The Upper Skagit Core Area comprises the Skagit River basin upstream of Diablo Dam, including Diablo Lake and most of Ross Lake. The upper Skagit River is a transboundary system that flows south from British Columbia into the United States. A significant portion of the upper Skagit River drainage lies within Canada. Much of the habitat in the Core Area is undisturbed because large portions of the watershed are located in North Cascades National Park, Pasayten Wilderness Area, and Skagit Valley Provincial Park.

Adfluvial, fluvial and, possibly, resident life-history forms of bull trout occur in the Upper Skagit Core Area. This Core Area supports both bull trout and Dolly Varden.

The status of the bull trout Core Area population is based on four key elements necessary for long-term viability: (1) number and distribution of local populations; (2) adult abundance; (3) productivity; and (4) connectivity (USFWS 2004b).

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Thirteen local populations occur in the upper Skagit River. Having more than 10 local populations diminishes the risk of extirpation of the bull trout in this Core Area. Seven of the local populations occur in the United States. Bull trout spawn and rear in at least eight streams in the United States: Ruby (including Canyon and Granite Creeks), Panther, Lightning, Big Beaver, Little Beaver, Silver, Pierce, and Thunder Creeks.

ADULT ABUNDANCE

Adult abundance probably exceeds 1,000 adults in the Upper Skagit Core Area, including those portions of the drainage in British Columbia. Therefore, the bull trout population in this Core Area is not considered at risk from genetic drift. Each of the Ruby Creek and Lighting Creek local populations probably has at least 100 adults. Adult abundance and the risk of inbreeding in the remaining local populations are unknown.

PRODUCTIVITY

The bull trout in the Upper Skagit Core Area are considered to be at increased risk of extipation until sufficient information is collected to properly assess productivity.

CONNECTIVITY

The presence of migratory bull trout in the majority of the local populations indicates the bull trout in the Upper Skagit Core Area has a diminished risk of extirpation from habitat isolation and fragmentation. However, Diablo Lake supports only a single population of migratory bull trout and remains a concern. If connectivity between the Diablo Lake system and the rest of the Upper Skagit Core Area cannot be adequately restored at Ross Dam, establishment of additional local populations probably will be necessary to ensure persistence of bull trout in the Diablo Lake system.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Since the bull trout listing, Federal actions occurring in the Upper Skagit Core Area have caused harm to, or harassment of, bull trout. These actions include statewide Federal restoration programs that include riparian restoration, restoration of fish passage barriers, and habitat-improvement projects, and federally funded transportation projects involving repair and protection of roads and bridges. No section 6, section 10(a)(1)(A), or 10(a)(1)(B) permits have been issued in the Upper Skagit Core Area for effects to bull trout from capture and handling.

The number of non-Federal actions occurring in the Upper Skagit Core Area since the bull trout listing is unknown. Because most of the Core Area is in Federal ownership, few non-Federal actions likely have occurred in this Core Area.

THREATS

Threats to bull trout in the Upper Skagit Core Area include:

- Ross Dam restricts connectivity between the Thunder Creek local population and most of the Core Area.
- Past logging practices have some residual effects on bull trout populations in the United States, and past and ongoing forest practices remain a significant threat to some local populations in Canada.
- Brook trout are established in a number of tributaries to Ross Lake that are also used by bull trout. Brook trout apparently have replaced or displaced bull trout in some tributaries (e.g., Hozemeen Creek).

Columbia River Population Segment

Lower Columbia River Basin Management Unit

Klickitat Core Area

Based on recent surveys, bull trout are known to occur in the West Fork Klickitat River. Tributaries of the West Fork Klickitat River which currently support bull trout include: Trappers Creek, Clearwater Creek, Two Lakes Stream, Little Muddy Creek, and an unnamed tributary of Fish Lake Stream. The West Fork Klickitat population is currently the only population identified in the Klickitat Core Area. This Core Area likely supports only the resident life-history form based on recent trapping efforts (USFWS 2002). Although a migratory size bull trout was observed in the Klickitat River in the early 1990’s, surveys conducted in 2001 did not find bull trout in the mainstem Klickitat River upstream of the confluence with the West Fork (Byrne et al. 2001; Thiesfeld et al. 2001; J. Byrne, Washington Department of Fish and Wildlife, Personal Communication, 2005).

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

Number and Distribution of Local Populations

Only one local population is known to occur in the Klickitat Core Area. In additional to the West Fork Klickitat River, bull trout are also found in Trappers Creek, Clearwater Creek, Two Lakes Stream, Little Muddy Creek, and an unnamed tributary of Fish Lake Stream.

Adult Abundance

Bull trout in the West Fork Klickitat local population are thought to be primarily resident. Low numbers indicate that this local population is at risk from the deleterious effects of inbreeding depression. If fluvial bull trout persist in the Klickitat Core Area, their abundance is most likely below 100 spawning adults and, therefore, should be considered at risk from inbreeding depression. Abundance of both resident and migratory (if present) in the Klickitat Core Area is likely below a 1,000 spawning individuals and, as a result, the Klickitat Core Area is considered to be at risk from genetic drift.

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. Given the overall lack of long-term population-census information in the Klickitat Core Area, this Core Area is considered to be at increased risk of extirpation.

Connectivity

Currently, bull trout in the Klickitat Core Area are most likely represented by resident forms, and consequently are considered to be at an increased risk of extirpation.

Threats

Threats to bull trout in the Klickitat Core Area include:

- Increased sediment loads associated with logging roads near tributary streams has been identified as problem in several basins within the Klickitat Core Area.
- Some cattle grazing has occurred in the Klickitat River basin which has lead to eroded stream banks, increased sedimentation, and incised channels.
- Warm temperatures due to natural low flows within in the Klickitat drainage my be a concern for adult bull trout that spawn in the mainstem or lower reaches of tributary streams as well as for juveniles that may rear in those locations. Any agricultural diversions would only exacerbate an already tenuous flow conditions.
- Introduction of non-native species has affected bull trout populations through a combination of hybridization, competition, and predation.

Lewis River Core Area

Currently, reproducing populations of bull trout within the Lewis River Core Area are found in Lake Merwin, Yale, and Swift Creek reservoirs. Bull trout in the Lewis River are considered to be predominately adfluvial. The number of bull trout inhabiting the Lewis River Core Area is estimated to be low. Spawning and juvenile rearing occur in Cougar Creek, Rush Creek, and Pine Creek.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Two local populations are known to occur in the Lewis River Core Area. Spawning adfluvial bull trout in Yale Lake migrate into Cougar Creek from the middle of August through early September and spawn from late September through early October. The other population occurs in Swift Creek Reservoir and spawns in Rush and Pine Creeks.

ADULT ABUNDANCE

The estimated Cougar Creek spawner population ranges from 0 to 40 individuals based on annual estimates taken between 1979 and 2001. Due to low spawner numbers this population is consider at risk of inbreeding depression. The annual spawner population estimates from Rush and Pine creeks (Swift Creek Reservoir) between 1994 and 2001, range from 101 to 542 fish. The majority of spawning occurs in Rush Creek and the 8-year average for both creeks is 309 fish. Bull trout in this population are not at risk of inbreeding depression. Additional escapement estimates, based on “mark and recapture” counts are also available for Swift Creek Reservoir (Pine and Rush Creeks) since the time of listing. Estimated escapement was variable during the 1990’s (ranging between 101 and 437 adults), but has increased since 1999, with a 2004 population estimate of 1,287 adults (USFWS 2002; WDFW 2005). Overall the population is probably below 1,000 spawning adults and, therefore, is considered to be at risk of genetic drift.

PRODUCTIVITY

Recent genetic analyses suggest that only one genetically distinct group (Pine and Rush Creek local populations) exists within the Lewis River system (Neraas and Spruell 2004). Previous analyses indicated that two genetically distinct groups (Pine and Rush Creeks, and Cougar Creek) were present in the Core Area (Spruell et al. 1998). Increased sample size and samples collected from known spawning sites indicate that the Cougar Creek local population, which represents the only spawning tributary in Yale Reservoir, likely represents a mixture of spawners from the two upstream local populations in Swift Creek Reservoir.

For a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time. Given the overall lack of long-term population census information in the Lewis River Core Area and the variability in the Cougar Creek population, this Core Area is considered to be at increased risk of extirpation.

CONNECTIVITY

Lack of passage at hydroelectric facilities with in the Lewis River Core Area has fragmented populations and prevented bull trout from using foraging and overwintering habitats in the mainstem Columbia River. Migratory bull trout persist at low levels by virtue of adopting an adfluvial life-history form in Swift

Creek and Yale Lake reservoirs. Lack of passage and the low abundance of the migratory life-history strategy, limit the possibility for genetic exchange and local-population refounding, placing the Lewis River Core Area at increased risk of extirpation.

Changes in Environmental Conditions and Population Status

A settlement agreement for the relicensing of the Yale, Merwin, Swift No. 1 and Swift No. 2 hydroelectric projects was signed in 2004 (PacifiCorp et al. 2004). Conservation measures are incorporated in the project description to minimize or compensate for the effects of the projects on listed species, including bull trout. Conservation measures for bull trout include: perpetual conservation easements on PacifiCorp's lands in the Cougar/Panamaker Creek area and PacifiCorp's and Cowlitz Public Utility District's lands along the Swift Creek arm of Swift Creek Reservoir; upstream and downstream fish passage improvements at all reservoirs; limiting factors analysis for bull trout to determine additional enhancement measures; public-information program to protect bull trout; and monitoring and evaluation efforts for bull trout conservation measures. This agreement will also restore anadromous salmon to the upper Lewis River system, restoring a substantial part of the historic forage base for bull trout.

Threats

Threats to bull trout in the Lewis River Core Area include:

- Construction of three hydropower dams on the Lewis River have fragmented habitat, isolated local populations, and prevented access to foraging and overwintering habitat.
- Past logging practices in the Lewis River basin have altered flow regimes, riparian conditions, and instream habitat.
- Introduction of non-native species including brook trout, lake trout, rainbow trout, kokanee, largemouth bass, and tiger musky have affected bull trout populations through a combination of hybridization, competition, and predation.
- Harvest has played a role in the decline of local populations, but fishing for bull trout in the Lewis River Core Area closed only as recently as 1992. Misidentification of bull trout by anglers may remain a threat.

Middle Columbia River Basin Management Unit

Yakima Core Area

The Yakima River has bull trout dispersed throughout the basin. Resident and migratory (both fluvial and adfluvial) bull trout are all found within the Yakima Core Area. Bull trout in the Yakima Core Area are currently found in 16 local populations. These populations are included within habitat in the mainstem Yakima River (Keechelus to Easton Reach for spawning some migration/overwintering in lower Yakima); Ahtanum Creek (North, South, and Middle Forks); Naches River tributaries (American River, Bumping River; Bumping Lake and Deep Creek, Rattlesnake Creek, and Little Naches River and Crow Creek); Tieton River (North Fork Tieton River); Rimrock Lake tributaries (South Fork Tieton River and Indian Creek; Teanaway River and tributaries (North Fork Teanaway); Kachess Lake tributaries (Box Canyon Creek, upper Kachess River - including Mineral Creek); Keechelus Lake (Gold Creek); the Cle Elum River (including its tributaries); Waptus River and Waptus Lake, and Cooper River and Cooper

Lake. Taneum Creek, in the upper Yakima River, is the location where the one population is expected to be reintroduced.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

Number and Distribution of Local Populations

Historically, bull trout occurred throughout the Yakima River basin, but are now fractured into isolated populations. Bull trout in the Yakima Core Area are currently found in 16 local populations including: the mainstem Yakima River (Keechelus to Easton Reach); Ahtanum Creek (North, South, and Middle Forks); Naches River tributaries (American River, Rattlesnake Creek, and Crow Creek); Rimrock Lake tributaries (South Fork Tieton River and Indian Creek); Teanaway River; Kaches Lake tributaries (Box Canyon Creek and upper Kachess River); Keechelus Lake (Gold Creek); the upper Cle Elum River; and the North Fork Tieton River.

Although bull trout are present in the mainstem Ahtanum Creek they are probably more abundant in the upper portion of the drainage, particularly in the North, Middle and South Forks where habitat conditions are more favorable.

U.S. Forest Service surveys found one bull trout in Oak Creek, and one in Milk Creek. WDFW telemetry information shows that much of the mainstem Naches and portions of the lower tributaries are used for overwintering habitat. The radio-tagged bull trout were seen below the mouth of the Naches River in the mainstem Yakima River.

In the Tieton drainage above the Rimrock Dam, local populations of bull trout are found in the South Fork Tieton River (including Bear Creek) and Indian Creek. Juvenile bull trout have been observed in several other South Fork Tieton tributaries including Short, Dirty, Grey, Spruce, and Corral Creeks. These fish most likely originated from native fluvial fish in the Tieton River. Construction of the Tieton Dam in 1925 forced bull trout to adopt an adfluvial life-history pattern. WDFW catch records for Clear Lake on the North Fork Tieton documented bull trout presence in the 1950's. In 1993, U.S. Forest Service staff reported capturing one 75 to 100 millimeter (3 to 4 inch) bull trout from a minnow trap in Clear Lake. In addition, biologists from Central Washington University observed an adult bull trout in the upper North Fork Tieton River in 1996 and interagency surveys located both a redd and adult migratory bull trout in 2004. Bull trout have been found in the Tieton River (below Rimrock Lake).

Within the Naches system, other bull trout local populations have been identified in Rattlesnake Creek (including Little Wildcat Creek), American River (including Union and Kettle creeks), and in the Little Naches River in Crow Creek. Larger bull trout have been observed spawning in the American River.

In the Bumping River, adfluvial bull trout inhabit Bumping Lake and are part of the local population in Deep Creek. The local population in Deep Creek probably originated from a native adfluvial life-history form, which was present even before the construction of the dam in 1910. Construction of the dam enlarged the natural lake and forced any fluvial bull trout to adopt an adfluvial life-history. While Deep Creek is the only identified local population above Bumping Lake, the U.S. Forest Service reported a single redd with three bull trout in the upper Bumping River in 1994. A bull trout redd was seen in the Bumping River during a U.S. Forest Service snorkel survey in September 2003 and juveniles were seen in another snorkel survey in September 2002. Bull trout have been found in the Bumping River (below Bumping Lake).

Within the upper Yakima River and in the Teanaway River, the bull trout local population uses habitat within the North Fork Teanaway River and the mainstem and DeRoux Creek. Limited spawning occurs, and most recently two redds were observed by FWS in 2005 in the North Fork Teanaway River just upstream of DeRoux Creek. Bull trout have also been observed in Jungle and Jack Creeks. Although the habitat appears to be suitable for bull trout in the West and Middle Forks, no bull trout have been found in these streams. Bull trout in the North Fork Teanaway River are likely a mix of both small resident forms and larger fluvial forms.

Bull trout local populations above Kachess Dam probably originated from a native adfluvial life-history form, which was present in the existing lake before the construction of the dam in 1905. Local populations identified by the Middle Columbia Bull Trout Recovery Team in this area include Box Canyon Creek and the upper Kachess River. However, some spawning may occur in Mineral Creek when adequate flows are available.

Similar to Kachess Lake, bull trout in Keechelus Lake include the Gold Creek local population which most likely originated from a native adfluvial life-history form which was present before the construction of the dam and irrigation reservoir in 1914 (which modified the natural lake). Anecdotal reports indicate that bull trout may have been present in Rocky Run Creek in the early 1980's. However, surveys to confirm their presence have not been conducted. In 2005, a bull trout was located in Cold Creek, below the barrier culvert.

The Middle Columbia Bull Trout Recovery Team has identified two local populations above Cle Elum Dam; one using Cle Elum mainstem and its tributaries and the other associated with Waptus Lake and River system. It is thought that due to distance and geologic landform and/or thermal barriers, that these populations may be separate. A waterfall located on the lower Waptus River between Waptus and Cle Elum lakes may act as a barrier to bull trout migration between the two systems. Additional surveys are needed to determine if additional local populations exist in the Waptus River system. However, similar to other areas within the Yakima Core Area, these bull trout most likely originated from a native adfluvial life-history form which were present even before the construction of the dam in 1931. Construction of the Cle Ulum Dam enlarged the natural lake and forced any fluvial bull trout stock to adopt an adfluvial life-history pattern. WDFW catch records indicate that bull trout were present in Waptus Lake in the 1940's and early 1950's. WDFW biologists confirmed the presence of bull trout in Waptus Lake by capturing a single juvenile fish in a gill net in 1996 and a large adult bull trout in 1997.

ADULT ABUNDANCE

Overall, bull trout in the Yakima Core Area persist at low numbers in fragmented, local populations. The strongest bull trout populations are represented by local populations in the South Fork Tieton River and Indian Creek. There has been a large degree of variability in redd numbers since listing. Directly comparable data from redd surveys for all the local populations only occurs between 1999 and 2004 and only data from the main spawning tributary in Ahtanum are used (North Fork Ahutanum) because it had complete surveys. Within this data set, the range of the number of redds in the Yakima Core Area varies from 687 in 2000 to 460 in 2004. Since 1999 there are an average of 548 redds in the Yakima Core Area. The average number of redds (548) is less than in 1998 when redds numbered 593. This is a lower number of adults than the Recovery Team thought could be obtained (USFWS 2002). This is low in comparison to the amount of habitat available. There are the only four populations (Rattlesnake, South Fork Tieton, Indian, and Deep Creek) with greater than 50 redds or 100 spawning adults and three of them (South Fork Tieton, Indian, and Deep Creek) are fragmented from the rest of the populations in the

Yakima basin because of Bureau of Reclamation (BOR) dams, and no populations are located in the upper Yakima River portion of the basin. There is a concern about the variability within the redd counts for all populations except the South Fork Tieton River which has the highest number of redds in the Yakima Core Area.

Recent radio-telemetry studies have shown that bull trout tagged in the mainstem Columbia River move into tributaries to spawn. The FWS draft Bull Trout Recovery Plan identifies that it could be possible for the bull trout in the Yakima Core Area to use the lower portion of the river and migrate to the Columbia River, but that further research is needed. A new WDFW telemetry study in the Yakima basin has identified bull trout tagged in the Tieton River, Naches River, and Bumping River are overwinter in sections of the mainstem lower/middle Naches and in the Yakima River mainstem to Ahtanum Creek. One bull trout even went up into Wenas Creek, above the Naches River in the Yakima River mainstem. In the Yakima River mainstem, a bull trout was caught by a WDFW biologist doing surveys near Toppenish in 2003. During a telemetry study, a bull trout was tagged at Rosa Dam upstream on the Naches River near the canyon reach in 2004, and a gravid female was tagged just below Kachess Dam in Jan 2005.

There is new information describing the estimated number of entrained bull trout in Rimrock Reservoir on the Tieton River (James 2001; Heibert et al. 2003). Bull trout entrainment was most recently estimated at 145 (range 60 to 90) during the August through October 2002 sampling period (Heibert et al. 2003). In a previous effort by James (2001), over 80 percent of the fish entrained through the dams were mortalities. This may be an example of entrainment that is occurring at the other four BOR dams.

Bull trout in the South Fork Tieton River, Indian Creek, and Deep Creek are not considered to be at risk from inbreeding depression. However, the recent decrease in numbers in Indian Creek may be a concern and for the other two populations there is a concern that BOR dams do not provide adequate connectivity within the Core Area. All other populations were either at risk due to low abundance levels or classified as unknown due to lack of information. Because of the lack of interconnectivity, the Yakima Core Area is currently considered to be at intermediate risk from the deleterious effects of genetic drift.

<u>PRODUCTIVITY</u>

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 a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time.

In the Yakima Core Area, there are less than 10 years of consistent data collected in the same stream reaches between all populations in the Core Area. When you consider the two largest populations in the Yakima system, the South Fork Tieton River, the trend looks stable, but when consider Indian Creek (the longest data set) the trend is decreasing. These populations are disconnected from the rest of the populations and not long ago Indian Creek was considered the largest population in the Yakima basin. Based on the data set from 1986 to 2004, Indian Creek numbers are unstable and more recently decreasing. This is of special concern because this population is located above a barrier (Rimrock Dam) and it has decreased in redd numbers from a high of 226 to only 50 in the last four years. The redd number are variable within and among populations. Redd data have been collected similarly since 1994 in only the South Fork Tieton and numbers have increased and remained somewhat stable.

Because four of the local populations have connectivity issues and low abundances and the other populations (13 as currently defined by the FWS Recovery Team) are fragmented and located above five BOR irrigation reservoirs with no passage, or are considered resident (Ahtanum), the Yakima Core Area continues to be at risk for genetic drift and inbreeding. Research needs to further look at the genetics of these populations for this reason. Of further concern, is that with low abundances and reduced connectivity in the Yakima Core Areas due to the BOR dams and manipulations of downstream habitats, populations could be lost should a catastrophic event such as fire or flood occur.

Given the lack of consistent, population-census information in the record of redd count surveys, the low numbers of adult spawning bull trout in most of the local populations, the continued lack of connectivity, and decreases in one of the largest populations, bull trout in the Yakima Core Area are considered to be at increased risk of extirpation.

Connectivity

The Yakima Basin continues to be one of the most highly fragmented Core Areas with five total passage barriers at irrigation reservoirs, and numerous inchannel irrigation diversion structures and diversions that reduce flow up to approximately 80 percent (Van Stralen, Personal Communication, 2005) in the mainstem. Low flows, high temperatures, and chemical contaminants cause other barriers. Killing and entrainment of bull trout at the dam at Rimrock Reservoir in the Naches River has been documented. There is the potential for this to be occurring at the other reservoirs. Fish (salmonids) have been stranded at Rosa Dam in the canal and one of the radio-tagged bull trout was located in a diversion in lower Rattlesnake Creek.

A recent assessment indicated some connectivity between the Yakima River populations with the Upper Columbia River units and the Snake River units and that some populations in the Yakima also have their own assignment or a unique genetic characteristic (USFS 2004b). This continues to be a new research need for this management unit. Samples taken from Early Winters Creek and Goat Creek in the Methow River were compared to samples taken in the Yakima River and identified to be genetically different (Spruell and Maxwell, 2002).

Lack of passage within the Yakima Core Area has fragmented bull trout populations and prevented migration to foraging and overwintering habitat. Connectivity to high quality spawning habitat continues to be a problem since the listing of bull trout. This is still a highly fragmented population and entrainment is documented at least one of the five BOR dams, and may occur at all. Low numbers of migratory bull trout accompanied by a lack of passage, limits the possibility for genetic exchange and the reestablishment of local populations. Because four of the local populations have connectivity issues and low adult abundance, and the other populations are either fragmented and located above five BOR irrigation reservoirs with no passage, or are considered resident (Ahtanum), the Yakima Core Area continues to be at risk for genetic drift and inbreeding. Of further concern, is that with low adult abundance and reduced connectivity in the Yakima Core Area, populations could be lost should a catastrophic event such as fire or flood occur.

Changes in Environmental Conditions and Population Status

Statewide Federal restoration programs which include riparian restoration, restoration of fish passage at barriers, and habitat improvement projects have been authorized in the Yakima Core Area. The Yakima River watershed groups have coordinated to apply for monies to complete stream habitat work along the mainstem Yakima River and its tributaries and are working with the U.S. Forest Service to complete culvert repairs. Most large fish passage culverts on the national forest land have been replaced with open bottom arches or bridges. The Plum Creek Timber Company Cascades HCP was developed on lands in the I-90 Corridor. The HCP has provisions for timber harvesting and other land management that benefited bull trout. Grazing problems in Ahtanum Creek on WDNR lands and Ahtanum Irrigation District lands have been reduced with the placement of a fence in 2004 along riparian areas adjacent to most of the spawning habitat. Grazing problems on national forest lands in the South Fork Tieton have been reduced with the special use permit changes to preclude cows from areas with redds during/after spawning and to reduce effects to riparian areas.

Available information indicates implementation of section 6 and/or section 10(a)(1)(A) permits have resulted in direct effects to bull trout due to capture and handling and indirect mortality (BOR, WDFW, EPA, CWU, Yakama Nation, and FWS fisheries studies). Although projects associated with the restoration programs may result in long-term benefits for bull trout and their habitat, all projects included above resulted in take of this species.

It is unknown how many non-Federal actions have occurred in the Yakima Core Area since the listing of bull trout. Activities such as emergency flood control, development, and infrastructure maintenance are conducted on a regular basis and affect riparian and instream habitat. Hydraulic Permits issued by the State also affect bull trout and bull trout habitat. Recent land-use changes from agriculture to urban development along the riparian areas may also be affect bull trout and bull trout habitat. County permits have likely increased for construction of homes in floodplain and riparian areas.

THREATS

Threats to bull trout in the Yakima Core Area include:

- Of the five major storage reservoirs in the Yakima Core Area, four were historically natural lakes. Potential effects from each facility include: fragmentation of populations; entrainment; altered water temperatures; reservoir passage; altered basin flow regimes; affected prey base; and habitat characteristics such as cover, holding pools, and diversity.
- Genetic bottlenecks are a concern above the diversion dams especially with the numbers of redds rapidly declining in Indian Creek, a tributary above Rimrock Dam on the Tieton River.
- Past timber logging, and logging-related activities (such as roads), have degraded habitat conditions in the Yakima Core Area, especially in the upper Yakima River, Cle Elum River, Taneum River, Ahtanum Creek, Teanaway River, Naches River, and the Tieton River.
- Livestock practices have degraded bull trout habitat in the Yakima Core Area, especially in Ahtanum Creek, Teanaway River, and the Tieton River.
- There may be increased concerns for stream habitat within the drawdown zone in the irrigation reservoirs, to sloughing of streambank during draw down and predation by birds (i.e., Gold Creek). Gold Creek and Box Canyon Creek recently have needed temporary salvage/restoration operations in the channel within the drawdown zone to allow enough water to get bull trout to move up stream during spawning.
- Irrigation diversions and water withdrawals associated with agricultural practices result in low flow conditions, seasonal dewatering, entrainment, and water-quality problems. Specific areas of concern include: Lower Rattlesnake Creek; Big Creek; Lower Taneum Creek; Teanaway River; Gold Creek; and Ahtanum Creek.

- Placer suction dredging, and hard rock mining occurs on a limited scale in several watersheds including the Little Naches and Cle Elum.
- Effects from residential development and urbanization are likely to increase as the population increases. Development in the upper Yakima Basin along the river is occurring at record levels. Water rights are changing and wells are being developed that can directly affect water levels for migrating fish in the Yakima River.
- The combination of hatchery-stocked rainbow trout, large catch limits, use of bait, and easy public access to mainstem and tributaries has generated high angling pressures that have probably negatively affected bull trout. In addition, poaching has been identified as a serious concern in Gold Creek, Box Canyon Creek, Deep Creek, South Fork Tieton River, and Indian Creek.
- Introduction of non-native species including brook trout, brown trout, lake trout, bass, catfish, bluegill, sunfish, and crappie have affected bull trout populations through a combination of hybridization, competition, and predation. Brook trout F2 hybrids have been observed in upper Cle Elum River where brook trout are numerous.
- Fire regimes in eastern Washington have shifted from historically frequent, low-intensity ground fires to low-frequency, high-intensity crown fires due to past fire suppression. Fire severity has also increased in recent years due to grazing, fire suppression, silvicultural practices, and timber harvest practices.
- Chemical contamination in the Yakima River from pesticides and other chemicals has been noted recently by EPA in the Yakima Basin.
- Habitat variables identified by the U.S. Forest Service, BOR, FWS, and Corp. of Engineers in the habitat condition baselines of biological assessments identifies that habitat and watershed variables are still functioning at risk or not properly functioning for some indicators identified in the Bull Trout Matrix of Pathways and Indicators.
- Concern exists that the instream-work windows for Hydraulic Permits may require adjustments because bull trout are using lower portions of the rivers at different times of the year than previously thought.

Upper Columbia River Basin Management Unit

Entiat Core Area

Bull trout in the Entiat River Core Area are presumed to be primarily fluvial, rearing there, and in the Columbia River (USFWS 2002). Currently two local populations of bull trout are found in the Entiat Core Area (mainstem Entiat River and Mad River). The two local populations are thought to be isolated from each other due to a natural thermal barrier. Recent telemetry studies by the Public Utility District in 2000-2004 and by the FWS in 2003 indicated that most tagged fish in the Mad and Entiat River are using the mainstem Columbia River for overwintering and feeding. In the draft Bull Trout Recovery Plan (USFWS 2002), the U.S. Forest Service expressed concern for the long-term persistence of bull trout in the Entiat Core Area due to the low number of spawning fish, restricted spawning distribution, and limited opportunities for refounding. Spawning habitat is mostly in the Mad River. Some recent spawning has been observed in the Entiat River mainstem, below the Entiat Falls, which is an artifact of increased survey effort. Habitat may be a potentially limiting factor for bull trout in tributaries to the Entiat. The tributaries are either low in the drainage where thermal regimes are not presumed to be suitable for bull trout, or the streams are blocked by natural falls. There is no lake habitat for bull trout use. Spawning habitat for migratory fish the Mad River has been reduced by 4.2 miles due to a log jam.

Spawning habitat for migratory fish is currently located downstream of this log jam. Resident/sub-adult sized bull trout were found upstream of this log jam in 2005 by the U.S. Forest Service. Additional tributary surveys are needed to identify other potential spawning habitat.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

Number and Distribution of Local Populations

Currently two local populations of bull trout are found in the Entiat Core Area. The FWS Proposed Critical Habitat Rule including the Columbia River Distinct Population Segment (50 CFR 17, Vol 67, No. 230, 11-29-02) describes a total of 48.8 miles of stream which are used by the bull trout in the Entiat River. Bull trout have been found in small numbers throughout the Entiat River mainstem up to Entiat Falls, during spawning migrations and some were caught in salmon smolt traps downstream of the Mad River. A small amount of spawning has been observed below the Entiat falls and redd surveys currently document use of this area. The other local population found in Mad River, a tributary to the Entiat River, continues to be the major spawning area for the Core Area. Historically, spawning on the Mad River occurred over a 7.7 mile reach between Young Creek and Jimmy Creek. Currently, spawning habitat of migratory bull trout is blocked by a log jam and this habitat is reduced by approximately 4.2 miles.

Bull trout may also spawn in Tillicum Creek, a tributary to the lower Mad River, but additional survey information is needed to characterize the use of this stream by bull trout. Bull trout were also observed in Stormy Creek, a tributary to the Entiat River, about 7.0 miles upstream of the mouth of the Mad River, in 2004. Recent radio-telemetry studies have shown that bull trout tagged by the Public Utility Districts in the mainstem Columbia River at Rock Island, Rocky Reach, and Wells Dams as well as those tagged by the FWS in the Mad River and Entiat River use the Entiat and Mad Rivers mainly for migrating, holding, and spawning for half the year and the Columbia River mainstem for overwintering, migrating, and foraging for the other part of the year. Sub-adults/juveniles have also been located within the Columbia River upstream and downstream of the Entiat Core Area. A screw trap operated by the FWS in the lower Entiat River mainstem has collected juvenile bull trout moving downstream during the outmigration of smolting salmon.

Adult Abundance

Bull trout in the Entiat Core Area persist at a very low abundance. The majority of bull trout spawning in this Core Area occurs in the Mad River between Young Creek and Jimmy Creek. Redd numbers range from 33 (66 spawning adults) in 2002 to 57 (114 spawning adults) in 2003 for the entire Core Area for similarly collected data. Since 2000, there is an average of approximately 43 redds (86 spawning adults) for the Core Area, this is the same as the number of redds found in 1998. However, if we look at only the Mad River data which is directly comparable since 1989, (in 1999 this river lost a substantial portion of spawning habitat because of the formation of a log jam), the trend seems to be increasing with a high of 52 (104 spawning adults) redds observed in 2003.

Only a few bull trout redds have been found the Entiat River mainstem from 1994 to 2001. In most years no redds were observed. The most redds observed during 1994 to 2000 was six, while in three different years three redds were observed. Recently there were 40 redds (80 spawning adults) identified in 2004 in a newly identified spawning section of the Entiat River mainstem. None-the-less, there is currently only one strong spawning area for this Core Area, the Mad River, and it has only had 52 redds on one occasion and numbers for the Entiat have averaged less than 10 redds. Bull trout redd surveys have been conducted annually between 1989 and 2005 in this Core Area. Data from redd counts for the entire Core Area could only be used from 2000 to 2004, because the Mad River Spawning reach changed in length and the Entiat River reach was added. Overall, the trend for the Entiat Core Area looks stable and is slightly increasing due to the Mad River data. Although, because of the overall low adult abundance, the Entiat Core Area is still considered to be at risk of both genetic drift and inbreeding depression today as it was in 2002 (USFWS 2002)

PRODUCTIVITY

The Entiat Core Area redd counts seem to be stable with slightly increasing redd numbers, but still low in abundance. Because of the low number of adults and the fact that there are only two local populations, there is a risk of inbreeding and genetic drift. Between 1998 and 2002, the redd numbers for the Mad River have remained stable. Since the development of the FWS draft Bull Trout Recovery Plan in 2002, the average number of redds has decreased slightly. However, there is less than ten years of consistent data collected in the same stream reaches between both the Entiat and the Mad River and data variability is a concern.

There is concern about the substantial reduction in spawning habitat in the portion of the Mad River, essentially the majority of spawning habitat before 1999. Finding an area in the Entiat River mainstem with 40 redds in 2004 is, at the same time, encouraging. The spawning habitat is not as high of quality as the Mad River so the number of fish making it to adulthood or returning to spawn may be lower. Genetic baselines are not completed. Connectivity remains the same as in 1998 with a few culverts replaced. Data also shows that the populations in the Core Area uses the mainstem Columbia River for more time than originally thought and potentially increasing the effect of mainstem dams.

For a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time. Given the overall lack of long-term, consistent, population census information of redd count survey and the low numbers of adult spawners, this Core Area is considered to be at increased risk.

CONNECTIVITY

Within the Entiat Core Area, the migratory life-history form is predominant within the existing local populations. Resident forms were observed above the log jam in 2005 after blockage created a barrier to the migratory form since 1999. The FWS's draft Bull Trout Recovery Plan describes that the Entiat Core Area is considered at a diminished risk due to the presence of the migratory life-history form. Current telemetry information and observation show the migratory form using the mainstem Columbia River as its major overwintering/migratory/and feeding habitat. Also, in the Mad River, the loss of 4.2 miles of spawning habitat due to the log jam which is a migration barrier currently increases the risk of extirpation, especially while numbers of spawning adults are low. There may be some positive prey benefits in the mainstem Columbia River provided from increased smolts releases due to hatcheries in the Columbia River. However, the dams also adversely affect the mobility of bull trout (i.e., lack of passage during winter maintenance and lack of downstream passage). Currently the Enitat Core Areas is considered to be at an intermediate risk of extirpation due to connectivity issues.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Statewide Federal restoration programs which include riparian restoration, restoration of fish passage barriers, and fish habitat improvement projects have been authorized in the Entiat Core Area. The Entiat watershed groups have coordinated to apply for monies to complete stream habitat work along the mainstem Entiat River and are working with the U.S. Forest Service to complete culvert repairs (i.e., the Stormy Creek culvert replacement). The Mid Columbia HCP developed for salmon with NMFS and the local Public Utility Districts is the only HCP in effect in this Core Area. Bull trout are not a covered species but an Opinion (FWS Reference Number: 04-W0203) has been completed for bull trout between the FWS and Federal Energy Regulatory Commission (USFWS 2004b) and included conservation measures that should benefit bull trout.

Available information indicates implementation of section 6 and/or section 10(a)(1)(A) permits have resulted in direct effects to bull trout due to capture and handling and indirect mortality (PUD, WDFW, and FWS fisheries studies). Although projects associated with the restoration programs may result in long-term benefits for bull trout and their habitat, all projects included above resulted in take of this species.

It is unknown how many non-Federal actions have occurred in the Entiat Core Area since the listing of the bull trout. Activities such as emergency flood control, development, and infrastructure maintenance are conducted on a regular basis and impact riparian and instream habitat that likely adversely affects this species. State issued Hydraulic Permit Approvals (HPAs) have also affect bull trout and their habitat. Recent land use changes from agriculture to urban development along riparian areas has also be affected the species.

<u>THREATS</u>

Threats to bull trout in the Entiat Core Area include:

- Historically, dams on the major tributaries in the Upper Columbia Management Unit probably contributed to the decline in bull trout by blocking migratory corridors and restricting connectivity to upstream spawning areas and downstream overwintering areas.
- Past logging practices (such as roads), have diminished natural channel complexity, streambank stability, and riparian conditions to a greater extent in the lower Entiat River but the Mad River has been affected as well.
- The Entiat River has some of the highest road miles identified in the baselines of biological assessments from U.S. Forest Service activities (USFS 1998 and USFS 2003). Most of these are legacy roads but as large fire disturbance comes in closer intervals these roads either remain open or are considered closed but get used during fire emergencies.
- Irrigation diversions and water withdrawals associated with agricultural practices may have exacerbated natural low flow conditions in the Entiat River.
- Effects from residential development and urbanization, like the degradation of water quality, instream habitats, and riparian areas, are a concern as the Entiat Core Area continues to experience socio-economic shifts away from agriculture to industry.
- Effects from recreational developments such as campgrounds, trails, etc., include a reduction in LWD, loss of riparian habitat, alterations of streambanks, and an increase in poaching.
- The presence of non-native brook trout in the Entiat Core Area is a concern, particularly upstream of the falls on the Entiat River mainstem.
- The loss of 4.2 miles of spawning habitat in the upper most portion of the Mad River spawning reach, which historically was the most productive, is a threat to productivity in the Entiat Core Area.

- Large fires during 1994 in the upper Mad River spread across upper spawning reaches and suppression activities resulted in the reduction of large woody debris and the removal of key pieces of wood in some pool habitat (USFS 2003).
- Fire regimes in eastern Washington have shifted from historically frequent, low-intensity ground fires to low frequency, high-intensity crown fires due to past fire suppression. Fire severity has also increased in recent years due to grazing, fire suppression, silvicultural practices, and timber harvest practices.
- Habitat and passage at dams produce impacts to juvenile, sub-adult, and adult life history stages of bull trout.
- Habitat variables identified by the U.S. Forest Service in the habitat condition baselines of biological assessments identifies that habitat and watershed variables are still functioning at risk or not properly functioning for many indicators identified in the Bull Trout Matrix of Pathways and Indicators.
- Genetic baselines are not completed.

Methow Core Area

Bull trout are dispersed through out the Methow River basin. Adfluvial, fluvial and resident life-history forms are present. Bull trout are know to occur in habitat within Gold, Beaver, Wolf, Goat, and Early Winters Creeks, the Twisp River (including Buttermilk, North, War Creeks) the Chewuch River (including Lake Creek), and in the Upper Methow River (including the West Fork and Trout Creek). Resident life-history forms are found above passage barriers and suspected in areas where habitat connectivity has been degraded, such as Gold Creek, Beaver Creek, Goat Creek, etc. Adults overwinter in pools throughout the Methow River mainstem. Recent telemetry studies by the Public Utility District in 2000-2005 and by the FWS in 2000-2004 indicated that tagged fish in the Methow Core Area are also using the mainstem Columbia River for overwintering, feeding, and year round use. The studies also show that fish tagged in the Columbia River travel down to Rock Island Dam below the mouth of the Wenatchee River. The studies also show that a bull trout tagged in the Wenachee River was located near the mouth of the Methow River. Juveniles have been captured in smolt traps in the lower Methow and Twisp Rivers. Additional tributary surveys are needed to identify other potential spawning habitat.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

Number and Distribution of Local Populations

Currently 10 local populations of bull trout are found in tributaries or the upper mainstem within the Methow Core Area. The Recovery Team has identified eight local populations since listing: Gold Creek, Twisp River, Chewuch River, Wolf Creek, Early Winters Creek, Upper Methow River, Lost River, and Goat Creek. There are two other local populations: Lake Creek and Beaver Creek identified by the Recovery Team, since the draft Bull Trout Recovery Plan was released, for a total of 10 local populations. The lower Methow River and mainstem Columbia River are used as a migratory corridor. Spawning occurs in tributary streams and in the mainstem upper Methow River. Carter Creek, a tributary to Gold Creek, has the only documented fluvial spawning population within the Gold Creek basin. A population also occurs in Blue Buck Creek within Beaver Creek. Bull trout in the Twisp River local population are comprised of migratory and resident forms and spawning occurs in the mainstem Twisp River, Buttermilk Creek, Bridge Creek, Reynolds Creek, North Creek and War Creek. Wolf Creek is an important spawning and rearing stream for migratory bull trout and resident bull trout also contribute to this local population. In the Chewuck River local population spawning occurs in the mainstem Chewuck and Lake Creek, while overwintering, rearing, and foraging likely occur in Black Lake. Spawning in the Upper Methow population occurs within the West Fork of the Methow River, Trout Creek, Robinson Creek, and Rattlesnake Creek. Spawning has bee observed in the upper reaches of Goat Creek. Early Winters Creek included both resident and migratory forms and thus, spawning occurs both upstream and downstream of the barrier fall. The Lost River local population may be represented by resident, fluvial, and adfluvial forms. Bull trout in the Lost River have been located in Cougar Lake, First Hidden Lake, and Middle Hidden Lake, as well as downstream of the gorge. Spawning in the Lost River has been documented both upstream and downstream of the gorge area in the river. Some spawning may occur in the lakes and small tributaries to the lakes due to the glacial moraine and springs/upwellings within the lakes near the shorelines.

Bull trout have been located in and upstream of the reaches of the mainstem Twisp River and Methow Rivers which go subsurface in the summer. Bull trout have been killed by the freezing water when trapped upstream in the Twisp after spawning, and they have been found trapped within ponds of water as the mainstem Methow River goes subsurface upstream of Wolf Creek.

Radio-telemetry studies have located bull trout tagged in the Columbia River in Libby Creek, Wolf Creek, lower Lost River, the Twisp River and Buttermilk Creek, and in the lower Methow River. There was one radio-tagged bull trout that moved into the lower Okanogan River for a short period but moved back out and into the Methow River and one that moved into Libby Creek. Juveniles/sub-adults have been trapped in smolt traps in the lower Methow River mainstem and in the Twisp River.

ADULT ABUNDANCE

There was a large variability in redd numbers between 1998 and 2004. Redd numbers within the local populations remain variable. Directly comparable data from redd surveys are only available between 2000 and 2004 because of differences in survey techniques and changes in surveyed areas. Redd numbers range from 117 in 2001 to 174 in 2003 for the entire Core Area where data were collected similarly. The number of redds in 2004 is 148. Since 2000, there have been an average of 144 redds in the Methow Core Area, which is lower than the number cited in the draft Bull Trout Recovery Plan in 2002 of 174. The average number of redds (144) is slightly higher than numbers in 1998, at the time of listing, when redds numbered 127. If we look just at the Twisp River redd data which are directly comparable since 1998, the numbers were 89 in 1998, as high as 105 in 2000, as low as 55 in 2001, and are currently at 74 in 2004. The upper Methow population also seems to be stable since 1998. The low number of redds in the entire Methow Core Area is less than the Recovery Team thought the system could support (USFWS 2002a). There are only two of the 10 local populations that have had greater than 50 redds or 100 adults. There are larger numbers of fish in the Lost River but no new data on spawning or population estimates are available and the degree of connectivity is unknown. Overall, the trend for the Methow Core Area seems to show that since 2000 the numbers of redds are not stable and slightly decreasing. The Methow River population may be at risk of inbreeding and genetic drift due to the large distances between populations (i.e., the Lost River and the rest of the populations) and small numbers of spawning adults in most of the other populations as it was in 2002.

There is a concern about the variability within the redd counts particularly for the largest spawning populations (Twisp River, Upper Methow River); even comparable data are variable. Recent annual averages for adult abundance (174) in the Twisp River indicate that this local population may not be at risk of inbreeding depression. This is caveated by high variability in redd counts. Several other local populations in the Methow Core Area are mostly under 100 adults annually and are at risk of inbreeding depression. Overall, adult spawning abundance in the Methow Core Area is probably less that 1,000 individuals and therefore the Core Area is considered to be at risk of deleterious effects of genetic drift.

PRODUCTIVITY

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-history 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 a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time.

Overall, the trend for the Core Area seems to show that, since 2000, the numbers of redds are not stable and slightly decreasing. Numbers are still low for the amount of habitat available in the Methow Core Area. There is a lower number of redds than the Recovery Team anticipated. There are only two of the 10 local populations that have had greater than 50 redds or 100 adults. The Methow may be at risk of inbreeding and genetic drift due to the large distances between populations (i.e., the Lost River and the rest of the populations) and small numbers of spawning adults in most of the populations.

Irrigation and connectivity continue to be a problem in the Methow Core Area, however culverts and diversions are being addressed. Genetic baselines are not completed. Connectivity remains the same as in 1998, with a few culverts replaced. However, since 1998 data shows that the populations in the Core Area uses the mainstem Columbia River for more time than originally thought and effects of mainstem dams may have increased in magnitude of effect.

CONNECTIVITY

There is information about the migratory patterns of radio-tagged fish to show some connectivity between multiple local populations and with the Columbia River. Recent radio-telemetry studies have shown that bull trout tagged by the Public Utility Districts in the mainstem Columbia River at Rock Island, Rocky Reach, and Wells Dams migrate and use tributaries in the Methow River. The radio-tagged fish were found in the Twisp River during spawning and overwintering in the Twisp, Lower Methow River, and the Columbia River mainstem. Very little tributary tracking occurred with this project; however, some single other observations of some of the radio-tagged fish occurred in Libby Creek, Wolf Creek, Twisp River including Buttermilk Creek, Lost River, Upper Methow River, and Chewuch River. Some radio-tagged and non-radio-tagged bull trout that moved into the Twisp River were stranded above an intermittent natural channel and died when they could not move downstream post spawning. The lack of fall freshets prevented water from coming to the surface in the upper Twisp River. (M. Nelson, Personal Communication, 2004). Juveniles and sub-adults have been trapped in smolt traps in the lower Methow River mainstem and in the Twisp River

Early Winters Creek has a barrier falls with a population of bull trout above the falls. Genetic samples have been collected from above the falls and below the falls to determine if the population above the falls has unique genetics in comparison to other populations.

More is known today about habitat conditions such as irrigation-diversion structures and the levels of in-stream flows. Some of the barriers and flow levels that are man caused are now identified and beginning to be addressed but many still are not addressed. The diversion structures and private land management practices such as grazing and agriculture activities near the lower reaches of these kinds of streams continues to degrade bull trout habitat and minimize connectivity. Lack of connectivity may disrupt mixing of genes which may inhibit long-term, self-sustaining, complex, interacting groups of bull trout in the Methow Core Area.

It is thought that the population in the Lost River may be two different local populations. The Lost River population is thought to be fragmented in most years due to a natural rock slide downstream of the gorge area which may preclude migration in most years, in turn, precluding gene flow and mixing with other populations in the basin. However, the upper Lost River population is somewhat removed from the rest of the Methow River populations; although it does provide for downstream migration and it may serve as a source population to reduce inbreeding and refounding of downstream populations in the Core Area. With the rock slide acting as a barrier occurring in some years, bull trout are fragmented from the upper habitat which includes many lakes. This local population contains both adfluvial (above the gorge) and fluvial (below the gorge) life-history forms.

The Twisp River local population is affected by a section of the upper river that goes subsurface and in some years may not allow downstream passage of post-spawn bull trout due the low levels of in stream flows. The low instream flows are viewed as natural and the lack of fall precipitation in recent years does not allow the water to resurface to allow downstream movement (M. Nelson, Personal Communication, 2004) especially before the onset of freezing temperatures. This same concern exists for the upper Methow River population where the upper Methow River, below the spawning reach, goes subsurface. It is thought that this is a natural condition but is not well understood how it impacts post-spawn migrations or rearing juveniles.

There is also some new information about bull trout being found in lower Beaver Creek since the culvert has been fixed allowing passage and connectivity for migratory fish back into the system. Last fish surveys in 2003 identified bull trout in this lower reach.

Within the Methow Core Area, habitat degradation has fragmented bull trout populations. Reductions in habitat quality resulting from irrigation water withdrawals, diversion dams, grazing, and passage barriers have collectively contributed to the decline of bull trout in the basin. Bull trout in the Methow Core Area are considered to be at an increased risk of extirpation.

Changes in Environmental Conditions and Population Status

Statewide Federal restoration programs which include riparian restoration, restoration of fish passage at barriers, and habitat improvement projects have been authorized in the Methow Core Area. The Methow watershed groups have coordinated to apply for monies to complete stream habitat work along the mainstem Methow River and its tributaries and are working with the U.S. Forest Service to complete culvert repairs. Most large, blocking culverts on national forest lands have been replaced with open-bottom arches or bridges. The Mid-Columbia HCP developed for salmon with NMFS and the local Public Utilities Districts is the only HCP in effect for salmonids in this area. Bull trout are not a covered species under the Mid-Columbia HCP, but a biological opinion (FWS Reference Number: 04-W0203) has been completed for bull trout between the FWS and Federal Energy Regulatory Commission (USFWS 2004b) and conservation measures should benefit bull trout. There have been several attempts to develop HCPs with the irrigation districts in the Methow Basin (i.e., Skyline Ditch, the upper Methow irrigation districts, and Wolf Creek). The Wolf Creek HCP work is the furthest along and the Wolf Creek Irrigation District and Sun Mountain Lodge are the proponents. However, this has not been finalized at this time.

Available information indicates implementation of section 6 and/or section 10(a)(1)(A) permits have resulted in direct effects to bull trout due to capture and handling and indirect mortality (PUD, WDFW, EPA, and FWS fisheries studies). Although projects associated with the restoration programs may have affected bull trout and their habitat, all projects included above resulted in take of this species.

It is unknown how many non-Federal actions have occurred in the Methow Core Area since the listing of bull trout. Activities such as emergency flood control, development, and infrastructure maintenance are conducted on a regular basis and affect riparian and instream habitat that likely adversely affect this species. There have been Hydraulic Permits issued by the State which also has affected bull trout and bull trout habitat. Recent land-use changes from agriculture to urban development along the riparian areas may also be an impact to the species. County permits have likely increased for construction of homes in floodplain and riparian areas, where there use to be orchards.

THREATS

Threats to bull trout in the Methow Core Area include:

- Historically, dams on the major tributaries have contributed to the decline in bull trout by blocking migratory corridors and restricting connectivity to upstream spawning areas and downstream overwintering areas.
- Past logging and logging-related activities (such as roads), have diminished natural channel complexity, streambank stability, and riparian conditions. Forest roads that access timberlands are often located in the narrow floodplains including sensitive bull trout areas. This is particularly true for the Twisp River, Chewuck River, and Lake Creek basins.
- Over 60 percent of the private bottom lands in the Methow River area have erosion problems related to grazing. Of specific concerns are riparian areas adjacent to the Twisp River, lower Wolf Creek, Upper Methow River, Chewuck River, Buttermilk Creek, Gold Creek, and Goat Creek.
- Irrigation diversions and water withdrawals associated with agricultural practices may have resulted in partial or complete barriers on many of the systems that support bull trout.
- Effects from residential development and urbanization on water quality, instream habitats, and riparian areas are a concern as this area continues to experience socio-economic shifts away from agriculture to industry.
- Effects from recreational developments, especially on the Twisp River, such as campgrounds, trails, etc., include a reduction in LWD, loss of riparian habitat, alteration of streambanks, and increased poaching.
- Brook trout are widespread within the Methow River and the potential for genetic introgression to bull trout is a concern.
- Instream flow in the Chewuch River, Twisp River, Methow River, Wolf Creek, Goat Creek, and Beaver Creek, continue to be a concern and may be a large affect to bull trout. Irrigation water continues to be diverted in these areas while populations are low or unknown.
- The Lost River fishery may continue to have negative effects on the population as it continues to be the only open fishery on bull trout in eastern Washington.
- Fire regimes in eastern Washington have shifted from historically frequent, low-intensity ground fires to low-frequency, high-intensity crown fires due to past fire suppression. Fire severity has also increased in recent years due to grazing, fire suppression, silvicultural practices, and timber harvest practices.

- Subsurface reaches in the Twisp and Upper Methow Rivers, within spawning and rearing reaches, may continue to fragment populations. This will occur as drought continues to be a problem in the northwest and it will continue to cause a reduction in area of habitat and quality of habitat in the stream. It will continue to strand fish and fragment the populations of fish as instream flows are reduced.
- Habitat variables identified by the U.S. Forest Service in the habitat condition baselines of biological assessments identifies that habitat and watershed variables are still functioning at risk or not properly functioning for many indicators identified in the Bull Trout Matrix of Pathways and Indicators.
- Genetic baselines are not completed.

Wenatchee Core Area

The Wenatchee River has bull trout dispersed throughout the basin. Resident and migratory (both fluvial and adfluvial) bull trout are all found within the Wenatchee Core Area, which includes habitat within the Chiwawa River, White River, Little Wenatchee River, Nason Creek, Chiwaukum Creek, Icicle Creek, and Peshastin Creek. The strongest populations are centered on Lake Wenatchee and the Chiwawa River. The majority of spawning and fry rearing habitat are within national forest lands including Glacier Peak and Alpine Wilderness areas, while the majority of overwinter habitat is adjacent to multiple landownerships between Lake Wentchee and the Columbia River. Resident and migratory bull trout occur in Icicle Creek above the boulder cascades near the Snow Creek trailhead. Adults, sub-adults/resident sized fish have been found in Mill Creek and Nason Creek in the Nason Creek drainage, the Little Wenatchee River, Panther and Canyon Creeks in the White River drainage, Alder, Chikamin, Rock, Phelps, Buck, James, and Alpine Creeks in the Chiwawa River drainage, in Chiwaukum Creek, in Jack, French, and Icicle Creeks in the Icicle Creek drainage, and in Ingall's and Negro Creeks in the Peshastin drainage. Migratory bull trout frequent habitat in Icicle Creek below the Leavenworth National Fish Hatchery, most likely for foraging year round. Adults overwinter in pools throughout the Wenatchee River mainstem. Recent telemetry studies by the Public Utility District in 2000-2004 and by the FWS in 2000-2004 indicated that tagged fish in the Wenatchee Core Area are using the mainstem Columbia River for overwintering, feeding, and year-round use. The studies also show that fish tagged in the Wenatchee River travel at least as far as Pateros near the mouth of the Methow River in the Columbia River. Juveniles have been captured in smolt traps located in Nason, Chiwawa, and Peshastin Creeks, at the head of the Wenachee River, and in the lower Wenatchee River. Additional tributary surveys are needed to identify other potential spawning habitat.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Seven local populations are currently known for the Wenatchee Core Area. They reside in the following tributaries to the Wenatchee River: the Chiwawa, White, and Little Wenatchee Rivers; and Nason, Chiwaukum, Icicle, and Peshastin Creeks. The Chiwawa River local population complex is a strong-hold for bull trout in the upper Wenatchee River. Spawning has been documented in Rock Creek, Chikamin Creek, Phelps Creek, Buck Creek, and the Chiwawa River mainstem. Rock Creek supports the strongest population of bull trout in the Wenatchee Core Area. Bull trout have also been observed in Alpine, James, and Alder Creeks, tributaries to the Chiwawa River. The White River local population is known to spawn in the White River mainstem and Panther Creek a tributary to the White River. Bull trout have been observed in other tributaries to the White River (Napeequa River, Canyon Creek and Sears Creek), but no spawning has been documented. The Little Wenatchee River local population spawns in the Little Wenatchee River (tributary to Lake Wenatchee) up to Little Wenatchee Falls at river mile 6.8. The Nason Creek originates at Steven's Pass and flows into the Wenatchee River just below the outlet of Lake Wenatchee. Redd surveys indicate that spawning for the local population occurs in Nason Creek and Mill Creek. These populations are in Chiwaukum Creek which enters the Wenatchee River just above Tumwater Canyon and spawning occurs in the mainstem. Icicle Creek is located at the Town of Leavenworth and spawning areas have not been located. Migratory adults have been located upstream of a boulder cascade previously thought to be a migration barrier. Resident-sized fish have been seen in the upper reaches of the mainstem Icicle Creek, and in Jack Creek and French Creek, tributaries to Icicle Creek just below Rock Island Campground. Peshastin Creek is the lowest tributary with bull trout in the Wenatchee Core Area, located near the town of Dryden. Spawning is known to occur in Ingall's Creek and sub-adults/resident sized bull trout and hybrids were located in Negro Creek in 2005.

Recent radio-telemetry studies have shown that bull trout tagged by the Public Utility Districts in the mainstem Columbia River at Rock Island, Rocky Reach, and Wells Dams, and tagged by the FWS in the Wenatchee Core Area use the tributaries for holding, foraging, and spawning for half the year and Lake Wenatchee and the Wenatchee and Columbia River mainstems for overwintering, migrating, and foraging for half the year or more. Some of the tagged bull trout moved between tributaries within the same year, in multiple years, and resided in migratory habitat in these areas for a year or more before migrating to spawning grounds.

Juvenile bull trout have been captured in smolt traps located in Nason, Chiwawa, and Peshastin Creeks, at the head of the Wenachee River. Bull trout in the lower Wenatchee River also have been located year-round in many of the tributary habitats of the local populations. Sub-adults/juveniles have also been located within the Columbia River upstream and downstream of the Wenatchee Core Area.

ADULT ABUNDANCE

There is a large variability in redd numbers between 1998 and 2004. Directly comparable data from redd surveys for all the local populations only occurs between 2000 and 2004 due to added area and different methods. The range of redds in the Wenatchee Core Area varies from 283 in 2001 to 538 in 2002. The number of redds in 2004 was 440. Since 2002, there are an average of 443 redds in the Wenatchee Core Area which is within the range previously portrayed in the draft Bull Trout Recovery Plan in 2002 of 246-462 for the Core Area.

The strongest population in the Wenatchee Core Area is in the Chiwawa River. The Chiwawa River has the longest data set and largest redd counts that are directly comparable; it ranged from 93 redds in 1990 to 436 in 1999 and was at 292 in 2004. However, there is concern about the variability within the redd numbers, even the directly comparable data. This is a lower number of adults than the FWS Recovery Team thought would be found in the system (USFWS 2002a), but it is not that different from the lower abundance number in the range. The Chiwawa River, which has the highest number of redds in the whole management unit, is still one of the most prolific populations in the Columbia River Distinct Population Segment. However, numbers of redds/adults for the Core Area are still slightly below the lowest number in the range that the Recovery Team wants to reach as discussed at the most recent recovery meetings and identified in recovered abundance tables.

The Chiwawa River local population itself is not at risk of inbreeding, but other local populations in the Wenatchee Core Area persist in low numbers and are considered to be at risk of extirpation because these other local populations have generally less than 50 redds. Due to the lack of baseline genetic information and inconsistent data collection, the Core Area continues to be at risk for genetic drift and inbreeding.

Recent radio-telemetry studies have shown that bull trout tagged by the Public Utility Districts in the mainstem Columbia River at Rock Island, Rocky Reach, and Wells Dams migrate and use tributaries in the Methow River. These radio-tagged fish were found in the Chiwawa River, Wenatchee River, Icicle Creek, and Peshastin Creek spawning areas and tracked back to the Columbia River mainstem where they overwintered. Another radio-telemetry study conducted by the FWS found bull trout tagged in the Wenatchee River, Lake Wenatchee, the Chiwawa River, and at Icicle Creek used Lake Wenatchee, the Wenatchee River, and the Columbia River for overwintering for at least six months of the year. These tagged fish moved into new spawning areas, migrated multiple years to the same tributaries, upstream into wilderness and downstream to the Columbia River, and in some cases they migrated into two rivers during the spawning period.

Also, bull trout are being observed in smolt traps in Nason Creek, at the head of the Wenatchee River, the Chiwawa River, and Peshastin Creek. A few redds have been identified in Ingalls Creek but the spawning area and timing has not yet been determined.

Productivity

Overall, the trend for the Wenatchee Core Area seems to be stable and increasing due to data from the Chiwawa population. However, numbers of redds/adults for this Core Area are still slightly below the lowest number in the range that FWS Recovery Team wants to reach as discussed at the most recent recovery meetings and identified in recovered abundance tables. Since listing in 1998, the redd numbers have remained stable with only one year when redds were below 300 (2001). Since the development of the FWS's draft Bull Trout Recovery Plan in 2002 average redd numbers are lower. There is less than 10 years of consistent data collected in the same stream reaches between all populations in the Core Area. There is a concern with the variability in the data. Redd data has been collected since 1989 in the Chiwawa and was as low as 93 redds. Since then, new spawning reaches have been identified in the mainstem. It is difficult to attribute all increases to a trend. There is still a risk of inbreeding and genetic drift due to the low number of adults, compounded by the fact that there are only two local populations that have had numbers greater than 50 redds or 100 adults. One of those populations has limited information. Connectivity still does not exist for the Icicle Creek population and there is still a partial barrier during low flows in Peshastin Creek. In both Icicle and the Peshastin system, low flows exist and may continue to minimize connectivity. Tumwater Dam and the Chiwawa Dam weirs are maintained only for fish monitoring. There is a concern that trying to pass bull trout though these structures may cause injury to some bull trout.

For a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time. Given the lack of consistent, population census information in the record of redd count surveys and the low numbers of adult spawning bull trout in most of the local populations, this Core Area is considered to be at intermediate risk of extirpation.

Connectivity

There is information about the migratory patterns of radio-tagged fish to show some connectivity between multiple local populations and with the Columbia River. The Wenatchee Core Area is unique in that it has most of its connectivity to the Columbia River and to a natural large lake in the upper basin. As telemetry has indicated, bull trout are able to exhibit resident, fluvial, and adfluvial patterns and mix between local populations. Bull trout were documented overwintering in areas of the Wenatchee River near the Icicle Creek, in Icicle Creek near the Hatchery, in upper portions of the Wenatchee River, in Lake Wenatchee River, and in the Columbia River. The Chiwawa, Nason Creek, Icicle Creek, and Chiwaukum Creek are used by fish that use the Columbia River. Fish that overwinter in Lake Wenatchee and the Columbia also use at least the Chiwawa Creek and Nason Creek. Fish use Chiwaukum Creek for spawning and seem to overwinter in the Wenatchee River and in the Columbia River. New spawning areas in the mainstem Chiwawa Creek and White Rivers were confirmed in 2000. Approximately 30-32 large fluvial bull trout were observed in a pool in upper Nason Creek just below the spawning tributary (Mill Creek) in 2004.

Bull trout that were fluvial in size have been observed above the anadromous barrier on Icicle Creek. Snorkel surveys in Jack Creek on the upper Icicle show bull trout further up than previously known. One radio-tagged bull trout that was with Chinook at the Leavenworth National Fish Hatchery ascended into the boulder cascade in Icicle Creek (anadromous barrier), but it was thought not to have moved much further above it. The head gate at the Leavenworth National Fish Hatchery continues to block bull trout passage into Icicle Creek even though there has been work done for the past five years to restore the channel. Bull trout are continuing to pool up at the large pool below the hatchery weirs and head gate (Kelly Ringel 2004). It is unknown if bull trout currently still exist above the barrier cascade on the Little Wenatchee River. A few bull trout were identified by the U.S. Forest Service in 1998 and previously, but no surveys have been completed since then, however, brook trout are abundant in this area.

A total fish barrier still exists on the Icicle Creek and a partial barrier still exists on Peshastin Creek. The Tumwater Dam and Chiwawa Dam fish weirs operate only for fish-monitoring purposes. Trapping and telemetry data indicate that some delay may be occurring at these dams, causing a concern with stress, particularly when water temperatures increase.

Within the Wenatchee Core Area, the migratory life-history form is the dominate life-history form within the existing local populations, and therefore, this Core Area was considered to be at a diminished risk of extirpation. While localized habitat problems currently exist that may impede connectivity and affect bull trout migration, there are no large scale, man-made migration barriers that block access to known critical habitat in this Core Area.

Changes in Environmental Conditions and Population Status

Statewide Federal restoration programs which include riparian restoration, restoration of fish passage at barriers, and habitat-improvement projects have been authorized in the Wenatchee Core Area. The Wenatchee watershed groups have coordinated to apply for monies to complete stream habitat work along the mainstem Wenatchee and its tributaries and are working with the U.S. Forest Service to complete culvert repairs. Most large fish passage barriers on the national forest lands have been replaced with open-bottom arches or bridges. The Mid-Columbia HCP developed for salmon with NMFS and the local Public Utilities Districts is the only HCP in effect for salmonids in this area. Bull trout are not a covered species under the Mid-Columbia HCP, but a biological opinion (FWS Reference Number: 04-W0203) has been completed for bull trout between the FWS and Federal Energy Regulatory Commission (USFWS 2004b) and conservation measures should benefit bull trout.

Available information indicates implementation of section 6 and/or section 10(a)(1)(A) permits have resulted in direct effects to bull trout due to capture and handling and indirect mortality (PUD, WDFW, EPA, and USFWS fisheries studies). Although projects associated with the restoration programs may result in long-term benefits for bull trout and their habitat, all projects included above resulted in take of this species.

It is unknown how many non-Federal actions have occurred in the Wenatchee Core Area since the listing of bull trout. Activities such as emergency flood control, development, and infrastructure maintenance are conducted on a regular basis and impact riparian and instream habitat that likely adversely affects this species. Hydraulic Permits issued by the State also affect bull trout habitat and bull trout habitat. Recent land-use changes from agriculture to urban development along the riparian areas may also affect bull trout. County permits have likely increased for construction of homes in floodplain and riparian areas.

Threats

Threats to bull trout in the Wenatchee Core Area include:

- Historically, dams have contributed to the decline in bull trout by blocking migratory corridors and restricting connectivity to upstream spawning areas and downstream overwintering areas.
- Past logging, and logging-related activities (such as roads), have diminished natural channel complexity and riparian conditions in many of the drainages that support bull trout.
- Irrigation diversions and water withdrawals associated with agricultural practices result in low flow conditions, seasonal dewatering, entrainment, and water-quality problems in many of the drainages that support bull trout especially Peshastin Creek, Mill Creek, Icicle Creek, Chiwaukum Creek, Chiwawa River, and Phelps Creek.
- Small-scale gold mining on Peshastin and Chiwawa River could have effects to water quality.
- Effects from residential development and urbanization on water quality, instream habitats, and riparian areas are a concern as this area continues to experience socio-economic shifts away from agriculture to industry.
- Effects from recreational developments, especially on the Wenatchee River, such as campgrounds, trails, etc., include a reduction in LWD, loss of riparian habitat, alteration of streambanks, and increased poaching.
- The presence of non-native brook trout in many of the drainages is a concern due to possible competition and inbreeding.
- Prior to harvest restrictions, large numbers of adult bull trout were harvested in Lake Wenatchee potentially depleting the number of spawning fish.
- Effects from activities in the mainstem Columbia River on populations that spawn in the Wenatchee Core Area (i.e., Nason Creek, Icicle Creek, Chiwaukum Creek and the Chiwawa River). Degraded habitat and passage at dams affect juvenile, sub-adult, and adult life-history stages of bull trout.
- Instream flow in Icicle Creek and Peshastin Creek continue to be a concern and may be a larger affect to bull trout than we know. Irrigation water continues to be diverted in these areas while populations are low or unknown.
- Potential delay or stress caused to bull trout when passing through the Tumwater and the Chiwawa Dam weirs.
- The Lake Wenatchee Sockeye fishery continues to have detrimental effects on the bull trout population in the lake.
- Fire regimes in eastern Washington have shifted from historically frequent, low-intensity ground fires to low-frequency, high-intensity crown fires due to past fire suppression. Fire severity has also

increased in recent years due to grazing, fire suppression, silvicultural practices, and timber harvest practices.

- Chemical contamination in the Wenatchee River from pesticides and other chemicals has been noted recently by EPA in the Wenatchee River and Icicle Creek.
- Habitat variables identified by the U.S. Forest Service in the habitat condition baselines of biological assessments identifies that habitat and watershed variables are still functioning at risk or not properly functioning for some indicators identified in the Bull Trout Matrix of Pathways and Indicators.
- Genetic baselines are not completed.

Northeast Washington River Basins Management Unit

Pend Oreille Core Area

Migratory and resident life-history forms of bull trout are found within the Pend Oreille Core Area, which includes Pend Oreille River and tributaries from the Canadian border upstream to the Albeni Falls Dam. The adfluvial life-history form which historically returned to Lake Pend Oreille was eliminated with the construction and operation of the Albeni Falls Dam and other dams on the river and within tributary streams. However, in recent years, approximately one dozen large migratory bull trout have been captured within the Pend Oreille River, and on a single occasion documented within a tributary stream on a redd. Recent sightings in the Core Area include LeClerc Creek, Mill Creek, Cedar Creek, Indian Creek, Sullivan Creek, Sweet Creek, and the Box Canyon and Boundary reservoirs, and at the mouths of Marshall Creek and Slate Creek.

At the time of listing, it was assumed that adfluvial bull trout from Lake Pend Oreille utilized this portion of the Pend Oreille River and associated tributaries. Several recent studies have confirmed that a downstream adfluvial migration strategy still exists in the Pend Oreille River (above Albeni Falls Dam) and was likely the more prominent life-history form found in this Core Area (DuPont and Horner 2002; Geist et al. 2004). Geist (et al. 2004) tracked six radio-tagged bull trout from below Albeni Falls Dam making repeated movements to the base of the dam in 2003. In 2004, several additional bull trout were tagged and placed above the dam (Geist in litt. 2004). Subsequent tracking documented that they migrated to Pend Oreille Lake and that one individual migrated to a known spawning stream, presumably to spawn. Albeni Falls Dam presents a substantial threat to the continued existence of bull trout in this Core Area as long as there is no fish passage.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

Number and Distribution of Local Populations

While sighting of individual bull trout have occurred in several tributaries to the Pend Oreille River Core Area, only one extant local population has been identified: the LeClerc Creek complex. With only one local population, this Core Area is considered to be at an increased risk of extirpation.

Adult Abundance

Population estimates in the Pend Oreille Core Area are not currently available. However, due to relatively few numbers of bull trout documented recently, abundance of bull trout in LeClerc is probably below 100 adult spawning individuals and should be considered at risk from inbreeding. Similarly, bull trout in the entire Core Area most likely number fewer than 1,000, and should be considered at risk from genetic drift.

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. In the Pend Oreille Core Area, bull trout are considered to be at an increased risk of extirpation, due to the lack of long-term census information.

CONNECTIVITY

The downstream migration of bull trout was presumed to occur in the Pend Oreille River basin. Adult bull trout would migrate out of Pend Oreille Lake, down the Pend Oreille River and into tributary streams to spawn. This migration pattern was eliminated with the construction and operation of the Albeni Falls Dam. Fragmentation of the mainstem by this dam and Boundary Dam as well as tributary dams places the Pend Oreille Core Area at an increased risk of extirpation.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

The FWS's Opinion on the operations of the Federal Columbia River Power System (USFWS 2000c) assesses effects of system operations at Albeni Falls Dam on bull trout. The operations of the dam are reviewed on a regular basis and the FWS is routinely consulted on operational changes that are constantly needed in an attempt to balance species needs against other downstream ESA concerns (salmon and steelhead), hydropower demand, flood control and storage, and other factors. Management strategies and operational scenarios are in a constant state of flux. Multiple aspects of bull trout recovery are incorporated into (and funded through) the Bonneville Power Administration Fish and Wildlife Program guided by the Northwest Power and Conservation Council.

Idaho Department of Fish and Game (2001) published a statewide fisheries management plan for 2001-2006 that included the specific objective of “Restoring a fishable population of bull trout in Pend Oreille Lake” with a program which will evaluate creating fish passage at Albeni Falls Dam on the Pend Oreille River. Management strategies to achieve that objective that were identified included angler regulation and education, increased law enforcement, habitat protection, and removal of non-native fishes that compete directly with bull trout (e.g., lake trout). Some of those strategies are being implemented, though the State of Idaho has largely abandoned a formal role in the implementation of their Bull Trout Conservation Plan. An experimental trap-net program with potential to remove lake trout has been at least temporarily halted, due primarily to public resistance.

In May 2004, the Department of the Interior filed with the Federal Energy Regulatory Commission, their modified mandatory terms and conditions prepared by the FWS and the Bureau of Indian Affairs (Bureau) pursuant to sections 18 and 4(e) of the Federal Power Act for the Box Canyon Hydroelectric Project (Project) in the Pend Oreille River and tributary waters. The Department of the Interior fully expects that the Federal Energy Regulatory Commission license will be issued with the FWS’s and Bureau’s mandatory prescriptions and conditions.

Fish Passage (Section 18 FPA Fishway Prescription) - The Project consists of two major facilities; Box Canyon Dam and the Calispell Creek Pumping Plant, both of which presently preclude fish passage under most flow and operational conditions. The FWS has prescribed upstream and downstream fishways at both project facilities to accommodate upstream and downstream movement of bull trout, westslope cutthroat trout, and mountain whitefish. These native salmonids will eventually have access restored to about 73 miles of contiguous barrier-free habitat in the Pend Oreille River, and access to over 100 miles of barrier-free tributary streams upstream and downstream from the dam. In addition, fish passage at the Calispell Creek Pumping Plant would open an additional 21 miles of barrier-free habitat to migratory salmonids.

Trout Restoration (Section 4[e] Conditions) - While the FWS's fishway prescription focuses on the restoration of fish passage in the Pend Oreille River and its largest tributary (Calispell Creek) in the project area, the Bureau's Trout Assessment and Restoration Plan (TARP) provides for the increase of bull trout and westslope cutthroat trout populations in streams tributary to the Pend Oreille River in the project area. The TARP includes strategies to achieve naturally sustainable trout populations in about 328 tributary miles through instream and riparian restoration, conservation and maintenance, removal of fish passage barriers, and the purchase of land or conservation easements, exotic species control, and other measures. The Pend Oreille River would function primarily as a migratory corridor under the TARP.

<u>THREATS</u>

Threats to bull trout in the Pend Oreille Core Area include:

- Past logging, and logging-related activities (such as roads), have degraded habitat conditions in the especially in portions of Sullivan, Mill, Cedar, Ruby, Tacoma, Calispell, and LeClerc Creeks.
- Livestock grazing practices on both public and private lands has affected upland and riparian areas of most tributaries in the Pend Oreille Core Area. Specific areas of concern where grazing has affected stream habitat include the middle and east branches of LeClerc Creek, Ruby Creek, and Calispell Creek.
- Agriculture, although limited in scope, has contributed to effects through stream channelization, sediment inputs, and water quality problems.
- Mining is limited, but dredging and sluicing occurs primarily on Sullivan Creek and may affect fry and juveniles if present in the system.
- Effects from residential development and urbanization are likely to increase as the local, human population increases.
- Introduction of non-native species including brook trout, brown trout, bass, and walleye and the migration of northern pike from the Clark Fork River, Montana, have affected bull trout populations through a combination of hybridization, competition, and predation.
- The role harvest played in the decline of local populations is unknown, but fishing for bull trout in the Pend Oreille Core Area closed only as recently as 1992. Misidentification of bull trout by anglers may remain a threat.
- Road culverts pose a barrier to upstream passage especially on U.S. Forest Service roads in Sullivan Creek, Saucon Creek, and LeClerc Creek basins.

Snake River Basin in Washington Management Unit

Asotin Creek Core Area

Resident bull trout are the primary life-history form found in the Asotin Creek Core Area. Fluvial bull trout may still exist as evidenced by the capture of four sub-adult fish in a smolt trap in the lower reaches of Asotin Creek in 2004. Historically, migratory bull trout were likely much more prevalent and likely used the mainstem of Asotin Creek and the Snake River. Bull trout currently inhabit portions of the upper mainstem Asotin Creek, North Fork Asotin Creek, Cougar Creek, the Middle Branch and South Fork of North Fork Asotin Creek, and South Fork Asotin Creek. Bull trout were also documented in Charlie and George Creeks in the 1990's. Subsequent fish surveys in these portions of the Core Area have failed to document bull trout in recent years, which may indicate a loss in distribution. North Fork Asotin Creek and Cougar Creek are the only streams where spawning has been documented. Juvenile and sub-adult bull trout are known to rear in Asotin Creek from Charley Creek to the confluences of the North and South Fork Asotin Creeks as well as lower North Fork Asotin Creek and the Middle Branch and South Fork of North Fork Asotin Creek.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

Number and Distribution of Local Populations

There are currently two known local populations distributed in the Asotin Creek Core Area. These local populations occur in North Fork Asotin Creek and Cougar Creek. Both populations were presumed to consist of isolated groups of resident fish because seasonal water temperatures and poor habitat conditions (riparian zone, channel embeddednesss) were thought to exclude bull trout use of the mainstem Asotin Creek below the confluence of Charley Creek. However, with the recent capture of sub-adult bull trout in the lower mainstem of Asotin Creek, a remnant fluvial population may still exist. Nonetheless, with only two potentially isolated local populations, the Asotin Creek Core Area is considered to be at increased risk of extirpation.

Adult Abundance

Adult abundance in the Asotin Core Area was estimated at less than 300 individuals total in the two known local populations based on the results of bull trout surveys. Bull trout in this Core Area are considered to be at increased risk of inbreeding depression.

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. Because of the depressed and probably declining population trend and the loss of range with in the basin, bull trout in the Asotin Creek Core Area are currently considered to be at increased risk of extirpation.

Connectivity

Migratory forms of bull trout in the Asotin Creek Core Area are presumed to be extremely limited in both local populations. Based on the extremely low numbers of the migratory life history form and the poor connectivity between populations and with the mainstem Snake River, the Asotin Creek Core Area is considered to be at increased risk of extirpation.

Changes in Environmental Conditions and Population Status

The FWS's Opinion on the operations of the Federal Columbia River Power System (USFWS 2000c) assesses effects of system operations at Snake River dams on threatened bull trout, a protected species under the ESA. The operations of the dams are reviewed on a regular basis and the FWS is routinely consulted on operational changes that are constantly needed in an attempt to balance species needs against other downstream ESA concerns (salmon and steelhead), hydropower demand, flood control and storage, and other factors. Management strategies and operational scenarios are in a constant state of flux. Multiple aspects of bull trout recovery are incorporated into (and funded through) the Bonneville Power Administration Fish and Wildlife Program guided by the Northwest Power and Conservation Council. The most recent effort in that regard includes the current subbasin planning for the Asotin subbasin (NPPC 2004).

Critical habitat was formally designated in Asotin Creek and all or part of the following watersheds: Charley Creek, George Creek, and the North Fork Asotin Creek (USDI 2005). There are a variety of programmatic activities that have been recently completed or are ongoing in this Core Area, of which have the potential to improve aquatic habitat (NPPC 2004). These include but are not limited to: Conservation Reserve Program; Continuous Conservation Reserve Program; Conservation Reserve Enhancement Program; Wildlife Habitat Incentives Program; Wetland Reserve Program; Environmental Quality Incentives Program; and Total Maximum Daily Load programs. In addition to these programmatic activities, a wide range of Federal, State, tribal, and local agencies and organizations are involved in protecting and restoring aquatic habitat in this area.

THREATS

Threats to bull trout in the Asotin Creek Core Area include:

- Several small concrete and earthen dams impede passage of bull trout on Asotin Creek and Charley Creek. Silt behind these structures also effect downstream habitats.
- The two local populations in the Asotin Creek Core Area exist in tributaries completely surround by U.S. Forest Service lands. Past logging practices have resulted in elevated water temperatures, degraded pool habitats, and sediment deposition in spawning areas.
- Livestock practices have degraded bull trout habitat in the Asotin Creek Core Area.
- Crop production is the second largest land use in the Asotin Creek Core Area. Agricultural development has removed native vegetation, fragmented riparian habitats, increased sediment loads, and diverted water for irrigation.
- Expanding residential development in the lower reaches of Asotin Creek have degraded stream habitat.
- Rainbow trout were heavily planted in Asotin Creek and Charley Creek to support a recreation fishery. In addition to direct competition by rainbow trout and incidental harvest of bull trout, small dams created to enhance the rainbow trout fishery, have impeded bull trout passage on Charley Creek.

Tucannon River Core Area

Both resident and migratory forms of bull trout occur in the Tucannon River Core Area. Migratory bull trout probably also use the mainstem Snake River on a seasonal basis. Spawning occurs in the upper Tucannon River and at least seven tributary streams. Bull trout spawn in Sheep, Cold, Bear, and Panjab Creeks, all tributaries to the upper Tucannon River. Spawning also occurs in three tributaries to Panjab Creek: Turkey Creek, Meadow Creek, and Little Turkey Creek, a tributary to Meadow Creek. Multiple age classes of bull trout have been sampled within the Cummings Creek watershed on several occasions. However, spawning activity has yet to be documented, but surveys have been limited.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

Number and Distribution of Local Populations

There are currently eight known local populations distributed in the Tucannon River Core Area. These populations coincide with the mainstem and tributary streams where spawning is known to occur. Genetic work has been initiated to determine population structuring within these streams, but results are not yet available. Some spawning streams are very close to one another, which may promote free movement of adults among spawning areas from one year to the next. Such a situation could result in a single population of fish with a common genetic make-up using more than one stream for spawning and rearing. With eight interconnected local populations, bull trout in the Tucannon River Core Area are at intermediate risk of extirpation.

Adult Abundance

Bull trout redd surveys have been occurring in portions of this Core Area since 1990. However, they have not been done consistently year-to-year and index reaches have not been established. From the data set obtained from WDFW (2004), there are four areas that have been surveyed on a fairly consistent basis. An average number of redds per stream over all the years surveyed for these streams resulted in an adjusted estimate for each stream per year and finally for the Core Area. For the years 1990-1997, the adjusted estimate resulted in an average of 200 redds/year, and for the years 1998-2004 an estimate of 197 redds/year. Therefore the trend in this Core Area appears to be stable.

Adult abundance in the Tucannon River Core Area is estimated (based on redd counts) at 600 to 700 adult spawners for the eight known local populations. Other spawning areas in the Tucannon River watershed have not been surveyed. Bull trout in this Core Area were considered at intermediate risk of extirpation.

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. The Tucannon River Core Area is considered to be at intermediate risk of extirpation because of an apparent population trend that is not declining and has low to moderate annual variability.

Connectivity

There is some evidence that Tucannon River bull trout use the Snake River as habitat for foraging and overwintering. Additional evidence suggests that some Tucannon River bull trout also encounter dams on the Snake River. At least two dams on the Tucannon River had documented effects on bull trout from the early 1900's until recently. The De Ruwe Dam no longer exists and, therefore, is no longer a barrier to bull trout. The Starbuck Dam has been only partially removed and whether it interferes with bull trout migration is unknown. Recreational dams in numerous tributary streams in recent years have been known to kill bull trout or severely limit their ability to reach spawning areas. Migratory bull trout persist in most local populations in the Tucannon River Core Area and, therefore, it was considered to be at intermediate risk.

Changes in Environmental Conditions and Population Status

The FWS's Opinion on the operations of the Federal Columbia River Power System (USFWS 2000c) assesses effects of system operations at Snake River dams on bull trout. The operations of the dam are reviewed on a regular basis and the FWS is routinely consulted on operational changes that are constantly needed in an attempt to balance species needs against other downstream ESA concerns (salmon and steelhead), hydropower demand, flood control and storage, and other factors. Management strategies and operational scenarios are in a constant state of flux. Multiple aspects of bull trout recovery are incorporated into (and funded through) the Bonneville Power Administration Fish and Wildlife Program guided by the Northwest Power and Conservation Council. The most recent effort in that regard includes the current subbasin planning for the Tucannon subbasin (NPPC 2004).

Critical habitat was formally designated in the Tucannon River and all or part of the following watersheds: Cummings Creek, Hixon Creek, and the Little Tucannon River (USDI 2005). There are a variety of programmatic activities that have been recently completed or are ongoing in this Core Area which have the potential to improve aquatic habitat (NPPC 2004). These may include but are not limited to: Conservation Reserve Program; Conservation Reserve Enhancement Program; Wildlife Habitat Incentives Program; Wetland Reserve Program; Environmental Quality Incentives Program; and Total Maximum Daily Load programs. In addition to these programmatic activities, a wide range of Federal, State, tribal, and local agencies and organizations are involved in protecting and restoring aquatic habitat in this area.

THREATS

Threats to bull trout in the Tucannon River Core Area include:

- Dams on the mainstem Snake River and two dams on the Tucannon River have had an effect on bull trout since their construction. One of the smaller dams has been completely removed, while the other still presents as a partial barrier. Dams on the Snake River remain and present a passage issue.
- In the Tucannon watershed, the majority of the legacy effects from roads and past logging activities occurred prior to the listing of spring Chinook in 1992. Most national forest lands in the watershed have been harvested and 50 to 75 percent have been cut two to three times. Forestry continues to be a predominant land use in the Tucannon Watershed.
- Livestock practices have degraded bull trout habitat in the Tucannon River Core Area. Grazing on pasture and rangeland is one of the three predominant land uses in the Tucannon Watershed.
- Agricultural practices in the Tucannon watershed have resulted in high erosion rates, and low seasonal water levels can in part be attributed to irrigation diversion.
- Expanding residential subdivisions, numerous individual homes, and associated infrastructure are located primarily in floodplain areas of the Tucannon River.
- The Tucannon River and it tributaries receive substantial fishing pressure all year, that probably has a corresponding effect on adult bull trout escapement.
- Road densities and locations in the Tucannon River Core Area are described as “functionally at risk”. Culverts impede passage and roads funnel sediment into the creeks.

Umatilla-Walla Walla Basins Management Unit

Touchet River Core Area

Resident and migratory (both fluvial and adfluvial) bull trout are all found within the Touchet River Core Area which includes the mainstem Touchet River, North Fork Touchet River, Wolf Fork Touchet River, and South Fork Touchet River.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

Number and Distribution of Local Populations

The currently known spawning distribution in the Touchet River population occurs in the North Fork Touchet River from Bluewood Creek to Spangler Creek, in Sprangler Creek, Wolf Fork Touchet River from Whitney Creek upstream of the U.S. Forest Service boundary, and in Burnt Fork of the South Fork Touchet River. Bull trout in the Touchet River Core Area are primarily restricted to upper portions of the Wolf Fork and North Fork Touchet Rivers (Mendel et al. 2003a). An additional local population was discovered in the South Fork Touchet River, but it appears to be very small and tenuous. Water flows and temperature in lower and middle sections of the South Fork Touchet River have been identified as potential limiting factors (Kuttel 2001). Habitat conditions are relatively good in the North Fork and Wolf Fork Touchet Rivers and the local populations in these drainages appear to be holding their own. Annual variability in redd count totals is high, so it is difficult to make reliable inferences on long-term population trends.

Adult Abundance

Redd counts have been done annually on the Wolf Fork Touchet River (from 1990-2004), North Fork Touchet River (1994-2004), and South Fork Touchet River (2000-2004) (annual redd count results up to 2003 are summarized in Mendel et al. 2004; unpublished 2004 results obtained from Glen Mendel, WDFW, Dayton, WA). The Wolf Fork Touchet River continues to support the largest population, although redd totals on that stream have fluctuated a great deal (from 71 in 1994, down to 4 in 1997, then up to 101 in 2003). Despite the high variability, the overall trend in redds per year has been upward in Wolf Fork Touchet River since 1998. On the North Fork Touchet River, redd totals hovered in the 40s from 1998 to 2001, but have dropped each year since to a low of 22 in 2004, which is approximately at levels from the mid-1990s. It is unclear if this represents natural fluctuations or a steady decline. A local population was discovered in the South Fork Touchet River in 2000. However, after 16 redds were observed in the South Fork Touchet River in 2001, the count dropped to one in 2002, and no redds were seen in 2003 and 2004 surveys.

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. Based on the depressed or variable population trends, bull trout in the Touchet River Core Area were considered to be at increasing risk of extirpation.

Connectivity

Migratory bull trout persist in some local populations in the Touchet River Core Area. Physiological barriers and impediments to bull trout passage and rearing were extensive in terms of stream miles affected. Water temperature appears to be the most critical physiological barrier, particularly for passage or rearing. Seasonal temperature related barriers for bull trout generally occur in lower areas of the Touchet River.

Changes in Environmental Conditions and Population Status

A number of barriers or impediments to bull trout passage and rearing have been identified since 1998 (Mendel et. al. 1999, 2000, 2002, 2003b; Coyle et al. 2001). Some of the barriers are physical conditions (e.g., structures or dewatered streambeds) that block movement (see Mendel et al. 2003a); others are physiological barriers (e.g., temperature, sediment, lack of pools). Physiological barriers and impediments to bull trout passage and rearing were extensive in terms of stream miles affected. Water temperature appears to be the most critical physiological barrier, particularly for passage or rearing. Seasonal temperature-related barriers for bull trout generally occur in lower areas of the Touchet River.

Progress has been made with screening irrigation ditches and eliminating barriers to fish passage along the Touchet River

THREATS

Threats to bull trout in the Touchet River Core Area include:

- Numerous dams, physiological barriers and impediments to bull trout passage and rearing are extensive in terms of stream miles affected.
- Increased sediment loads associated with logging roads and recreation trails, loss of future large wood, and passage barriers associated with road culverts are problems that have result from past and logging practices in Touchet River Core Area.
- Multiple reaches of the mainstem Touchet River are dewatered as a result of agricultural irrigation practices.
- Foraging and overwintering habitat in the mainstem Walla Walla from the Little Walla Walla River downstream to the mouth contains numerous non-native species, but at this time the effects are not well know.
- Angling effects have adversely affected and continue to affect bull trout through direct harvest and incidental harvest. Poaching is a threat to bull trout in the Touchet River upstream of Dayton and the North Fork Touchet River.

Walla Walla Core Area

Bull trout in the Walla Walla Core Area exhibit both fluvial and resident life-history forms. Both forms spawn in headwater tributaries. After spawning, fluvial bull trout return to overwintering areas in the mainstem Walla Walla River until upstream migration begins. They spend the summer through fall in lower order tributaries or the upper mainstem Walla Walla River.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

The Walla Walla Core Area currently has two known local populations: upper Walla Walla complex, which includes the North and South Forks of the Walla Walla River; and Mill Creek and its tributaries. Fish in the upper Walla Walla local complex spawn mainly in the North and South Forks of the Walla Walla River between Table Creek and the second major tributary above Reser Creek with the majority of spawning fish found in Bear Creek. Fish from the Mill Creek local population spawn in Mill Creek and its tributaries upstream of the national forest boundary.

ADULT ABUNDANCE

Due to the lack of abundance data, bull trout local populations in the Walla Walla Core Area could not be evaluated relative to the risk of inbreeding depression. Abundance estimates for the Walla Walla Core Area were conservatively estimated by doubling the number of redds counted in 1999 and 2000 and taking the average of both years for an adult abundance estimate of 1,437 individuals. Based on this adult abundance estimate, the Walla Walla Core Area is not at risk from genetic drift.

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. Based on depressed or variable population trend in the two local populations, bull trout in the Walla Walla Core Area are considered to be at increasing risk of extirpation.

CONNECTIVITY

Migratory bull trout continue to persist in some local populations. Connectivity among populations is limited by numerous dams and diversion structures on the mainstem Walla Walla River and many of its tributaries creating physical and thermal barriers at certain times of the year. Because of these factors, the Walla Walla Core Area is considered to be at an intermediate risk of extirpation.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

In June 2000, the Walla Walla settlement agreement was signed by three local irrigation districts and the FWS. This agreement provided for the maintenance of instream flows in a stretch of the Walla Walla River that had been seasonally dewatered by irrigation diversions (Mendel et al. 2002, 2003). In 1999, over 6,500 fish, including 108 bull trout, were salvaged after being stranded in this dewatered reach. In 2000, a total of 3,887 fish, including 15 bull trout, were salvaged from the area. In 2001, for the first summer in nearly a century, the increased flows resulted in a watered stretch of the Walla Walla River between Milton-Freewater, Oregon, and the Washington/Oregon State line. Since implementation of the agreement, there has not been a fish-stranding problem in this area. The settlement agreement has been amended several times since 2000 to accommodate increased flow requirements; a new 3-year agreement was signed on June 28, 2004.

In 2001, a major new fish ladder was installed at Nursery Bridge near Milton-Freewater to facilitate passage of large salmon, steelhead, and bull trout. Considerable progress has been made in eliminating barriers to fish passage on the Walla Walla River and Mill Creek through screening irrigation ditches, consolidating ditches, and modifying diversion structures.

THREATS AND RECOVERY OBJECTIVES

Threats to bull trout in the Walla Walla Core Area include:

- Numerous dams and diversion structures have been constructed on the mainstem Walla Walla and tributaries for agriculture and flood control.
- Increased sediment loads associated with logging roads and recreation trails, loss of future large wood, and passage barriers associated with road culverts are problems that have resulted from past logging practices in several basins within the Walla Walla Core Area.
- Past livestock grazing on U.S. Forest Service lands has contributed to the degradation of aquatic habitats and present day livestock grazing on private lands continues to degrade habitats.
- Flood control and agricultural practices have simplified aquatic habitats and dewatered others. Poorly maintained diversions also strand bull trout.
- Residential development has meant the loss of floodplain habitats as well as low flow conditions due to municipal water withdrawals.
- The mainstem Walla Walla from the Little Walla Walla River downstream to the mouth contains numerous non-native species, but at this time the effects are not well know.

- Angling effects past and present have adversely affected and continue to affect bull trout through direct harvest and incidental harvest. Poaching is a threat to bull trout in the Walla Walla River and some tributaries.

Grande Ronde River Basin Management Unit

Grand Ronde Core Area

The Grande Ronde Core Area is one of two Core Areas located within the Grande Ronde River Basin. Oregon Department of Fish and Wildlife and the FWS have identified eight distinct local populations of bull trout within this Core Area (Buchanan et al. 1997, Service 2002). Both resident and fluvial life-history forms are known to occur in the Grande Ronde Core Area.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

The Grand Ronde Core Area eight distinct bull trout local populations include: the Upper Grande Ronde River (where the headwaters of the Grande Ronde River begins); Catherine Creek; Indian Creek; Minam River/Deer Creek; Lostine River/Bear Creek; Upper Hurricane Creek; Wenaha River; and Lookingglass Creek. Only a portion of one of those populations (Wenaha River) is found in Washington. Bull trout have been observed throughout the mainstem Wenaha River, South Fork Wenaha River, North Fork Wenaha River, Butte Creek, Crooked Creek and Mill Creek, a tributary the South Fork Wenaha River. Wenatchee Creek, a Washington tributary to the Grande Ronde, historically supported fluvial bull trout. However, a barrier water fall that formed in the 1960's, has impeded migration since. A survey in the mid 1980's documented one resident bull trout. More-recent surveys have not been able to confirm bull trout presence. The Grande Ronde Core Area also includes Wallowa Lake and the Wallowa River above the lake where bull trout have been extirpated.

Bull trout have been observed throughout the mainstem Wenaha River, South Fork Wenaha River, North Fork Wenaha River, Butte Creek, Crooked Creek, and Mill Creek, a tributary to the South Fork Wenaha River. Spawning occurs in the headwaters of Wenaha River and many of its tributaries. All known summer rearing and holding areas in the Wenaha River or its tributaries are on national forest land. This population is considered to be at low risk of extirpation. Wenatchee Creek is not considered a local population, but is identified as a research need.

ADULT ABUNDANCE

Bull trout in the Grand Ronde Core Area persist at moderate levels and best estimates are that approximately 4,000 bull trout spawned in each of the past few years. The majority of spawning likely occurs in the Wenaha River and its tributaries.

The extent to which local populations within the Grande Ronde Core Area are genetically distinct is unknown; they were delineated based primarily on known geographic, physical, and thermal barriers between spawning populations. Genetic information on bull trout metapopulation structure in the Grande Ronde Core Area has recently been collected and the University of Montana is currently analyzing the data. (Howell, USFS, Personal Communication, 2005).

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. Given the overall lack of long-term population-census information in the Grande Ronde Core Area and the variability in abundance estimates, the Grande Ronde Core Area is considered at risk of extirpation. The Wenaha River local population is one of the strongholds as it has multiple age classes, contains fluvial fish, has an anadromous prey base, has connectivity with the Grande Ronde and Snake Rivers, and contains pristine habitat. The status for the Wenaha bull trout population appears to be stable with a low risk of extirpation (although, consistent redd count data is not available for this population).

Connectivity

There are many physical or thermal barriers obstructing connectivity and migratory forms are present in only four of the eight local populations within the Grande Ronde Core Area. Specific passage barriers identified in the draft Bull Trout Recovery Plan include fish weirs (e.g., upper Grande Ronde River, Lookingglass Creek, and Lostine River) and hatchery intakes (e.g., Wallowa and Lookingglass fish hatcheries, Big Canyon satellite facility, and satellite facilities in the Lostine River, and upper Grande Ronde River). The draft Bull Trout Recovery Plan also identified several possible thermal barriers from warm water temperatures (e.g., upper Grande Ronde River, Bear Creek watershed, Lostine River, and Hurricane Creek below the Consolidated/Moonshine Ditch diversion dam).

Changes in Environmental Conditions and Population Status

Since the bull trout listing, Federal actions occurring in the Grande Ronde Core Area may have caused harm to, or harassment of bull trout. These actions include riparian restoration, grazing activities, federally funded weed-treatment activities in riparian areas, restoration of fish-passage barriers, fish-habitat-improvement projects, and federally funded transportation projects involving repair and protection of roads and bridges. Several scientific permits have been issued in the Grande Ronde Core Area for effects to bull trout from capture and handing (including Catherine Creek, Lostine River, and Wenaha River, among others).

The U.S. Forest Service has conducted an extensive culvert inventory to determine fish-passage concerns and limited replacements have been conducted for bull trout in the Grande Ronde River Core Area to date. The Oregon Department of Environmental Quality Total Maximum Daily Load and Water Quality Management Plan for the Upper Grande Ronde River Management Plan have recently been completed. Wallowa County is currently conducting a Total Maximum Daily Load and Water Quality Management Plan for the Lower Grande Ronde River. (ODEQ 2000).

The number of non-Federal actions occurring in the Grande Ronde Core Area since the bull trout listing is unknown. Fifty-four percent of the land is in private ownership within the Grande Ronde River Basin. Primary uses of private land are forest, range, and cropland.

Threats

Threats to bull trout in the Grand Ronde Core Area include:

- Ratliff and Howell (1992) listed habitat degradation, passage barriers, over harvest, and hybridization and competition with non-native brook trout as possible suppressing factors for bull trout populations in the Grande Ronde River Basin.

- Agricultural practices, mining, logging practices, and past road construction in the upper Grande Ronde River watershed have resulted in the alteration and degradation of instream habitats, and have been implicated in stream channel simplification and reduced frequency of large, deep pools (McIntosh *et al.*1994).
- Irrigation diversions and water withdrawals have created passage barriers and reduced stream flows, which often results in elevated water temperatures. Brook trout are present in a number of upper elevation streams where bull trout spawn and rear.
- Gunckel *et al*. (2002) studied two eastern Oregon streams and documented the ability of brook trout to out-compete bull trout and to replace bull trout through hybridization. Furthermore, once brook trout are introduced, they are difficult to eradicate from a watershed and will likely impact bull trout well into the future.

Coeur d'Alene Lake Basin Management Unit

Coeur d'Alene Lake Basin Core Area

The majority of the Coeur d'Alene Lake Basin Core Area resides in northern Idaho. Only a small portion of the Core Area is within Washington and no local populations reside in the State.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Three local populations are currently identified in the Coeur d'Alene Lake Basin Core Area. They are Medicine Creek; Wisdom Creek; and St. Joe River between Heller Creek and St. Joe Lake. Juvenile bull trout as well as bull trout redds have been documented in many other tributary streams of the St. Joe River over the last decade, but because these documentations are infrequent and of limited numbers, fish from these tributaries have not been classified as local populations.

Distribution within the Core Area appears to have become increasingly fragmented since 1992, and even more so since 1998. Since 1992, bull trout redds have been observed in 19 tributary streams. Since 1998, bull trout redds have only been observed in 11 tributary streams. Furthermore, in 6 of these streams, only a single redd has been observed over the seven years since listing.

With fewer than five local populations, the Coeur d'Alene Lake Basin Core Area is considered to be at an increased risk of extirpation. No populations from this Core Area occur in Washington.

ADULT ABUNDANCE

Overall, bull trout in the Coeur d'Alene Lake Basin Core Area persist at low numbers in fragmented and relatively isolated local populations. Adult abundance was previously estimated at 119 to 166 adult spawners per year in the 3 known local populations. However, adult abundance over the last few years is estimated to be increasing, since redd counts in 2004 and 2005, 72 and 91 respectively, have roughly doubled over the previous 12 year (1992–2003) with an average of approximately 42 redds. The adult abundance is now likely greater than 250 adult individuals. None-the-less, based on this low adult abundance, the Core Area is considered to be at increased risk of inbreeding depression.

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. Data obtained from Idaho Department of Fish and Game annual redd surveys since 1992 indicate an increasing trend for three index streams since the surveys began. However, prior to listing, there was a downward trend with less than 20 redds reported in 1997, and an average of 37 redds annually between 1992 and 1997. Since 1997, greater than 40 redds have been report for most years (only 15 in 1998), with highs of 72 in 2004, and 91 in 2005 for the three index areas. Furthermore, there appears to an increasing trend in one additional stream, Heller Creek. In previous years, redds were rarely documented, but in 2004, seven redds were found, resulting in 79 documented redds for the Core Area. Given the 14 years of population information from annual redd surveys, with only the last few years having a marked increase for a few local populations, bull trout in the Coeur d'Alene Lake Basin Core Area are still considered to be at an increased risk of extirpation.

CONNECTIVITY

Bull trout spatial distribution in the main basin of Coeur d'Alene Lake Basin Core Area and its' direct tributaries is fragmented. Seasonally, unsuitable habitat along with barriers such as water diversions, road crossings, and culverts on smaller streams are known to impede connectivity between local populations and previously occupied suitable habitats.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

The Idaho Panhandle National Forest has implemented many habitat-restoration and enhancement activities in this Core Area. The types of restoration projects that have been implemented include: construction of pool habitat using both large woody debris and/or boulders; placement of large woody debris as cover; placement of boulders to diversify habitat; planting of shrubs and trees within the riparian zone; replacement of culverts which were migration barriers; riparian fencing; and the removal of a small dam. While these activities are expected to improve overall habitat conditions in the Core Area as well as benefit bull trout, only a small number of these activities have occurred in areas currently inhabited by the species.

A Conservation Partnership consisting of the local Soil and Water Conservation Districts, the Idaho Soil Conservation Commission, and the Natural Resources Conservation Service has been established to assist private landowners with the management of their natural resources. As a whole, the focus of the Conservation Partnership is to reduce non-point source pollution from agricultural lands by increasing the voluntary implementation of agricultural best management practices on various agricultural lands.

Critical habitat has formally been designated in Coeur d'Alene Lake, the Coeur d'Alene River, the North Fork Coeur d'Alene River, the St. Joe River, Beaver Creek, Eagle Creek, Fly Creek, Prichard Creek, Ruby Creek, Steamboat Creek, and Timber Creek (USFWS 2005).

Idaho Department of Fish and Game (2001) published a statewide fisheries management plan for 2001-2006. While the management plan emphasizes that wild native populations of resident and anadromous fish species will receive priority consideration in management decisions, there are no specific objectives or programs identified within the Spokane River drainage section of the management plan for bull trout. Management direction identified in the plan for bull trout in this area includes: maintain harvest closure; better define life-history patterns in the lake; and investigate distribution, status, and critical habitat needs to better guide conservation efforts.

The ongoing State and Federal management programs have identified opportunities that have not yet translated into meaningful recovery efforts in this Core Area. The population status of bull trout in this Core Area remains well below that deemed necessary for long-term persistence and remains at risk because of their isolation and other associated risks to the few remaining local populations

THREATS

Threats to bull trout in the Coeur d'Alene Lake Basin Core Area include:

- Post Falls Dam and its operation, and other smaller barriers that block fish passage.
- Effects related to past logging have degraded habitat including loss of riparian habitat, sedimentation, poorly designed and located roads, and blocking culverts.
- Non-native, invasive species including brook, lake, and brown trout.
- Residential development and urbanization leading to poor water quality

Clark Fork Rover Basin Management Unit

Priest Lakes Core Area

The majority of the Priest Lakes basin is in the northwest corner of Idaho. About 2.5 percent extends into Canada where the upper Priest River originates in the Nelson Mountain Range. Headwaters of the major tributaries on the western side of the basin originate in the Kaniksu National Forest and the Salmo-Priest Wilderness in northeast Washington. Recent redd surveys and fish sampling have failed to document use by bull trout in several of these streams, perhaps indicating a further decline in their distribution within this Core Area. Bull trout spatial distribution in the main basin of Priest Lake and its' direct tributaries is increasingly fragmented (IDFG 2004). The strongest remaining bull trout populations are found in Upper Priest Lake.

The status of a bull trout core population can be described based on four key elements: 1) number and distribution of local populations; 2) adult abundance; 3) productivity; and 4) connectivity.

NUMBER AND DISTRIBUTION OF LOCAL POPULATIONS

Twelve populations are currently identified in the Priest Lakes Core Area. They include the upper Priest River, Hughes Fork, Gold Creek, Trapper Creek, Lion Creek, Two Mouth Creek, Granite Creek, North Fork Granite, South Fork Granite, Indian Creek, Kalispell Creek, and Soldier Creek. Hughes Fork, Gold Creek, North Fork Granite Creek, South Fork Granite Creek, and Kalispell Creek originate in Washington.

ADULT ABUNDANCE

Based on recent analysis, there are fewer than 100 adult bull trout in this Core Area and the recent trend is considered stable at best, more probably declining. Bull trout in this Core Area are considered to be at an increased risk of extirpation.

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. Based on the depressed or variable population trend, bull trout in the Priest Lakes Core Area are considered to be at risk of extirpation.

CONNECTIVITY

Bull trout spatial distribution in the main basin of Priest Lake and its direct tributaries is becoming increasingly fragmented (IDFG 2004). Fish passage at Priest Lake dams needs to be addressed to provide year-round fish passage. Barriers on smaller streams such as water diversions, road crossings, and culverts also impede connectivity between populations.

CHANGES IN ENVIRONMENTAL CONDITIONS AND POPULATION STATUS

Idaho Department of Fish and Game (2001) published a statewide fisheries management plan for 2001-2006 that included the specific objectives of "restoring a fishable population of bull trout in Upper Priest Lake" and "examining the potential to shift management emphasis in Priest Lake from lake trout to cutthroat, bull trout, and kokanee." Identified management strategies to achieve those objectives included angler regulation and education along with active removal of non-native lake trout by intensive gill-netting in Upper Priest Lake.

The ongoing State and Federal management programs have identified opportunities that when fully implemented will promote recovery in this Core Area. Bull trout population response as a result of lake trout control activities is not certain, but there do not appear to be other viable options.

THREATS

Threats to bull trout in the Priest Lakes Core Area include:

- Fish passage at Priest Lake dams needs to be addressed to provide year-round fish passage. Barriers on smaller streams such as water diversions, road crossings, and culverts also impede connectivity between populations.
- Impacts related to past logging practices have degrade habitat including loss of riparian habitat, sedimentation, poorly designed and located roads, and blocking culverts.
- Non-native, invasive species including brook, lake, and brown trout.
- Dewatering occurs regularly on portions of Kalispell Creek.

8.6.3 EFFECTS OF THE ACTION ON THE INDIVIDUAL

The "effects of the action" is defined in the ESA section 7 implementing regulations as:

> "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline. Indirect effects are those that occur later in time, but that are reasonably likely to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration." (50 CFR §402.02).

The activities addressed in this Opinion have been previously described in the Project Description section and Description of Activities that are Effects of the Permit.

Bull trout have specific habitat requirements that appear to influence their distribution and abundance (Rieman and McIntyre 1993). All life-history stages are associated with complex forms of cover including large woody debris, undercut banks, boulders, and pools. Other habitat characteristic important to bull trout include: channel and hydrologic stability, substrate, and the presence of migration corridors (Rieman and McIntyre 1993). Stream temperatures are also an important habitat feature that can affect bull trout distribution, as they prefer cold water. In Alberta, Canada, bull trout occurrence and abundance was found to be inversely related to the percentage of commercial forest harvesting and road density in subbasins (Ripley 2005). Activities related to timber harvest and the development of forest road networks can influence bull trout occurrence through a variety of pathways. Forest practices that would be conducted under the FPHCP have the potential to both negatively and positively influence many of the components known to be associated with suitable, productive bull trout habitat.

8.6.3.1 Large Wood

Large wood serves several important roles in buffering small- and moderate-sized streams against temperature changes. The role of large wood in affecting stream temperatures is covered in the Temperature Effects section of this Bull Trout Effects analysis. This analysis will discuss the effects of large wood on channel hydrology and complexity.

Reduction of wood in stream channels, either from present or past activities, generally reduces pool frequency and quality, and channel complexity (Bisson et al. 1987, House and Boehne 1987, Spence et al. 1996). Large wood in streams enhances the quality of habitat for salmonids and contributes to channel stability (Bisson et al. 1987). It creates pools and undercut banks, deflects stream flow, retains sediment, stabilizes the stream channel, increases hydraulic complexity, and improves foraging opportunities (Murphy 1995). By forming pools and retaining sediment, large wood also helps maintain water levels in small streams during periods of low stream flow (Lisle 1986b). Large pools consisting of a wide range of water depths, velocities, substrates, and cover are characteristic of high-quality, aquatic habitat and an important component of channel complexity.

Research into wood recruitment from stream-adjacent areas helped shape the recruitment-distance relationships for large wood in the FPHCP, as is illustrated in Figure 4.9 (page 215) of the FPHCP. In a study of first- through third-order streams in western Washington and Oregon, McDade et al. (1990) found that for pieces whose source of origin could be determined, 70 percent of wood pieces recruited from mature conifer forests, and 90 percent of the wood from mature hardwood forests, originated from within 15 meters (50 feet) of the stream bank. Source distances of 20 meters (66 feet) and 30 meters (100 feet) correspond with 80 and 90 percent of the total recruitment, respectively, for woody debris from mature conifer forests (McDade et al. 1990). In a similar study, Murphy and Koski (1989) found that 90 percent of the in-stream woody debris recruited from old growth forests in southeast Alaska had source distances of 50 feet or less from the stream edge (Figure 4.10 of WDNR 2005) and almost all (99 percent) identified sources of large wood were within 30 meters (100 feet) of the stream bank (Murphy and Koski 1989). McKinley (1997) found that 95 percent of woody debris originated within 15 meters (50 feet) of the stream bank for small streams bordered by second growth forests in northwest Washington (Figure 4.11 of WDNR 2005).

Although McDade and others (1990) were able to estimate the point of origin of much of the large wood in the studied streams, they could not determine the source of a significant percent of the pieces. Earlier studies (such as McDade and others 1990, Murphy and Koski 1989) focused primarily on chronic inputs of wood from stream-adjacent riparian zones. More recent research suggest that these earlier studies (such as McDade and others 1990) did not sample study reaches influenced by upstream and upslope sources (Reeves et al. 2003). Other studies suggest that half, or more, of large wood inputs may come from upstream and upslope sources (Pollock and Kennard 1998, Reeves et al. 2003, May and Gresswell

2003, McGarry 1994 as cited in Pollack and Kennard 1998). As discussed by Fox (2003), McDade et al. (1990) included greater minimum piece size and included channel-straddling pieces whereas his study did not. Both of these factors would favor counting more pieces that are in proximity to their recruitment source, and undersestimate the contribution of large wood from upstream and upslope sources.

One study (McGarry 1994 as cited in Pollack and Kennard 1998) determined that 48 percent of the large wood in a mainstem creek came from upstream sources, primarily debris flows. In steep terrain, landslides and debris flows are potentially important mechanisms for delivering large wood from hillslopes and small headwaters to valley-bottom streams (Reeves 2006). Another study in a pristine watershed in coastal Oregon shows that the contribution of large wood to fish streams from upslope areas can be as much 65 percent of the total number of pieces and 46 percent of the estimated volume of wood (Reeves et al. 2003). More than 80 percent of the total number of pieces of wood in a western Washington stream were from upslope sources (Benda and others 2003; as cited in Reeves 2006); and large amounts of wood were recruited from upslope sources in the Oregon Coast Range (May and Gresswell 2003). These findings indicate that a substantial proportion of wood in the studied streams came from upslope sources and suggests that studies such as McDade et al. (1990) may have limited applicability for developing and evaluating riparian management policies for landslide-prone areas. Steeper, more highly dissected watersheds will likely have a greater proportion of wood coming from upslope sources than will watersheds with lower gradients (Reeves 2006). Murphy and Koski (1989) and Martin and Benda (2003) found that upslope sources of wood composed a relatively small portion of the total volume of wood in low gradient streams they studied in Alaska (Reeves 2006). In the steep forested terrain of the Pacific Northwest the contribution of large wood delivered by landslides or debris flow from the upslope may account for more than half of the wood in a stream (Reeves et al. 2003; May and Gresswell 2003). Stream size and geographic setting strongly influences processes that recruit wood and redistribute wood in the channel (May and Gresswell 2003). Therefore, it is expected that sources of large wood contribute differently in different areas, and that research results vary according to the location of the study.

It is important to note that pieces of large wood delivered from upslope areas are generally smaller than those originating from riparian zones along fish-bearing streams (Reeves 2006). The mean volume of a piece of wood from upslope areas was one-third the mean size of pieces from stream-adjacent riparian areas in a coastal Oregon stream (Reeves et al. 2003). Differences in mean size are likely attributed to fire history and other stand-resetting events (Reeves 2006). Hillslopes are more susceptible to fire and burn more frequently than riparian zones (Agee 1993 as cited in Reeves 2006). Thus, trees in riparian zones may be disturbed less frequently and achieve large sizes than upslope areas (Reeves 2006). Upslope sources are also more sporadic sources of wood and rely on stochastic events (landslides, slope failure, etc.) as the delivery mechanism.

Expressing wood-recruitment ratios for wood recruited from stream-adjacent riparian areas as a proportion of tree height rather than distance from a stream enables source-distance relationships to be compared across sites and between studies. McDade et al. (1990) reported average tree heights for mature and old-growth conifer forests of 48 meters (157 feet) and 57.6 meters (189 feet), respectively. Using these values to express wood recruitment as a function of tree height indicates that more than 80 percent of the stream-adjacent woody debris in mature and old-growth conifer forests is recruited within half of a tree height while over 90 percent originates from within three-quarters of a tree height. Murphy and Koski (1989) found that 99 percent of large woody debris in streams in southeast Alaska was recruited within three-quarters of a tree height from the stream bank. The generalized wood recruitment curve presented in FEMAT (1993) and shown in Figure 4.8 of WDNR (2005) suggests that at least 80 percent of woody debris originates from within three-quarters of a tree height.

The effective buffer width needed to deliver a high proportion of the wood sufficiently large enough to be considered functional or key-piece sized to the adjacent stream or river is generally narrower than the buffer width needed to deliver a similar proportion of all available wood. Model predictions by Van Sickle and Gregory (1990 as cited in May and Gresswell 2003) suggest that wood entering a stream from trees growing close to the channel should contribute longer and larger pieces of wood than wood delivered from a greater distance. May and Gresswell (2003) found that along a low-elevation floodplain of an alluvial channel that the majority of wood pieces within a distance of less than 10 meters were young hardwoods. Larger conifers were located beyond the floodplain and terrace surfaces. They also found that along colluvial channels riparian areas were more representative of upland areas and large conifers were dominant in the near-stream area. These two studies emphasize again that stream size and geographic setting strongly influences processes that recruit wood and redistribute wood in the channel (May and Gresswell 2003).

FPHCP Effects on Large Wood

Riparian buffer widths in the FPHCP would vary dependent on site class, size of the stream, whether the stream is fish-bearing or not, and where the stream is located (east or west of the cascade crest). For fish-bearing streams, the FPHCP would also divide the riparian buffer into three distinct zones: the Core, Inner, and Outer Zones. Riparian management zones are measured from the edge of the bankfull width or the CMZ which ever is greater. The widths of the riparian buffers and the amount of harvest that can occur within identified zones are described in **Description of Washington Forest Practices Rules under the Proposed FPHCP** as well as within the rules themselves (i.e., Title 222 WAC).

Tree removal in riparian corridors reduces the potential for the input of large wood, small woody debris, and organic matter to the stream and can reduce bank stability if trees too close to the stream bank are removed (Swanson et al. 1987, MBTSG 1998). These changes have the potential to alter the channel morphology and reduce habitat complexity and the input of organic matter to the stream. In Washington, large wood in streams has been greatly reduced in nearly all streams due to not only historic logging practices, but via agriculture and urbanization as well (USFWS and NMFS 2005). As a result, current riparian habitat conditions have become simplified, both in species composition and structure. Presently, for example, it is thought that red alder dominates more riparian areas in western Washington than was typical under natural disturbance regimes (WFPB 2001a, McHenry et al. 1998). It is also estimated that approximately 78 percent of western Washington stream miles and 61 percent of eastern Washington stream miles flow through early-seral stage riparian stands. Early-seral stage was defined as “reproduction, conifer pole, hardwood pole, and mixed pole stands less than 12 inches in diameter at breast height (dbh)(WFPB 2001a).

In contrast, only 1 percent and 5 percent of the stream miles in western and eastern Washington, respectively, flows through riparian stands considered to be late-seral stands of trees greater that 24 dbh. This is significant, at least in the near-term, as a large percentage of large wood can be a result of bank erosion, windthrow, and near-bank tree mortality, and most riparian stands in Washington currently lack sufficient numbers of large trees. As noted earlier, in steep terrain in the Pacific Northwest, the contribution of large wood delivered by landslides or debris flow from the upslope may account for more than half of the wood in a stream (Reeves et al. 2003; May and Gresswell 2003). However, other studies have found that topographic features of a watershed influence the relative contribution of riparian-adjacent and upslope sources of large wood. In less steep terrain and in U-shaped valleys, a proportionally lower amount of large wood will be delivered from debris flows. In the near-term, sources of large wood from both near-bank and upslope areas are in early seral condition in many cases and therefore will not be a source of large functional wood for likely decades.

Under the FPHCP, the conditions of riparian areas adjacent to fish-bearing streams are expected to improve as trees are left to mature in the no-harvest core zone, the inner zone, and, to a lesser extent, the outer zone. For both the eastside and westside, the intensity of harvest and RMZ management increases with the distance from the stream. The proportion of the stream-adjacent large wood source area affected by FPHCP prescriptions also increases with distance from the stream (CH2MHill 2000). More specifically, the CH2MHill (2000) review of the scientific foundations of the Forest and Fish plan concluded that the 50-foot, no-harvest core zone on the westside would maintain an unmanaged stand supplying 62 to 79 percent of the potential stream-adjacent large wood depending on stream size and site class. The limited-harvest options for the inner zone in some cases may supply an additional 14 to 34 percent of the potential large wood. On the eastside, numbers are similar. The 30-foot core zone would maintain an unmanaged stand predicted to provide 66 to 82 percent of the potential stream-adjacent large wood, and the inner zone would supply an additional 12 to 30 percent (CH2MHill 2000). Again, these percentages depend on stream size and site class. According to the CH2MHill (2000) study, only five percent or less of the potential stream-adjacent large wood supply would be affected by the more-aggressive harvest prescriptions permitted in the outer zone.

Depending on the stream type and bankfull width, WDNR (2005; Appendix J, part 2) it was estimated that RMZs on 20-acre exempt parcels would provide between 45 and 95 percent of the potential wood recruitment from mature conifer forest. However, in situations where CMZs are present, the amount of the potential large-wood recruitment provided by such buffers may be substantially less. The WDNR estimate was based upon observed buffers on 20-acre exempt parcels and included additional trees retained, ostensibly, to meet shade requirements.

For Type Np streams on the westside, the prescriptions are designed to protect sensitive sites (e.g., headwall seeps, springs, alluvial fans, and stream junctions) by requiring 50-foot-wide buffers along at least 50 percent of the unit length. Where tree-retention buffers are located, the prescriptions would maintain unmanaged timber stands predicted to supply 62 to 79 percent of the potential large wood (CH2MHill 2000). Where buffers are not required, all of the harvestable timber could be removed. Because smaller Type N streams have less power than larger streams, smaller wood will often remain in place and function in sediment storage and channel morphology (Bilby 1995). However, larger wood is expected to be more persistent and form deeper steps and sediment wedges.

For Type Ns streams on the westside, timber harvest would not be restricted except where potentially unstable slopes occur near the channel. In reaches with stable side slopes, all timber could be removed which would eliminate any large wood recruitment in these areas. In reaches with potentially unstable side slopes, a portion of the timber would be retained, and therefore so would a portion of the potential large wood recruitment.

In Type Np streams on the eastside, the effectiveness for maintaining timber in the source area is dependent on the management option used. In partially cut units, a 50-foot-wide buffer with a basal area (BA) equivalent to the BA required for Type F stream would be required along the entire unit. In clear-cut units, a 50-foot-wide no-harvest buffer would be retained along 30 to 70 percent of the unit length. No more than 30 percent of the stream length within a harvest unit would be left without a buffer. The no-harvest reaches of the partial harvest and clear-cut units are predicted to supply 81 to 95 percent of the potential large wood (CH2MHill 2000). Where buffers are not required, all of the harvestable timber could be removed.

In summary, stream size and topographic setting strongly influence processes that deliver wood to the channel network (May and Gresswell 2003). In larger alluvial channels, the majority of the functional large wood along fish-bearing streams comes from near-stream processes (streambank erosion, wind throw, and near-bank tree mortality), with the remainder coming from channelized landslides or debris flows, and stream-adjacent hillslope landslides (Pollack and Kennard 1998; Murphy and Koski 1989). Riparian buffers adjacent to fish-bearing streams prescribed in the FPHCP are expected to maintain 91 to 100 percent of the potential large wood that originates adjacent to these streams (CH2MHill 2000). This percentage would be substantially less along 20-acre exempt parcels bordering fish-bearing streams. In small colluvial channels draining steep hillslopes, processes associated with slope instability dominate large-wood recruitment.

Due to the portions of many of Type Np or Ns streams without buffers, there will be some reduction in large-wood recruitment to fish-bearing streams. The portions of Type Np and Ns streams that are left unbuffered will result in a more-acute reduction in large-wood recruitment to fish-bearing streams, especially fish-bearing streams nearer headwaters. When debris flows occur, we expect initiation points to provide some wood in most cases. Debris flows will entrain additional wood as they travel downstream. Due to the presence of harvested reaches, a lesser amount of wood would be entrained. Additional wood may also be delivered in the run-out reach in lower segments. Not all debris flows will deliver to fish-bearing streams. When debris flows do deliver to fish-bearing streams, a lesser amount of wood may be delivered due to riparian timber harvest along Type Np and Ns streams. However, wood delivered through debris flows may be damaged and broken as a result of the transport mechanism and may not be as effective at retaining sediment as larger whole pieces recruited lower in the stream reaches affected by these processes. For instance, wood recruited by debris flows or other mechanisms within the 300 to 500 foot sensitive site at the confluence of Type F and Np streams may be longer and less broken, less transportable by fluvial processes, and may be more important for retaining sediment. Regardless of these considerations, the FWS expects that some negative effects will result from the incremental difference in wood delivered at these points. As a result, at these delivery points and in downstream reaches, there may be fewer deep pools, reduced stability of streambanks, channel widening, and additional bedload movement.

Effects of the Reduction of Large Wood on Bull Trout

Bull trout are strongly associated with various components of habitat complexity, including cover, large wood, side channels, undercut banks, boulders, pools, and interstitial spaces in coarse substrate (Rieman and McIntyre 1993; Jakober 1995; MBTSG 1998). Several life-history features of bull trout make them particularly sensitive to activities that reduce the quantity, quality, and distribution of large wood that directly or indirectly affects stream-channel integrity and natural flow patterns (MBTSG 1998). Examples of these life-history features and their association with habitat complexity are:

- An extremely long period from egg deposition to fry emergence from the gravel (220 days or more during winter and early spring);
- Strong association of juvenile bull trout with streambed cobble and substrates low in fine sediments;

- Extensive spawning and overwintering migrations of adult bull trout, which require a large network of suitable freshwater habitat with migratory corridors;
- Use of deep pools by both adults and juveniles for cover and thermal refuge;
- Selection of redd sites by adults in low-gradient reaches and in areas of groundwater influence;
- The lower-gradient sites are sometimes located adjacent to channel roughness elements (large wood and boulders) within stream reaches having overall moderate to steep grades;
- Use by both adults and juveniles of areas with reduced water velocity, such as side channels, stream margins, and pools (Watson and Hillman 1997; MBTSG 1998).

Bull trout of all age classes are closely associated with cover, especially during the day (Baxter and McPhail 1997, Fraley and Shepard 1989). Bull trout distribution and abundance is positively correlated with pools; complex forms of cover such as large or complex woody debris and undercut banks; and coarse substrates (cobble and boulder) (Rieman and McIntyre 1993, Jakober 1995, MBTSG 1998). Studies of Dolly Varden show that population density declined with the loss of woody debris associated with clear-cut harvest or the removal of logging debris from streams (Bryant 1983, Dolloff 1986, Elliott 1986, Murphy et al. 1986). Dolloff (1986) also found that the larger size classes of fish declined the most.

Loss of large-wood recruitment potential relative to 20-acre exempt parcels and Type Np and Ns streams draining steep hillslopes may negatively affect bull trout through bedload movement, lack of cover, lack of protection for undercut banks, and other factors. A reduction in large wood to bull trout streams also has the potential to result in reduced pool formation. These effects could affect bull trout at all life stages. At locations where Type Np and Ns streams occur above bull trout spawning reaches, effects from the loss of potential large wood could be more substantial. Embryos and juvenile bull trout are especially vulnerable to bedload movement and increased sediment and could experience mortality as well as injury. Indirect effects include increased risk of predation and reduced ability to forage. Migratory bull trout require complex habitat and large wood as they forage, migrate, and overwinter, and spawning sites are usually in proximity to large wood and other cover. Potential effects to adult and sub-adult bull trout include reduced ability to forage, loss of suitable habitat patches, reduced carrying capacity, and loss of available spawning habitat. A study by Hauer et al. (1999) suggests that land use practices, and specifically practices that result in changes in the frequency, character, and distribution of instream wood, may play a role in the decline in bull trout. We expect adverse affects associated with the loss of large-wood recruitment to occur in a number of bull trout streams. These effects are anticipated to be typically sub-lethal in nature since they will affect bull trout through the reduction of overall habitat complexity. This reduction in overall habitat complexity would contribute to the impairment of bull trout foraging, rearing, and spawning behaviors. Such adverse effects are not anticipated to occur in all streams that support bull trout, especially streams that derive most of their large wood from near-stream sources.

8.6.3.2 Stream Temperature

Stream temperature is the result of complex, interacting environmental factors. Human activities primarily influence stream temperature by affecting four major components of the physical environment: riparian vegetation, channel morphology, hydrology, and surface/subsurface interactions (IMST 2004).

There are numerous mechanisms that can result in temperature increases in streams. These mechanisms include 1) reduction in canopy cover, 2) increased coarse and fine sediment delivery to stream channels, which can lead to channel widening and loss of pools, 3) reduction in large wood, which result in reduction of pools, reduced channel capacity, and loss of thermal buffering and coldwater refugia, 4) increased heating of riparian soils, 5) interception of shallow groundwater by road systems, 6) increased air temperature over streams by loss of microclimate buffering, 7) riparian roads, which reduce the interaction of the floodplain with the channel, 8) loss of off-channel wetlands due to reduction in shading, 9) loss of streambank stability due to streamside harvest, leading to increased sediment delivery and channel widening, and 10) increase in basin-wide sediment delivery due to forest-related road systems, leading to pool loss and channel widening (Beschta et al. 1987; Brosofske et al. 1997; Johnson and Jones 2000; IMST 2004).

At the point of stream initiation, the temperature of water entering a forested stream system typically resembles that of the watershed's subsoil environment. Conduction between water and alluvial substrates is an important mechanism influencing stream temperatures (Beschta et al. 1987; Johnson and Jones 2000). In streams where a large amount of water is in contact with substrates, especially during subsurface and hyporheic flow, conduction may be second only to solar radiation in affecting stream temperatures (Johnson and Jones 2000).

As water continues to flow down the stream system, seasonal and diurnal variations in water temperatures are strongly influenced by solar radiation (Beschta et al. 1987). A loss or decrease in riparian vegetation diminishes the amount of shade available to block incoming solar radiation. In several studies the largest increases in stream temperature after riparian removal occurred not in the late summer, the usual time of maximum stream temperatures, but in early summer, which coincides with the timing of maximum solar inputs (Johnson and Jones 2000). Measured increases in maximum daily stream temperatures following canopy removal have ranged from 2 degrees to 12.7 degrees celscius (Beschta et al. 1987; Johnson and Jones 2000; IMST 2004; Story et al. 2003).

Riparian forests and the shade they provide are key factors affecting the thermal regimes of aquatic ecosystems (Brown et al. 1989). Although solar radiation is not the only factor affecting the thermal environment of streams, it is thought to be the primary driver of stream temperatures on FPHCP covered lands (WDNR 2005). Riparian canopy removal can lead to increased maximum water temperatures during summer and lower minimum water temperatures in the winter, thus resulting in increased diel fluctuations in both seasons. Streamside vegetation reduces incoming solar radiation thereby limiting stream heating, particularly during the summer months. In winter, riparian canopy cover may help moderate water temperatures by inhibiting energy losses through evaporation, convection, and long-wave radiation (Beschta et al. 1987).

The amount of influence riparian vegetation may have on stream temperatures is dependant on multiple factors including the size of the stream, water depth, groundwater inputs, riparian vegetative community, length of stream channel shaded, slope, aspect, and region. By altering the thermal regime of streams, reductions in streamside shade may also cause undesirable changes in primary production and fish metabolism, development, and behavior (Beschta et al. 1987). The loss of riparian vegetation and cover can also indirectly influence the thermal environment (local wind patterns, local air temperatures, humidity, conductive and convective heat transfer, outgoing or long-wave radiation), soil temperature, sediment delivery, base flow (and possibly hyporheic exchange), and large wood recruitment (IMST 2004).

Over the long-term, the FPHCP is expected to reduce the amount of water temperature increases from harvest activities from baseline conditions mainly through improved riparian management. Because relatively young stands provide shade for smaller streams (those most-easily warmed by solar radiation), the temperature regimes in these smaller streams has likely improved over the course of the last 5 years of operations under the current Washington Forest Practices Rules. Although the magnitude of changes in stream temperatures for any given stream is difficult to predict, improved canopy cover, an increase in stream bank stability and the amount of large wood, and the reduction of sediment delivery to the stream is anticipated to result in long-term improvements to the temperature regime of most waters supporting bull trout. Sediment reduction as a result of improved road management is also expected to maintain or improve water temperatures over the long-term.

In the short-term, some riparian timber harvest on FPHCP covered lands may likely result in some adverse effects to bull trout from additional increases in temperature along unbuffered portions of Type Np and Ns streams and potentially reaches of Type F streams that occur immediate downstream. This would primarily occur on FPHCP covered lands with currently mature stands.

The Role of Large Wood and Sediment in Maintaining Stream Temperatures

This section addresses the mechanisms by which losses of large wood and increases in sediments can affect stream temperatures. There are other sections within this analysis of effects to bull trout that present a more-detailed description of the effects of large wood and sediment on stream-channel complexity and hydrology, the effects of this HCP on these processes, and the resulting effects to bull trout from alterations in sediment and large wood.

Large wood also plays an important, but indirect role in buffering small streams against temperature changes by increasing the storage capacity of the alluvial aquifer and by contributing to streambed complexity that drives streambed-scale hyporheic flow (Poole and Berman 2000). In headwater streams where bull trout spawn and rear, large wood is important in helping buffer stream temperatures.

In moderate-sized streams buffering against temperature changes occurs through hydraulic forces associated with large wood (Poole and Berman 2000). Aggregates of large wood act as roughness elements that redirect flow, causing avulsions and creating pools, bars, and side channels (Abbe and Montgomery 1996). These hydraulic forces in the proximity of large wood contribute to streambed complexity, including formation of deep pools that can provide cold water refuges and to streambed-scale hyporheic flow, which provides an important source of cold water to maintain or decrease stream temperatures. Several studies have shown that water near the bottom of pools is sometimes 5 to 10 degrees C cooler than water near the surface (Beschta et al. 1987).

It is unlikely that large wood plays a similar role in large streams. Because large streams are generally subject to increased amounts of solar radiation, they exhibit more- substantive diel variation in temperature than do smaller headwater streams which are more-easily shaded (S. Johnson, Personal Communication, 2006).

Increased coarse and fine sediment delivery to streams can lead to increases in stream temperatures through channel widening and loss of pools. For example, decreased amounts of mature riparian vegetation can result in less large wood that falls into the stream; without large wood, sediments can be mobilized and deposited. A decrease or loss in riparian vegetation can also destabilize the streambank, resulting not only in a loss of shade but in an increase in sediments being deposited downstream. In both instances, an increase in sediments deposited in the channel can cause the channel to widen and increase the amount of solar radiation reaching the surface water of the stream. Sediment can also reduce the size and number of deep pools, not only reducing stream complexity but also the availability of cold-water refugia.

Fine sediments can also clog the streambed, leading to a decrease in base flow of cold water by disconnecting subsurface flow paths and diminishing groundwater and hyporheic discharge. In turn, the assimilative capacity of the stream is diminished and an important source of stream cooling is diminished, resulting in an increase in stream temperature (IMST 2004).

In summary, the loss of large wood and streamside vegetation and large increases in sediment, can directly and indirectly affect stream temperatures. For example, pools which allow for habitat partitioning by various species as well as providing cold water refugia, may be altered either by shallowing (increased sediment) or by decrease in complexity (loss of large wood) (Reeves et al. 1997b). Aggregates of large wood can act as roughness elements that redirect flow, causing avulsions and creating pools, bars, and side channels (Abbe and Montgomery 1996). Hydraulic forces in the proximity of large wood continues to contribute to streambed complexity and streambed-scale hyporheic flow in moderate sized streams buffering against temperature changes (Poole and Berman 2000). Large wood also plays a role in capturing and storing sediment. If adequate amounts are not available to capture and store sediment, sediments can clog the streambed disconnecting subsurface flow paths and diminishing groundwater discharge leading to a decrease in base flow. In turn, the assimilative capacity of the stream is diminished resulting in an increase in stream temperature. A decrease or loss in riparian vegetation also destabilizes the streambank resulting in an increase in sediments being deposited downstream. In turn, the deposition of sediments causes the channel to widen increasing the amount of solar radiation reaching the stream.

The potential reduction of large wood from 20-acre exempt parcels and Type Np and Ns streams has the potential to affect the amount of instream large wood in fish-bearing streams. This could decrease habitat complexity, potentially de-stabilize streambanks, and facilitate stream-channel widening. These habitat effects may result in subsequent stream warming near the confluences of Type Np or Ns streams with fish-bearing streams or adjacent to 20-acre exempt parcels. Where fish-bearing streams immediately downstream of these confluences or adjacent to these 20-acre exempt parcels contain bull trout, this stream warming would likely result in some sub-lethal effects. Severity of effects will vary based on available habitat and existing baseline habitat conditions

FPHCP Effects on Riparian Shade

Riparian management zone (RMZ) prescriptions in the FPHCP protect most shade along Type S and F streams by requiring the retention of shade-providing trees within a certain distance of the bankfull width or the channel migration zone. The size of the RMZ needed to meet the shade requirements varies depending on whether the RMZ is located in western or eastern Washington.

In eastern Washington, within the bull trout habitat overlay, all available shade must be retained within 75 feet from the edge of the bankfull width or outer edge of the CMZ (whichever is greater) along Type S or F waters. The “bull trout habitat overlay” includes those portions of eastern Washington streams containing bull trout as identified on the WDFW bull trout map. RMZ’s for Type S and F streams on 20-acre exempt parcels must also meet the 1998 shade requirements which are measured from the bankfull width.

In western Washington, a temperature prediction method is used to determine appropriate shade levels to prevent excessive water temperatures. The temperature prediction method is based on a nomograph that uses elevation, location (eastside or westside), and the water-quality stream temperature standard, either 16 degrees C or 18 degrees C, to predict the amount of shade beyond the no-harvest 50-foot Core Zone that is necessary to achieve those temperature standards. When using the nomograph to predict the amount of shade necessary, no tree within an area as much as 75 feet from the stream can be removed if, according to the nomograph, it provides shade necessary to maintain compliance with state water-quality standards. These water-temperature-specific shade requirements must be met regardless of harvest opportunities provided in the Inner Zone RMZ rules; however, meeting the “Shade Rule” does not mean that all shade is retained, nor does it guarantee obtaining any specific water temperature (e.g., 16 or 18 degrees C) or obtaining water temperatures protective of bull trout.

Washington Department of Ecology has recently revised their water quality standards. Although these standards are more protective of bull trout than the previous Class A/ Class AA standards of 16 degree C and 18 degree C, they have not yet received approval from EPA nor have they been adopted into the Forest Practices Board Manual. In Schedule L-1 of the FFR, the shade requirement on the westside for Type F & S streams is described as that produced by the shade model (nomograph) or, “if model not used, virtually all available shade” (WDNR 2004). As new data becomes available and is reviewed by CMER, or water quality standards change, the nomograph should be updated and modified by the Board. A high priority of adaptive management is to improve the shade model to better predict relationships between shade and temperature at a regional level and at different spatial scales, and update it to reflect current research and any updated water quality standards.

Landowners that meet the requirements of the 20-acre exemption are not required to leave the same riparian buffers as described in the FPHCP for larger private forest lands. In addition to smaller riparian buffer widths and fewer trees, RMZs and calculations regarding the shade requirements for 20-acre exempt parcels begin at the bankfull width. Also, under the rules for 20-acre exempt parcels, the shade rule only applies to the RMZs and not out to 75 feet. Therefore, on Type F streams, the shade rule would only provide additional shade within 29-58 feet of the stream, depending on stream size. Under the standard rules, the RMZs and shade requirements begin at the CMZ and the shade requirements extend out to 75 feet. Implementation of the 20-acre exemption may lead to an increased risk of blowdown and diminishing shade on some streams, especially as streams migrate across their historical channel and may re-occupy areas within or outside the RMZ. The estimate of 20-acre exempt parcels based on the available information ranges from 0.5 percent to 5.8 percent of watersheds, but is likely an underestimate (Rogers 2003). The report acknowledges that the percentages of 20-acre exempt parcels are likely underestimated due to lack of adequate data for statewide analysis. In spite of application of the “Shade Rule”, reduced shade associated with harvest on 20-acre exempt parcels has the potential to affect stream temperatures in Type F as well as Type N streams.

For segments of Type Np streams in western Washington, a 50-foot, no-harvest riparian buffer is required along each side of the stream for the first 500 feet if the Type Np streem is 1,000 feet or greater; or at least 50 percent of its length or 300 feet, whichever is longer, if the Type Np stream is less than 1,000 feet. This buffer will start at the confluence of the Type Np stream to the Type F or S stream. This theoretical upstream distance above a water temperature site where factors, such as temperature and canopy, influence water temperature is known as a “thermal reach” (Sullivan 1993). A thermal reach is a reach with relatively similar riparian and channel conditions for a sufficient distance in order to allow the stream to reach equilibrium with those conditions (Lewis et al. 2000). The length of stream reach required to reach equilibrium will depend on stream size (especially water depth) and morphology (Sullivan 1993). In one study, the distance of similar riparian and channel conditions required to establish equilibrium with those conditions in fish-bearing streams was estimated to be approximately 1,000 feet (Lewis et al. 2000). As described in the **General Effects of the Action – Water Temperature (Heat)** section, the distance needed to reach equilibrium is variable and depends on the substrate, size of the stream, groundwater influences, and other factors. Small streams can equilibrate more quickly (Adams and Sullivan 1990; Caldwell et al. 1991; Sugden et al. 1998; Cristea 2005), especially small streams with alluvial substrate (Johnson 2003, 2004). Equilibration does not mean that these streams attain the same temperature as prior to entering a harvest unit. It means that they reach the temperature they would have been in the absence of such a harvest unit. This will occur as thermal inputs and losses approach a balance.

Buffers are also required around sensitive sites including soil zones permanently saturated from headwall seeps, side-slope seeps, headwater springs that indicate the initiation point of perennial flow of Type Np streams, alluvial fans, or intersection of two or more Type Np streams. If these sensitive sites do not add up to 50 percent of the Type Np stream, then the landowner must buffer additional stream reaches in specified priority areas to ensure at least 50 percent of the Type Np stream length is buffered. In some areas, protection measures for sensitive sites and unstable slope protections will complement Type Np stream RMZ prescriptions and are expected to result in buffers along Type Np streams to range between 50 and 100 percent of their lengths. Given the large degree of variability in the occurrence of sensitive sites and unstable slopes throughout the State, it is difficult to quantify the degree of protection that would result from these features, or the degree of adverse effects.

Within 50 feet of the Type Np streams in eastern Washington the landowner may use either a partial cut or clear-cut management strategy. Once approved, the management strategy implemented will remain in effect until July 1, 2051, regardless of changes in ownership.

For the partial-harvest strategy, the basal-area requirements for a 50-foot RMZ on Type Np streams are the same as those for Type S and F streams and must be met regardless of stream-adjacent parallel roads. This strategy does not provide complete protection of shade. Implementation of the clear-cut strategy requires that the landowner designate a two-sided no-harvest 50-foot buffer along each side of a portion of the stream reach in the harvest unit. The buffer length must be equal to the clear-cut portion of the stream in the harvest unit and must meet the upper end of the basal area requirement of the RMZ inner zone for Type S and F streams in the corresponding timber habitat type. As with the westside Type Np stream strategy, stream temperatures may be increased due to removal of riparian vegetation adjacent to portions of the stream.

The FPHCP assumes that stream temperature increases in these Type Np streams will be attenuated when the water flows through a 300- to 500-foot long, 50-foot wide, no-harvest RMZ at the confluence with Type F streams. However, there is uncertainty as to the actual distance required to achieve that goal, due to variation in the many factors that could affect stream heating. In several studies, cold groundwater, hyporheic exchanges, or tributary inputs have been identified as a factor in daytime cooling in forested reaches downstream of clearings (Brown et al. 1971; Beschta et al. 1987; Story et al. 2003). In other studies, alluvium has been identified as a substantial factor in daytime cooling (Brown 1969; Johnson and Jones 2000; Johnson 2003; and Johnson 2004). An expanded discussion of thermal dynamics involved in stream heating and cooling is contained in the section **General Effects of the Action – Water Temperature (Heat)**.

Although shade does not physically cool a stream down, it can help reduce further heating of the stream and therefore it can maintain the cool temperature associated with groundwater inputs and tributaries. In addition, shade is more effective in controlling the rate of heating in cooler water than in cooling warmer water, and therefore it is more efficient ecologically to use shade to protect cool water from warming than to attempt to cool water that has already been warmed (IMST 2004).

For both the eastside and westside, water that may be warmed as it flows through unbuffered reaches of Type Np streams could affect stream temperatures in fish-bearing streams especially near the confluences of these streams with fish-bearing, headwater streams. Because there would be low to moderate protection of stream shade along Type Np streams, this would likely affect temperature in these Type Np streams. The degree to which temperature increases in Type N streams would affect downstream fish-bearing streams is uncertain and could be influenced by a number of factors, such as distance of harvest unit from fish-bearing streams; previous impacts to the thermal recovery zone including past harvest, debris flows, blowdown, fire, or conversion to other uses; hyporheic and groundwater input; volume of water in both the Type Np streams and the receiving fish-bearing waters; shade provided within harvest unit; and type of substrate.

Water from unbuffered Type Ns streams is likely to adversely affect temperatures in receiving Type Ns, Np, and F streams during the summer months. It is uncertain how shrubs and debris will provide shade to these waters, and therefore, there is a high probability of water temperature increases in Type Ns streams with flowing water in the summer. Where these Type Ns streams flow directly into Type F stream reaches containing spawning and rearing habitat for bull trout, this stream warming will likely result in some sub-lethal effects. Severity of effects will vary based on available habitat and existing baseline habitat conditions

Under the 20-acre exemption rule, minimal buffers are required on streams both with and without fish. Reliance upon the "Shade Rule" along Type F and S streams will not ensure that adverse effects from stream warming are avoided, especially along streams with the potential for channel migration. When 20-acre exempt buffers are required along Type Np streams, they are narrow and subject to a high percentage of harvest and, potentially, windthrow. Many of the trees retained can be deciduous, damaged, and/or small. In fact, only a small portion must be undamaged conifer. The lack of RMZs on both Type Ns streams and certain Type Np streams would produce a high probability of diminished shade and increased water temperatures. These effects could be transferred to downstream fish-bearing waters more easily than the effects on Type Np streams managed under the standard rules because standard rules require additional trees and also require sensitive site protection and a thermal-recovery zone.

Effect of Increases in Stream Temperature on Bull Trout

A well-documented facet of bull trout biology is the species' requirement for cold water (Rieman and McIntyre 1993). Bull trout require a narrow range of cold temperature conditions to reproduce and survive and are regarded as having one of the lowest temperature tolerances among North American salmonids (Selong et al. 2001; Bonneau and Scarnecchia 1996; Goetz 1977).

Species, such as bull trout, that have a narrow thermal "niche" are likely to be affected by even small increases in stream temperatures, particularly summer maximum temperatures (McPhail and Baxter 1996; Dunham et al. 2003). As temperatures increase, the following effects to bull trout may occur: 1) an increased rate of physiological damage, including sub-lethal impacts; 2) changes in the relative abundance of bull trout in relation to other salmonids; 3) reduction in overall abundance; and 4) behavioral adjustments (Saffel and Scarnecchia 1995; Myrick, *in litt.* 2002).

Temperature can influence the abundance and well-being of fish by controlling their metabolic processes. Fish and other aquatic species have optimal metabolic ranges. Increasing stream temperatures result in changes in metabolism because higher temperatures require more energy to sustain increased rates and processes (Johnson and Jones 2000). When stream temperatures are warmed over optimal, the increase in energy required for basic life processes can deplete the energy reserves of individual fish. Conversely, as food availability decreases, optimal temperature for bull trout decreases (lower temperatures require less energy to sustain metabolic rates and processes) (McMahon et al. 2001). The importance of understanding peak-growth temperature at less than satiation rations is related to evidence that bull trout tend to spawn and rear in headwater streams and that these streams in the Pacific Northwest are characterized by low levels of primary and secondary productivity (Gregory et al. 1987). Throughout the entire stream network of the Pacific Northwest salmon fry, eggs, and decomposing carcasses historically were an important source of food and nutrients in streams. With the recent decline of Pacific salmon, productivity of Northwest streams has been further diminished (Cederholm et al. 2000). See **General Effects – Aquatic Community** for additional discussion**.**

As species experience temperatures outside their physiological optimum range, sub-lethal and indirect effects may occur. For example, the composition of species present in a waterbody can change. These changes in composition can result in sub-lethal effects such as increased competition, predation, and disease, and reduced access to coldwater refugia (McCullough et al. 2001; Ebersole et al. 2001). Brook trout are an exotic species that is more thermally tolerant than bull trout. In a study by McMahon and others (1999), bull trout growth declined significantly when brook trout were present, especially at temperatures greater than 12 degrees C. Hybridization and competition with brook trout has been identified as a threat to bull trout populations and are implicated in reducing abundance within bull trout populations throughout their southern range (Dambacher et al. 1992).

Throughout the southern range of bull trout (e.g., within the coterminous United States), there is a consistent relationship between water temperature and the distribution of small bull trout (Dunham et al. 2003). The probability of occurrence for bull trout does not become high (e.g., >0.75) until the maximum daily temperature declines to between 11 and 12 degrees C. As stream temperatures warm there is less suitable habitat available for bull trout, which can result in populations becoming more fragmented as connectivity is disrupted by temperature increases (Dunham et al. 2003; Myrick, *in litt.* 2002).

The temperature requirements of bull trout vary by life-cycle stage, with the young generally being most sensitive to increases in the temperature of their environment (Buchanan and Gregory 1997; Johnson and Jones 2000), while adults are more sensitive to changes in the amount and distribution of thermal refugia as a result of changes in stream temperatures. Thermal refugia is primarily found at the confluence of small or moderate tributaries with larger, more-productive streams, in deep pools, or in areas of hyporheic or groundwater upwelling.

Spawning areas are often associated with cold-water springs, groundwater-infiltration sites, and streams with the coldest summer temperatures (Pratt 1992; Rieman and McIntyre 1993; Rieman et al. 1997; Baxter and Hauer 2000). It is well-documented that spawning is initiated as temperatures drop to 9 degrees C or lower, and increases in temperature during that period can interrupt or postpone spawning activity (Ratliffe and Howell 1992; Sexauer and James 1993; Brenkman 1998; Kraemer 1994). In areas where streams freeze in winter, spawning in groundwater-infiltration areas may actually ensure that the incubating eggs in the gravel remain in relatively constant cold water with little diel fluctuation and are not affected by anchor ice. Survival of bull trout eggs incubated at 2, 4, 6, 8, and 10 degrees C varies and is highest at 2 and 4 degrees C with mortality sharply increasing above 6 degrees C (McPhail and Murray 1979).

Juvenile bull trout survival, growth, and distribution are strongly influenced by water temperature. Numerous studies indicate that juvenile bull trout are associated with cold water and this relationship is most likely a very critical one (McPhail and Baxter 1996). Juvenile fish move far less than sub-adult or adult fish and tend to reside in the same stream segments or local stream networks for several years. Because juvenile bull trout tend to reside in the same area for a number of years, usually in headwater streams, increases in temperature could decrease the amount of thermally suitable habitat within their limited home range (McPhail and Baxter 1996; Rieman and Chandler 1999). Juvenile bull trout are rarely found at temperatures exceeding 15 degrees C (Rieman and McIntyre 1993; Buchanan and Gregory 1997). In their study, Saffel and Scarnecchia (1995) suggest that high water temperatures may be physically constraining to bull trout. This is supported by the findings of McPhail and Murray (1979) where bull trout fry grew larger and had better survival at low water temperatures (4 degrees C).

Although currently there is little information on temperature requirements of sub-adult and adult bull trout, adult fish are generally physiologically less tolerant of elevated temperatures than smaller fish of the same species (Myrick et al. 2002). As bull trout mature, they move to larger rivers, lakes, or marine waters in order to exploit the availability of larger prey items. Although temperatures in these habitats may be elevated during periods of low flow or during the warmest months, these fish are able to exploit the spatial variation of temperatures within a stream and can behaviorally thermoregulate by periodically moving to more-suitable, cooler thermal environments. For example, when water temperatures in the Blackfoot River were unfavorably warm during the summer, non-spawning migratory bull trout used confluences with cold water tributaries, which provided thermal refugia (Swanberg 1997). The purpose of the migrations to these confluence areas was unlikely to be feeding because prey fish densities in tributaries were lower than in the Blackfoot River. When the Blackfoot River cooled, these migrating fish returned to the Blackfoot River. In this case, the larger migratory bull trout were only able to use some habitats (i.e., the Blackfoot River) seasonally. Loss of coldwater habitat can reduce spatial variation within a stream. This loss of spatial variation can reduce the ability of bull trout and other salmonids to escape high temperatures or avoid other detrimental physiological and ecological conditions (Poole et al. 2001). This reliance upon access to patches of cooler stream temperature tends to make migratory bull trout sensitive to changes in the amount and distribution of thermal refugia.

Conclusion

In conclusion, the no-harvest portions of RMZs, the shade rule, and the bull trout overlay will provide a higher level of protection than previous forest practice rules, because shade will be increased in areas where these RMZ practices are applied. However, potential increases in water temperature along unbuffered Type Np and Ns streams might increase the water temperature on some Type S and F streams. Over the permit term, as riparian vegetation in previously or recently harvested areas in the core zone matures and portions of the inner zone are retained after harvest, improvements (further decreases) in the temperature regimes of fish-bearing streams are anticipated.

When reaches of a channel have become exposed to clear-cut harvest, they may warm, in some cases substantially. Temperature increases from harvests along small streams without fish may, in some cases, be transferred downstream to occupied fish habitat. Not all harvests will occur immediately above the sensitive site at the confluence of Type Np and F streams; some harvests will be located further upstream. Across the large FPHCP Action Area, it is likely that some Type Np streams will have the ability to route the additional heat energy to downstream waters. In some cases, the sensitive site at the confluence of Type Np and F streams may be degraded from past harvests, windthrow, fire, debris flows, or forest conversion to other land uses. Additionally, there may be some streams where the extent of fish use is underestimated and fish occur within or closer to harvest units. There is also significant variation in the characteristics of small streams; and the temperatures of some streams will adjust more rapidly than others.

Harvest on 20-acre exempt parcels adjacent to streams can increase the temperature regime in downstream reaches. Typically, 20-acre exempt parcels are located in the rural-urban interface on lower-elevation land. Because bull trout on the westside spawn in fairly low elevation streams (500 foot elevation or greater) some 20-acre exempt parcels may occur adjacent to or above spawning and rearing reaches. Where a number of 20-acre exempt harvests occur adjacent to or upstream of spawning and rearing habitat, especially where they occur within 300 to 500 feet of occupied streams, there is a high likelihood of additional stream warming. This stream warming could interfere with spawning, incubation, rearing, and feeding by young fish. These disruptions would have the potential to reduce the reproduction and survival of individual bull trout. Where 20-acre exempt parcels occur adjacent to foraging, migrating, and overwintering habitat in lower elevation mainstem rivers, these larger rivers are unlikely to be as affected by changes in shade as the smaller streams are. Where the 20-acre parcels are located on Type Np streams that flow directly into foraging, migration, and overwintering habitat, especially where they occur within 300 to 500 feet of occupied streams, the reduction in riparian canopy and associated stream warming may reduce the effectiveness of coldwater refugia within the occupied habitats. Disruption of cold water refugia may interfere with resting, foraging, and other essential functions.

The effects of these temperature increases from the FPHCP would be difficult to measure or quantify, but could be especially important in bull trout watersheds with a high degree of past harvest, where elevated stream temperatures already exist, or where there are a high proportion of Type Np and Ns streams occurring directly above spawning and rearing habitat or adjacent to 20-acre exempt parcels. These temperature increases are expected to be localized in nature and their effects to bull trout are expected to be mainly limited to headwater portions of occupied streams and areas providing coldwater refugia. These adverse effects to the habitat will range from short-term impairment to long-term temperature changes. However, long-term temperature changes are likely to be infrequent and to be associated with changes in channel morphology and hydrology, rather than associated with reduced shade.

Temperature increases from activities covered under the FPHCP are expected to have direct and indirect adverse effects to bull trout ranging from mortality to sub-lethal effects. In cases where temperature increases resulting from forest practices along Type Np streams or adjacent 20-acre exempt parcels can result in increase in the temperature downstream, and these increases are within a local population area where spawning and early rearing occurs, there is a risk that these temperature increases will adversely affect spawning, incubation, and early rearing. Life stages affected by these temperature increases are eggs, juveniles, and spawning adults. Where temperature increases occur in spawning habitats, reduced incubation success could occur (i.e., eggs or embryos killed). If increases in temperature on Type Np streams or adjacent 20-acre exempt parcels occur, and the temperature increases affect the downstream foraging, migration, and overwintering areas, there is the potential to alter the effectiveness of thermal refugia. The life stages most likely affected by this alteration are adult and sub-adult. Temperature increases would likely reduce the reproduction, feeding, and sheltering of individuals in some cases, but would be most severe when it occurs in bull trout spawning and rearing streams that exceed optimal temperature requirements for bull trout.

Increased stream temperature or alterations in cold-water refugia could also reduce the ability of some streams or stream reaches to support bull trout prey species, but would more likely reduce bull trout access to those prey species. Reducing the bull trout’s ability and success at accessing forage in these streams could significantly affect the growth and survival of adult and sub-adult bull trout. Increased temperatures may result in a competitive advantage for certain non-native species, which could reduce reproduction, feeding, and sheltering of individual fish in some stream reaches across FPHCP covered lands.

8.6.3.3 Sediment

FPHCP activities that are expected to generate sediment that could directly and indirectly affect bull trout can be grouped into one of the following two categories: 1) riparian timber harvest and 2) road system management (consisting of construction, reconstruction, relocation, realignment, culvert replacement, maintenance, abandonment, and similar activities).

Riparian Buffers and Stream Bank Stability

Timber harvest, if conducted in close proximity to the streambank can cause the stream bank to fail. Riparian vegetation aids in maintaining stream channel dimensions and bank stability, and affects where erosion and sedimentation of channels and floodplains occurs (IMST 2004). The loss of riparian vegetation along portions of Type Np and Ns streams can lead to the instability and eventual failure of the streambank, thereby delivering sediment to the stream channel. Sediment from streambank erosion is more likely to originate from the unbuffered portions of Type Np streams and the unbuffered Type Ns streams than buffered sections. Although these stream segments have a 30-foot equipment-limitation zone and harvest activities must avoid disturbing stumps, root systems, and any logs embedded in the stream bank, as well as brush and similar understory vegetation, where no riparian buffers are required, harvest can occur up to the edge of the stream. As a result, some habitat impairment within the unbuffered stream segments from sedimentation is expected to occur. In addition, the routing of sediment through streams without fish into fish-bearing waters may also occur, circumventing the effectiveness of riparian buffers on other typed waters (Rashin et al. 1999). Sediment from Type N streams could, in some cases, lead to aggradation and resultant channel widening in Type F streams that are immediately downstream. However, this would ultimately depend on how chronic and abundant the Type N stream sediment sources are that flow into a particular Type F stream.

Riparian prescriptions on Type S and F streams are anticipated to be adequate to prevent excessive (above natural levels) amounts of streambank erosion that could increase the amount of sediment delivery downstream. Downstream delivery of very large amounts of sediment could lead to substantial habitat modification sufficient to increase water temperatures. However, given the riparian prescriptions on Type S and F streams, delivery of that magnitude would require road failures or mass wasting. Riparian buffer widths in the FPHCP vary dependent on site class, size of the stream, whether the stream is fish-bearing or not, and where the stream is located (east or west of the cascade crest). For fish-bearing streams, the FPHCP also divides the riparian buffer into three distinct zones, the core, inner, and outer zones. Riparian management zones are measured from the edge of the bankfull width or the channel migration zone. The degree of riparian influence on the aquatic environment decreases with increasing distances from the stream (FEMAT 1993). Trees closer to the water generally provide greater direct ecological benefits to streams than those further away. Trees in the 50-foot (westside) and the 30-foot (eastside), no-harvest core zone of Type S and F streams and along the buffered portions of Type Np streams are intended to provide the majority of stability to stream banks. According to FEMAT (1993), trees within one-third of a tree height from the channel provide the rooting strength important for maintaining the integrity of the streambank. In most instances, all buffered portions of typed waters meet or exceed this criterion.

Riparian Timber Harvest

Timber harvest and associated activities can be a significant source of sediment if improperly conducted. Rashin et al. (1999) identified several timber harvest activities permitted by the State of Washington's forest practices rules in affect between 1992 and 1995 that contributed significant amounts of sediment to adjacent streams. The study evaluated those selected timber harvest activities to determine their effectiveness at achieving state water-quality standards pertaining to sediment. In summary, the study found that streamside buffers were generally effective at preventing sediment delivery and direct physical disturbance to the stream. Ground-based harvest and cable yarding in the vicinity of streams without buffers was generally found to be ineffective or only partially effective at preventing sediment-related water-quality effects.

The FPHCP has benefited from the study conducted by Rashin et al. (1999) and includes protective measures that regulate the methods of harvest in and near harvest units adjacent to water bodies. The measures include limitations on felling and bucking of timber, use of ground-based equipment, yarding, cable yarding, clearing of slash and debris, and site preparation. These measures are designed to minimize soil disturbance and compaction, reduce the potential for erosion, and minimize the amount of sediments reaching typed waters and wetlands where it could be harmful to bull trout and bull trout habitat. Generally, the amount of sediment generated from timber harvest activities is related to the amount of bare and compacted soils exposed to rainfall and runoff. Measures in the FPHCP that regulate aforementioned timber harvest practices are designed to minimize the amount of exposed and compacted soils close to the stream channel.

Felling and bucking

Limited felling and bucking as described in General Effects section are usually not expected to occur within riparian buffers of fish-bearing streams, and as such, the need for equipment to penetrate these areas will be very limited. Trees that need to be felled within the core zone must be left on the ground, and under most harvest scenarios, only a few trees are expected to be removed from the inner zone. However, in some cases, up to 70 percent of inner zone trees may be removed, so long as retention meets or exceeds stand-level guidelines. Felling and bucking within the outer zone and landward of riparian buffers should result in minimal effects due to the use of directional felling and the distance this activity will occur from typed water bodies. The required directional feeling away from the stream is not expected to contribute much if any sediment to the stream. Sediment generated from felling and bucking adjacent to buffered portions of Type Np streams, although in closer proximity to the stream channel, is also expected to be minor. Felling and bucking along unbuffered portions of Type Np streams and Type Ns streams is likely to result in the delivery of minor amounts of sediment to non-fish-bearing waters. In these situations harvest can occur up to the streambank, although rules prevent activities that would disturb stumps, root systems, logs embedded in the bank, and understory vegetation. A 30-foot ELZ is required along Type Np and Ns streams.

Ground-based Equipment Use

Modest amounts of sediment may be mobilized during yarding by ground-based and cable equipment. Rutting and soil compaction from skidding of logs within riparian zones may result in increased run-off and erosion rates, and thus may result in modest amounts of sediment being delivered to fish-bearing streams. Buffers on fish-bearing streams are expected to be adequate to intercept almost all sediment originating from timber harvest activities on timber harvest units. Where yarding is permitted across streams or equipment enters the 30-foot ELZ, delivery of sediment becomes more problematic. Rashin et al. (1999) in evaluating timber harvest best management practices in place during the summers of 1992 to 1995 in Washington, found that, based on the extent of exposed soil associated with erosion features that delivered sediment to streams, the main causes of erosion at harvest sites were skid trails and other yarding activities.

Cable Yarding

According to Rashin et al. (1999), cable yarding, although a less-frequently used yarding technique, actually produces more relative amounts of erosion than ground-based yarding. This may be due to the steeper terrain in which cable yarding is used. Erosion features at cable-yarding sites had a higher frequency of delivery to streams. Under previous forest practices rules, cable yarding without buffers resulted in sediment routing to the stream. Substantial disturbance of stream channels, valley walls, and steep inner gorge areas by cable yarding practices were observed resulting in chronic sediment delivery and extensive fine-sediment deposition on streambeds.

Under the FPHCP, limitations on cable yarding in and across typed waters and wetlands are intended to minimize soil disturbance and effects to their beds and banks. Cable yarding in or across Type S and F streams is not allowed, except where logs will not materially damage the stream bed, banks, sensitive sites, or the riparian management zones. If permitted, yarding is limited to cable or other aerial logging methods that suspend or partially suspend the logs above the riparian zones. Yarding in or above Type F and S streams also requires a HPA from WDFW that may carry additional restrictions to protect fish and fish habitat, such as limited corridors, specific placement of corridors, bank protection, and large wood placement. Such an HPA would also consider potential soil damage to slopes outside the RMZ that would have potential to deliver sediment. Cable yarding in or across Type A and B wetlands is not allowed without written approval from WDNR and a HPA from WDFW, if required.

When it is necessary to create yarding corridors through the RMZ of Type S or F waters, the corridors must be no wider than or more numerous than necessary to accommodate safe and efficient transport of logs. Generally, this means that yarding corridors should be located at least 150 feet apart and should be no wider than 30 feet. Total openings resulting from yarding corridors must not exceed 20 percent of the stream length associated with the forest practices application. Where logs are yarded from or across RMZs, WMZs, and sensitive sites, reasonable care must be taken to minimize damage to vegetation that provides shade and to understory vegetation, stumps, and root systems. When practical and safe, logs must be yarded uphill, in the direction in which they lay, and away from RMZs, WMZs, and sensitive sites. Where downhill yarding is necessary, reasonable care must be taken to lift the leading end of the log to minimize downhill movement of slash and soils. When yarding is parallel to Type S or F waters, below the 100-year flood level, or within the RMZ, reasonable care must be taken to minimize soil disturbance and to prevent logs from rolling into the water or RMZ. Limiting the use, location, widths, and frequency of yarding corridors is intended to minimize the amount of sediment delivered to typed waters.

Site Preparation

Unbuffered areas may be subject to even-aged harvesting (clear cutting). Uneven-aged harvest techniques utilized within and adjacent to some buffers may also require some site preparation and slash disposal or management before replanting. Various forms of site preparation are conducted to control competing vegetation, reduce fuel levels, and ensure seedling establishment and survival.

No site preparation will occur in the core zone. We expect that only minor site preparation will occur within the inner zone, because many areas will be retained with stocking levels that are not conducive to under-planting and would not provide access for mechanized equipment. What site preparation would occur would likely occur outside the core and inner zone approximately 80 to 100 feet from the stream.

Where scarification does occur, minor amounts of soil compaction and rutting may occur as a result of use of heavy equipment to scarify planting sites. Understory disturbance and disturbance of duff and debris layer would be expected as a direct result of scarification. Small amounts of sediment could be generated as a result of site preparation especially along unbuffered reaches of perennial and seasonal non-fish-bearing streams.

Clearing of Slash and Debris

Large accumulations of slash may contribute to the initiation or exacerbation of mass wasting events (e.g., debris slides and debris torrents), however, these events are expect to be rare occurrences under forest practices rules and FPHCP. Forest practices rules prohibit the machine piling of slash and debris within the 30-foot ELZ of unbuffered stream banks. In addition, limbing and bucking (activities that usually generate slash) are prohibited within the bankfull channel of Type S, F, Np streams, in RMZ core zones, sensitive sites, or open water areas of Type A wetlands. Where slash and debris is expected to plug culverts on Type Np and Ns streams, it must be cleared from the channel for a distance of 50 feet upstream.

There are some benefits to retaining slash and debris. Small woody debris provides cover for juvenile fish (bull trout and bull trout prey species) and may trap leaf litter and other detritus important to aquatic insects. Slash and debris left on flood plains also traps leaf litter and detritus, which subsequently decomposes and enriches the soil. Accumulations of small woody debris and slash may also help moderate fine sediment transport from the forest floor to downstream habitats. To prevent the removal of beneficial woody debris, forest practices rules limit the type and amount of material that can be removed. HPAs are required to remove harvest related slash or debris from Type S and F streams; and, depending on the circumstances, HPAs may be required for slash removal from Type Np and Ns streams. Material removed upstream of culverts to prevent culverts from plugging must be immediately placed downstream or as otherwise required by an HPA. Slash and debris that are excluded from removal include logs that are embedded along their length or at least substantially at one end, and slash buried under stable deposits of soil, rocks, and woody debris. Forest practices rules also prevent the limbing, notching, or removal of logs and trees that are to be left in the stream channel or ones that are firmly embedded.

In most instances, clearing slash and debris will not generate sediment. RMZs are expected to prevent sediment from entering typed waters and prevent the operation of equipment immediately adjacent to typed waters. The 30-foot ELZ under FPHCP does not exclude equipment from operating with in this area, but only limits the amount of soil disturbance to no more than 10 percent of the area. Some soil disturbance, therefore sediment, can be expected when equipment operates along unbuffered Type Np streams and Type Ns streams. Where slash is not required to be removed upstream of culverts (unbuffered portions of Type Np streams and Type Ns streams), culverts could become plugged with debris resulting in culvert failure. Under these circumstances, significant amounts of sediment could be delivered to Type Np and Ns streams. A portion of those sediments may eventually be routed to fish-bearing waters. Requiring that all culverts be capable of accommodating the 100-year flood flow should allow for the transport of most small wood, debris, and slash resulting in fewer culvert failures.

Log Placement

While large wood placement in streams is generally done to benefit the aquatic system as well as the fish species which depend upon those habitats, such actions may have localized adverse effects to bull trout and bull trout habitat. Occasionally, riparian restoration in the form of placement of large woody debris will be proposed as part of an FPA. Placement of large wood requires approval from the WDNR to work in the core zone and an HPA from WDFW to work within the wetted portion of the stream. Board Manual section 26 contains guidelines including limiting log placement to fish-bearing streams, minimum length and width criteria, and specifications for solid wood. Root wads must be placed entirely within the bankfull width. Log jams are encouraged, but are limited regarding their spacing and the number of pieces per jam. HPAs are required for all in-channel placements and may result in additional restrictions and guidelines. For instance, public-safety issues such as downstream bridge or culvert crossings that could reasonably be assumed to be endangered by stream-borne logs may necessitate anchoring of placed wood. Where unavoidable, anchoring is generally accomplished either by placing large boulders on top of the log, burying one end of the log in the bank (sometimes in conjunction with boulder placement), or cabling the log to an anchor (such as a boulder, buried ecology block, screw anchor, or driven anchor bar).

Placement would generally be accomplished in one of two ways: (1) Equipment would be used to place the bole with attached root wad into the stream; and/or (2) the bole would be adequately secured to the bank or bed. Placement of a bole without an attached root-wad will generally require (through HPA restrictions) other methods to secure the piece within the stream as described above. Work using heavy equipment may take 1 or more days and may result in some soil exposure. It is only expected that such placement activities would occur once per rotation, and most likely only once. Power tools and heavy equipment would be used in log placement. Ground disturbance must be less than 5 percent of the reach within the harvest unit. Crawler tractors and rubber-tired skidders are discouraged.

While placement of wood with attached root-wad will provide better stability of large wood, it will also increase the probability of sediment delivery and may generate a short-term sediment pulse or turbidity. Placement of a bole without an attached root-wad will generally require other methods to secure the piece within the stream, is less desirable from a stream-dynamics standpoint, but may result in less short-term sediment delivery.

Within the stream, the substrate may be disrupted by movement and positioning of logs. Following placement, large wood may not remain in place and may migrate downstream, having positive and/or negative effects lower down in the stream system. This potential for movement is especially true for large wood placed without attached root wad, and may be true even if secured in other ways. Large wood that remains in place is expected to alter the dynamics between predatory and prey fish, increase the amount of local sediment deposition and result in a temporary storage of that sediment, and act as a host site for aquatic invertebrates.

Effects regarding sediment from log placement are expected to occur to foraging, migrating, incubating, or rearing bull trout and their habitat, and to the forage species supporting these life stages. The effects are anticipated to be short-term and occur mostly during and immediately following log placement, with some additional effects becoming manifest with the first rains following placement.

Summary of Riparian Timber Harvest

In summary, activities associated with riparian timber harvest under the FPHCP have the potential to generate sediment that could enter fish-bearing streams directly or when routed through streams without fish. Sediment generated during timber harvest can generally be prevented from entering typed waters when riparian buffers of adequate widths are used. Based on observations of erosion and sediment routing from several different harvest practices (including skid trails) over a range of topographic conditions in both eastern and western Washington, Rashin et al. (1999) suggested that a 10–meter equipment-exclusion zone for ground-disturbance activities would prevent sediment delivery to streams from about 95 percent of harvest-related erosion features. Gomi et al. (2005) found that streams with buffers ranging from 10 to 30 meters wide had relatively small increases in sediment yield from physical disturbances (i.e., tractor yarding).

The 30- to 50-foot, no-harvest core zone along fish-bearing waters is expected to be adequate to prevent sediment from entering typed waters and prevent soil compaction adjacent to typed waters (CH2MHill 2000). Similarly, 50-foot buffers when required along Type Np streams should also be adequate to filter sediment from riparian timber harvest activities and prevent soil compaction within 50 feet of the stream. Only a 30-foot ELZ is require along unbuffered reaches of Type Np and Ns streams. The 30-foot foot ELZ in the FPHCP does not exclude equipment from operating within this area, but only limits the amount of soil disturbance that can occur without mitigation to no more than 10 percent of the harvest area adjacent to unbuffered Type Np and Ns streams. Washington Forest Practices Rules do prevent activities that would disturb stumps, root systems, logs embedded in the bank, and understory vegetation. Some soil disturbance can be expected when equipment is operated along unbuffered Type Np streams and Type Ns streams; therefore, some level of sediment would also be generated, especially in circumstances where less than 10 percent soil disturbance occurs and goes unmitigated. If the 10 percent criteria is exceeded, erosion-control mitigation measures are required, and we anticipate that they will attempt to address the total amount of ground disturbance.

Where sediment generated immediately upstream enters Type F streams containing bull trout, we anticipate a range of sub-lethal to lethal adverse effects to individual bull trout depending on life stage using the area and baseline habitat conditions.

Road System Management

Roads

Logging roads are particularly important factors affecting surface erosion and subsequent stream sedimentation. Surface drainage concentrated within roadside ditches, that is not dissipated or redirected to reduce its effects can lead to erosive cuts (resulting in soil erosion and stream sedimentation) and concentrated water flow onto slopes that may exceed a slope’s capacity to hold the weight (resulting in mass soil movements or landslides). Surface erosion on gravel roads also can lead to high levels of suspended sediment moved into streams. Inadequate road designs, such as inappropriate placement of backfill, undersized culverts, and other factors, can lead to mass-wasting events such as land slides or debris torrents. During periods of heavy rainfall, roads and ditches can become temporary stream systems, speeding water runoff into streams and reducing water absorption into forest soils.

Roads modify natural drainage networks and accelerate erosion processes. These changes can alter physical processes in streams, leading to changes in stream flow regimes, sediment transport and storage, channel bank and bed configurations, substrate composition, and stability of slopes adjacent to streams.

These changes can have important biological consequences, and they can affect all stream-ecosystem components (Furniss et al. 1991). Road construction can also causes the stream-channel network to increase, because the roads act as tributaries, creating a more efficient sediment delivery system (Castro and Reckendorf 1995). McCashion and Rice (1983) found that logging roads were responsible for 61 percent of the soil volume displaced by erosion in northwestern California. Forest roads are considered the most-detrimental forest-management operation to forest soil and water quality, perhaps accounting for 90% of sediment yield for forest lands (Megahan 1972b, 1974).

Severe erosion is almost inevitable if roads are not properly constructed and regularly maintained. Road construction and maintenance associated with timber harvest typically increases the amount of sediment delivered to streams through surface erosion, as compared to natural delivery rates. Roads can rarely be constructed that do not have adverse effects to streams (Furniss et al. 1991). Roads constructed within riparian areas and parallel to streams typically have pronounced adverse effects to aquatic systems, compared to roads built in other locations. In particular, stream crossings pose the greatest risk to fish habitats of any road feature. When culverts are plugged by debris or overtopped by high flows, road damage, channel realignment, and severe sedimentation can occur (Furniss et al. 1991). Failure to properly maintain road drainage can also result in large sediment inputs to streams (Furniss et al. 1991). "Roads, which are the major source of management-related sedimentation in streams associated with logging regionally, continue to have adverse effects to stream communities even when not actively utilized"; they continue to contribute high sediment loads until they are stabilized and/or abandoned (Cederholm and Reid 1987).

Existing and future roads are expected to be the single greatest source of sediment input from covered lands. Upgrading the existing road network, constructing new roads to higher standards, and abandoning old roads are not expected to completely eliminate the road network as a significant source of sediment in the near-term or long-term, but implementation of these measures should result in substantial reductions in sedimentation. A selection of watershed analyses from Washington State indicate that 70 to 85 percent of the road mileage does not contribute sediment to streams (Anderson 1996; McGreer 1997; Toth 1998). A similar study of State and private lands in western Oregon indicated that 61 to 71 percent of roads did not directly contribute sediment to streams (ODF 1996). The results of these studies show that roughly only 15 to 40 percent of the roads in a basin deliver sediment to streams. Developing and implementing RMAPs to address roads, especially those that contribute sediment to streams, will reduce the amount of sediment being delivered to streams.

CH2MHill (2000) modeled sediment production and delivery from three surface-erosion assessments conducted before and 5 years after developing and implementing road maintenance and abandonment plans. Results show that sediment delivery in the Chehalis, Stillman, and Taneum watersheds was reduced by 48, 34, and 44 percent, respectively, within 5 years after applying newly adopted road standards. Although each watershed is unique and road maintenance and abandonment plans varied, the results provide a reasonable indication of the expected benefits from implementing such road plans.

Regular road use can cause chronic sediment inputs to streams. Heavily used roads caused up to 130 times more sediment production that abandoned roads (Ried and Dunn 1984), and even unused roads can cause some sediment delivery. Reid and Dunne (1984) found that gravel forest roads generated up to 300 tons of sediment/mile/year from surface erosion in the Olympic Mountains of Washington. They also found sediment loss was found to be related to traffic intensity and was highest on heavy-use gravel roads compared to unused roads or paved roads. Sediment yield from cutbanks and ditches alongside paved roads was less than 1 percent of that from gravel roads in their study. Heavily used roads were calculated to produce up to 300 tons of sediment/mile/year over the period of study, compared to lightly used roads with 2.6 tons/mile/year and paved roads with 1.4 tons/mile/year. Therefore, it can be concluded that steps to manage traffic volume can substantially reduce sediment generation and subsequent delivery.

Roads generally accelerate soil-erosion rates due to surface erosion and mass soil movement such as slumps and earth flows, debris avalanches, debris flows, and debris torrents. High rates of stream sedimentation result from this increased erosion. Furniss et al. (1991) found soil erosion rates were 30 to 300 times higher on forests with roads than undisturbed forest. Roads can also alter stream flow rates and volumes, which along with increased sedimentation, resulted in altered stream channel geometry (Furniss et al. 1991). Acting as new flow paths for water, roads increased the channel network over watersheds, increasing the drainage density. By increasing the frequency, magnitude, and altering the composition of debris flows, road-caused erosion and delivery can affect the long-term potential for developing complex channel morphology and aquatic habitat (Jones et al. 2000).

Road abandonment adjacent to streams can also result in adverse effects to bull trout and their habitat through sedimentation of spawning and rearing habitat, degraded water quality (turbidity/contaminants), and direct injury to fish from heavy equipment used for instream work (e.g., culvert removal). Adverse habitat effects associated with these activities are generally short-term (i.e., periodic sediment inputs for up to 12 to 18 months, before vegetation becomes established on disturbed sites). Road abandonment or full decommissioning if properly done, however, will ultimately reduce the potential for excess sediment delivery to streams from roads and would eliminate further impacts of road use. On that basis, road abandonment or full decommissioning is generally considered to have long-term beneficial effects to bull trout habitat. Road abandonment is one option for addressing road-related sediment impacts. Road abandonment is not required by FPHCP. Although, it is likely that when it is used, road abandonment will address roads within the riparian zone of typed waters that are chronic sources of sediment. These roads are more likely to deliver sediment to streams and would be the roads that are more difficult to address using road maintenance BMPs. It should also be noted that the FPHCP and associated Permit will allow abandonment to occur in situations where avoidance of take might have precluded abandonment activities.

The condition of roads on FPHCP covered lands is a concern when public resources, including bull trout and bull trout habitat, are affected. Forest roads have been identified as a major source of sediments being delivered to streams and wetlands in Washington’s forests (WDNR 2005). The draft Bull Trout Recovery Plans for both the Coastal-Puget Sound and Columbia River population segments cite existing logging roads as a significant source of sediment that has contributed to declining bull trout populations and the loss or degradation of suitable bull trout habitat in most of the core areas throughout Washington (USFWS 2002).

Implementation of the FPHCP is expected to substantially reduce road-related erosion and sediment delivery from current and future roads relative to current levels of sediment delivery, both in the near-term (< 10 years) and over the long-term (10-50 years). Near-term reductions from existing sources are expected to result largely from implementation of RMAPs on large forest landowner lands. All roads owned and managed by large forest landowners must be improved to meet forest practices standards by the end of 2016. These standards require that roads be disconnected from the stream network through the installation of drainage structures, that road fills susceptible to mass wasting be removed, and that stream-adjacent parallel roads be repaired and maintained, or abandoned. Sediment reductions from small forest landowner lands will occur at a different rate. Therefore, sediment reductions accrued from small landowner lands will likely be distributed over a longer timeframe.

In cases where roads on small forest landowners' lands, or on 20-acre exempt parcels, are causing or have the potential to cause damage to public resources, WDNR can, at any time, require the landowner to take corrective actions to minimize and mitigate the effects. We expect WDNR will be using this authority to significantly reduce the period of time that ongoing, chronic effects remain uncorrected. Approximately 40 percent of covered lands are owned by small forest landsowners. Timberlands owned and managed by many of the small forest landowners (including those who meet the 20-acre exception) are less likely to be adjacent to the headwater streams that support much of the known bull trout spawning and rearing habitat. Large forest landowners are more likely to own and manage timber lands in areas where bull trout spawn and rear.

Under the FPHCP, a series of Best Management Practices (BMPs) (Washington Forest Practices Board 2002) are intended to guide the forest landowner in meeting road-related construction and maintenance obligations via the implementation of the Washington Forest Practices Rules. The primary focus of the BMPs is to protect water quality; to protect aquatic, wildlife, and riparian resources; and to help prevent potential and actual road-related resource damage. To ensure that resources are being adequately protected, landowners are required to apply the appropriate road-related BMPs necessary to address water and sediment delivery, fish passage, sub-surface flow, and natural drainage characteristics when constructing, reconstructing, and/or maintaining roads on their ownerships. BMPs have been specifically developed for road location and design; road construction and reconstruction; compacting and stabilizing embankment and waste materials; landing location and construction; road use; general road maintenance; and road abandonment. Although these BMPs will significantly reduce and minimize impacts to bull trout and their habitat, they will not avoid or eliminate all impacts. For a complete description of road-related construction activities refer to section on **Description of Activities that are Effects of the Permit -- Road Management,** or refer to Title 222WAC or the Forest Practices Board Manual.

The premise behind the road construction and maintenance program in the forest practices rules and the FPHCP is that a well-designed, located, constructed, and maintained system of forest roads is essential to forest management as well as the protection of public resources. To protect public resources such as fish habitat and water quality, roads must be constructed and maintained in a manner that will prevent potential and actual damage. This will be accomplished by constructing and maintaining roads so as not to result in the delivery of sediment and surface water to any typed water in amounts, at times, or by means that preclude achieving desired fish habitat and water quality goals. These goals are to be achieved through the following objectives: 1) providing for fish passage at all life stages; 2) preventing mass wasting; 3) limiting delivery of sediment and surface runoff to all typed waters; 4) avoiding capture and redirection of surface or ground waters; 5) diverting most road runoff to the forest floor; 6) providing for the passage of some woody debris; 7) protecting streambank stability; 8) minimizing the construction of new roads; and 9) abandoning old roads.

Although, the FPHCP is expected to substantially reduce road-related sediment inputs over the near term (10 years) and the long-term (10-50 years), the overall effect may be difficult to quantify in individual watersheds. The effects of decreasing the amount of sediment being delivered to typed waters via improving the existing road network, constructing new roads to higher standards, and abandoning unnecessary roads may not be readily apparent in watersheds where streams have already been substantially degraded by historic road management. In other, less degraded watersheds, these same actions are expected to lead to the recovery of aquatic habitat from the effects of historic road management more quickly.

In summary, the FPHCP area currently has over 60,000 miles of mapped roads, which yields an average road density of 4.1 miles per square miles on FPHCP covered lands. According to our GIS analysis, about 9 percent of these roads occur within a distance equal to a 100-year site-index tree height (averaged for Site Classes 2 and 3) of Type S, F, or Np streams. In addition, there are over 130,000 road-stream crossings in the FPHCP, including over 18,000 crossings on fish-bearing streams. Of these 18,000 road crossings, approximately 570 cross known bull trout spawning and rearing habitat (190) or bull trout FMO habitat (380). An additional ten crossings are unknown. Stream-adjacent parallel roads (those roads within a 100-year site-index tree height) and stream crossings are the two features on FPHCP covered lands that are most likely to deliver sediment to streams. Where sediment generated at these locations enters Type F streams containing bull trout, we anticipate a range of sub-lethal to lethal adverse effects to individual bull trout depending on life stage using the area and baseline habitat conditions.

The implementation of RMAP's on large forest landowners' lands through 2004 has resulted in 1,217 structures being removed or replaced and 705 miles of fish habitat being opened to fish passage. During the same time period, 40 passage barriers on small forest landowner parcels have been replaced under the Family Forest Fish Passage Program opening up 60 miles of fish habitat (Washington Forest Protection Association 2005). Short-term sediment releases will likely be associated with the replacement of road-crossing structures. These sediment releases could have short-term adverse effects to aquatic organisms including bull trout (if located in bull trout habitat), but new structures properly sized and correctly installed and maintained are expected to help minimize sediment delivery to streams over the term of the FPHCP and open up new stream habitat. Short-term adverse effects from sediment to bull trout will be reduced due to timing restrictions for construction and fish relocation efforts prior to replacement.

Road-generated sediment could adversely affect eggs and alevins in the gravel. The effects of suspended sediment deposited in a redd may include reduction in water flow, smothering of eggs or alevins, and/or impeding fry emergence. Additional effects may occur to foraging, migrating, and rearing bull trout and their habitat, and to the forage species supporting these life stages. Reducing the amount of sediment being delivered via the road network will minimize these adverse effects and lead to improved habitat condition over time.

Stream Crossings

Fish-passage barriers located at culverted crossings are typically created by one or a combination of several conditions. Improperly designed or placed culverts do not have the roughness and natural variability of stream channels and therefore do not dissipate energy as readily. In many instances high water velocities amplified by undersized culverts have created large scour pools at the culvert discharge point, altering the stream elevation below the natural gradient (i.e., downcutting). Over time, culverts become elevated or perched above the stream and create a physical barrier to fish passage. In other cases, water also drains under and around culverts, and migrating fish attempting to follow these flow paths can become stranded or impinged against the culvert or road fill.

In addition to allowing for fish passage for all age classes of bull trout, the replacement or removal of fish-blocking culverts should result in more-naturally maintained stream hydraulics, including bedload movement, sediment transport, and passage of moderately-sized woody debris, leading to more-natural stream dynamics and stream geometry. The overall impact of this requirement of the FPHCP on bull trout and bull trout habitat is expected to be beneficial because it will restore spatial and temporal connectivity of waterways within and between watersheds where movement of fish and habitat elements are currently obstructed. This will allow bull trout to access areas critical for fulfilling their life-history requirements, especially foraging, migration, spawning, and rearing, and help restore natural habitat-forming processes.

Although the overall effect of restoring fish passage and more of the natural stream dynamics to stream systems statewide is beneficial, the on-the-ground construction activities employed to correct fish-passage barriers can result in adverse effects to all life-history stages of bull trout. Sedimentation and turbidity will occur from heavy-equipment operation on access roads, excavation areas, and fill locations by exposing, destabilizing, and/or compacting streambanks, streambeds, and riparian soils. Additional sedimentation may occur from excavating the roadfill, backfilling, bank armoring, clearing and restoring the riparian area, culvert maintenance, and restoration of streambeds following high-flow events, as needed. Sediment can be expected to be generated as the existing culvert is excavated, the work area is enlarged, and the new structure is installed and buried.

Sediment inputs into aquatic systems may result from a variety of actions associated with removing and replacing fish barriers caused by culverts. These include the initial redirection of a stream back into its channel, disturbance of the bank and riparian area by construction and restoration activities, operation of heavy equipment at the work site, and the re-mobilization of sediments accumulated upstream of previous fish barriers during post-construction flows. In addition, sediment may be generated during the installation of large wood, boulders, spawning gravels, or other mitigation as required by the FPHCP or other permits.

The effects of sediment to the aquatic environment and bull trout during construction are expected to be minimal when the construction occurs in dewatered streams and when other best management practices (BMPs) are being implemented at each construction site. However, rain events during and after the construction period will likely mobilize sediment into the stream, even with sediment-control measures in place, as sediment-control measures are not always effective at precluding sediment deposition into streams (Rashin et al. 1999). As a result of changes in gradient, sediment stored behind the old culvert may also be mobilized and transported downstream. Several rain events may be necessary before all the sediment is mobilized and redistributed downstream of the culvert. The removal or replacement of culverts may also, in some cases, result in head cutting upstream of the project. Culverts may be acting as a stable nick point or gradient control, preventing the upstream migration of reach-scale channel incision. Should headcutting occur, this could result in loss of instream and riparian habitat due to channel instability, accelerated streambank failure, and increased sedimentation. Such impacts are likely to occur until equilibrium is reached. In most cases, we do not anticipate that headcutting will occur and, when it does occur, the extent of such headcutting is expected to be localized. However, where it does occur in spawning and rearing reaches for bull trout, we anticipate that spawning and rearing habitat may either be permenantly lost or made unsuitable for a period of time until naturally restored after a new channel equilibrium is reached.

The WDNR in consultation with WDFW, incorporates work-timing windows into forest practices applications to minimize impacts to salmonids. Work-timing windows are considered to be time periods when in-water work can be conducted because salmonids are at a stage in their life cycle when they are least sensitive to disturbances such as sediment or are least likely to be present at or near the work site. This is typically outside of the spawning or egg incubating period. Work-timing windows allow the fish to either move away from impacts or to better cope with short-term, minimal changes to the habitat and/or decreased water quality. The work-timing windows are usually between July and September, but can be further adjusted to meet site-specific circumstances. Timing windows may reduce adverse effects to spawning fish and egg incubating periods, but there still may be some adverse effects to juveniles, sub-adults, and adults. Not all adverse effects can be avoided via timing windows.

Effects to Bull Trout from Increased Sediment

Bull trout have spatially restrictive biological requirements at the individual and population levels (USFWS 1998b). Even though migratory life-history forms of bull trout may use much of a river basin or inhabit salt water throughout much of their adult life; spawning, rearing, and resident fish often live only in smaller watersheds or their tributaries (second- to fourth-order streams)(Rieman and McIntyre 1993). Resident bull trout inhabit the same streams or nearby tributaries in which they were hatched. Fluvial bull trout spawn in tributary streams where the young rear from 1 to 4 years before migrating to a river where they grow to maturity. Adfluvial bull trout spawn in tributary streams, and after rearing, migrate to a lake (Fraley and Shepard 1989). Anadromous bull trout spawn in tributary streams, but major growth and maturation occurs after migration to salt water. Their affinity to spend vulnerable life stages in headwater or tributary streams may make bull trout particularly susceptible to environmental changes such as sediment deposition. Under natural conditions, headwater streams tend to be less turbid than mainstems and estuaries (faster-flowing water transports suspended sediments downstream more quickly) (Bash et al. 2001). Headwater streams respond more quickly to changes in sediment loading because small streams have limited energy to transport the sediment and the distance from the sediment source to the stream is short (USFWS Native Fish biological opinion). Additionally, the patchiness of turbidity, both spatially and temporally, influences how salmonids, including bull trout, use a river system at various life stages (Sedell et al. 1990).

There is limited information on effects of suspended sediment specific to bull trout. There is generally more information of effects of suspended sediment on other salmonids; however, the body of this information is mainly restricted to effects to spawning and early-rearing stages. Increases in suspended sediment can affect salmonids in several ways (Rhodes et al. 1994). The effect of sediment beyond natural background conditions can be fatal at high levels. Noggle (1978) reported that extremely high concentrations of suspended sediments can cause fish mortality through gill abrasion. Fish may avoid high concentrations of suspended sediments altogether (Hicks et al. 1991). Coho salmon were observed avoiding excessive turbidity levels when less turbid water was easily accessible (Bisson and Bilby 1982). Harvey and Lisle (1998) disclosed that high concentrations of suspended sediment can affect survival, growth, and behavior of stream biota. Slight elevations in suspended sediment may reduce feeding efficiency and growth rates of some salmonids. At lower concentrations of suspended sediment fish may decrease feeding and at higher concentrations may cease feeding completely (Sigler et al. 1984). Noggle (1978) observed that feeding rates of coho salmon decreased when turbidity levels reached certain thresholds. Suspended sediment may alter food supply by decreasing abundance and availability of aquatic insects; however, the precise thresholds of fine sediment in suspension or in deposits that result in harmful effects to benthic invertebrates are difficult to characterize (Chapman and McLeod 1987). Sigler and Bjornn (1980) observed an inability of smaller coho fry reared in turbid water to compete for food and space with their larger cohorts reared in clear water.

Everest et al. (1987) indicated that the effects of deposited fine sediments on salmonid production in a given stream are a complex relationship among many variables that precludes generalization about effects of sediment on salmonid production. It has been well-established that high levels of deposited sediments in spawning gravels (12 - 20 percent typically) can increase mortality of salmonid eggs and alevins by reducing water flow through spawning gravel. Eggs can be suffocated and fry prevented from emerging from the gravel. Levels of fine sediment in streambed gravels have been negatively correlated with salmonid embryo survival (Cedarholm et al. 1981; Tappel and Bjornn 1983) and the quality of juvenile rearing habitat (Bjornn et al. 1977). Although bull trout generally have a narrow, specific spawning habitat requirement and, therefore, spawn in only a small percentage of the stream habitat available to them (MBTSG 1998), they seem to be slightly more tolerant of sedimentation during development and emergence than other salmonids. It has been reported that survival of bull trout embryos through emergence appears to be unaffected when the percentage of fines comprise up to 30 percent of the streambed. However, at levels above 30 percent, embryo survival through emergence drops off sharply with survival below 20 percent for substrates with 40 percent fine material (Shepard et al. 1984). Weaver and White (1985) found 50 percent survival to emergence in substrates that contained 10 percent fines, compared to 80 percent survival when no fines were present. Weaver and Fraley (1991) also observed an inverse relationship between the percentage of fine sediment in substrates and survival to emergence of bull trout embryos. They found that any increases in fine sediments within spawning areas over natural background concentrations could significantly reduce the emergence success of bull trout fry. Entombment was the major mortality factor in these tests. Densities of juvenile bull trout were found to be lower in areas of high sediment levels and embeddedness (MBTSG 1998). Because of their close association with the substrate, juvenile bull trout distribution and rearing capacity are affected by sediment accumulations (Baxter and McPhail 1997).

Bull trout are apex predators that prey on a variety of species including terrestrial and aquatic insects and fish (Rieman and McIntyre 1993). Fish are common in the diet of individual bull trout that are 4.3 inches (110 millimeters) or longer. Large bull trout may feed almost exclusively on fish. Therefore, when analyzing effects of sediment on bull trout, it is very important to consider other fish species. While sediment may not directly affect bull trout, the increased sediment input may affect the spawning habitat and population levels of species such as Chinook and coho salmon, coastal cutthroat and steelhead trout, mountain whitefish, and various sculpin (cottid) species, which are potential prey species for bull trout.

Distance of prey capture and prey capture success both were found to decrease significantly when turbidity was increased (Berg and Northcote 1985). Waters (1995) states that the loss of visual capability leading to reduced feeding, is one of the major sub-lethal effects of high suspended-sediment levels. Increases in turbidity was reported to decrease the percentage of prey captured (Bash et al. 2001). At 0 NTUs, 100% of the prey items were consumed; at 10 NTUs, fish frequently were unable to capture prey species; at 60 NTUs, only 35% of the prey items were captured. At 20 to 60 NTUs, significant delay in the response of fish to prey was observed. Loss of visual capability and the ability to capture prey leads to depressed growth and reproductive capability.

Downstream migration by bull trout provides access to more prey, better protection from avian and terrestrial predators, and alleviates potential intraspecific competition or cannibalism in rearing areas (MBTSG 1998). One of the benefits of migration from tributary rearing areas to larger rivers or estuaries is increased growth potential. However, increased sedimentation may result in premature or early migration of both juveniles and adults, avoidance of habitat, and migration of non-migratory, resident bull trout. Migration exposes fish to many new hazards, including passage of sometimes difficult and unpredictable physical barriers, increased vulnerability to predators, exposure to introduced species, exposure to pathogens, and the challenges of new and unfamiliar habitats (MBTSG 1998). High turbidity may delay migration back to spawning sites by interfering with cues necessary for orientation, although turbidity alone does not seem to affect homing. Delays in spawning migration and associated energy expenditure may reduce spawning success and, therefore, population size (Bash et al. 2001).

Conclusion

The major source of sediment from riparian timber harvest activities can be expected to occur when sediment that enters unbuffered portions of Type Np streams and Type Ns streams is subsequently routed to fish-bearing streams. Effects from sediment generated by riparian timber harvest activities may occur to foraging, migrating, and rearing bull trout and their habitat, and to the forage species supporting these life stages. This sediment could also adversely affect survival of eggs and alevins in the gravel. The potential sub-lethal and lethal effects of suspended sediment deposited in redds may include reduction in water flow, smothering of eggs or alevins, and/or impeding fry emergence.

Generally, there is a low probability of direct mortality to bull trout from sediment due to restoring fish barriers. Outside of an emergency, the work will most likely be performed when bull trout are least likely to be present based on in-water timing restrictions. However, bull trout are found in some locations at all times of the year and therefore, in some situations bull trout could be directly affected by an increase in suspended sediments.

Due to in-water timing restrictions, any major input of sediment generated during in-water construction activities such as log placement or culvert removal would generally not occur during the bull trout spawning period. Although this will typically avoid direct impacts to spawning adults and incubating eggs, spawning habitat may still be degraded as a result of sediment generated during construction activities. Spawning habitat and potentially redds could also be adversely affected by post-construction sediment releases that could enter the stream during subsequent high flows from either areas disturbed during construction or from sediment that has accumulated behind the fish barrier. As disturbed areas and the channel itself begin to stabilize, the amount of sediment generated during high flow events is expected to subside to background levels. With most sites, this is expected to occur within the first year or two following construction. Where suitable spawning habitat exists downstream of a fish barrier, sediment mobilized as a result of removal and/or restoration of the fish passage barrier could be deposited on bull trout redds and result in egg and alevin mortality. It is more likely that only spawning habitat would be degraded as timing restrictions would prevent construction during spawning or egg incubation, but subsequent erosion of exposed surfaces could affect redds and alevins. An emergency replacement could be an exception to this general rule. Sediment from roads, especially stream-adjacent parallel roads could adversely affect all life stages. Sediment entering bull trout streams, generated from road construction and use, could be deposited on spawning or juvenile rearing areas. Increased sediment could result in changes to channel morphology, and habitat could be reduced due to shallowing and filling of pools, and filling of streambed interstitial spaces. Feeding and rearing behaviors may be significantly affected under some circumstances, affecting individual fish fitness and survival. Siltation of spawning reaches could reduce egg and embryo survival. However, the FPHCP is not expected to significantly contribute to instream sediment loading to the point that bull trout would be impaired at more than a stream reach scale.

In FMO habitats, the potential effects from sediment are to sub-adult and adult life stages and their habitat, and to the forage species supporting these life stages. Fish movement may also be obstructed temporarily by increases in the amount of suspended sediment. However, depending on the location of the activity, the likelihood and the number of bull trout being present will be reduced by the use of restrictive timing windows used for in-water activities. Until stabilized, sediments from a construction site may enter a stream following the first rains (post-construction) when bull trout are more likely to be present. In some locations, bull trout are likely to be present at all times. It is also possible that newly installed and properly designed culverts can still fail during heavy rainfall events. This is expected to be less likely under the FPHCP and once old culverts are replaced using the new fish-passage standards. Regardless, culvert failure is still expected to occur on a limited basis and the results of such failure can have significant localized effects on bull trout and bull trout habitat. Depending on the timing and location of a culvert failure, which cannot be predicted, bull trout individuals and/or redds could be adversely affected, resulting in mortality of eggs, aelvins, and juveniles. Spawning and rearing habitat could also be affected by excess amounts of sediment with such effects lasting one or more spawning seasons.

In the absence of detailed local information on population dynamics and habitat use, any increase in the proportion of fines in substrates should be considered a risk to the productivity of habitat and to the persistence of associated bull trout populations (Suttle et al. 2005; Rieman and McIntyre 1993). For a general and more complete discussion of the effects of sediment on fish and fish habitat including bull trout and bull trout habitat, the reader should refer to **General Effects -- Sediment Effects** section of this Opinion.

8.6.3.4 Detritus

Detritus or organic litter includes leaves, needles, cones, twigs, bark, propagules, and other small plant materials. Leaves and other organic matter entering streams contribute to nutrient cycling and support food chains and aquatic community structures. Stream microbial communities, algae, and invertebrates encrust fallen litter, and then the litter is slowly decomposed. These processes provide nutrient and energy sources to fish and other animals that ingest them. Terrestrial sources of organic matter compose the largest proportion of the energy base for many smaller streams. In addition to providing energy and nutrients to streams, fallen organic litter and partially decomposed humus in riparian areas may intercept muddied waters and catch silt, and may provide food and cover for aquatic insects.

Organic litter inputs to streams are important food and energy sources for a variety of organisms that, in turn, provide food and energy for fish and other aquatic organisms. Also, organic litter influences water quality and habitat quality in riparian areas. Forest practices have the potential to affect organic-litter generation and transport from riparian forests to aquatic areas.

Although streamside litterfall is highly localized, stream transport systems readily move litter within streams from source areas to sink areas (Newton et al. 1996). Richardson (1992) estimated that 70 to 94 percent of all leaves that enter a stream segment are transported downstream until stored in a large pool or lake. Gregory et al. (1987) indicated that the greater the roughness elements (e.g., boulders, gravels, wood, roots) of a stream and the lower the hydraulic energy, the greater the retention of litter input. Thus, areas having large amounts of existing woody debris may retain more of the additional litter input.

Conclusion

These findings suggest that some litter input to upstream headwater reaches may contribute to downstream segments that support fish. Within watersheds, upstream litter source areas tend to compensate for areas where litter inputs are low. The overall importance and magnitude of this upstream contribution to litter input is not known, but they probably vary among watersheds with varying physiographic and biological conditions. Because it is expected that detrital inputs to fish-bearing streams would come from areas both adjacent to fish-bearing streams as well as upstream of fish-bearing streams, the change in inputs along individual stream segments without fish should not have a substantial effect on the quantity and quality of detritus in fish-bearing streams.

8.6.3.5 Habitat Access

<u>Fish-passage barriers</u>

Some fish habitat on FPHCP covered lands is currently inaccessible due to human-caused blockages at road crossings. Constricted flows at culverts or bridges resulting in fish blockages are largely due to poor installation, undersized structures, or neglected maintenance. In many instances, high water velocities amplified by undersized culverts have created large scour pools at the culvert discharge point, altering the stream elevation below the natural gradient. Over time, culverts become elevated above the stream and create a physical barrier to fish passage. In other cases, water also drains under and around culverts, and migrating fish attempting to follow these flows can become stranded or impinged against the culvert or road fill.

Migratory corridors allow individual fish access to unoccupied but suitable habitats, foraging areas, and refugia from disturbances (Saunders et al. 1991). Maintenance of migratory corridors for bull trout is essential to provide connectivity among local populations, and enables the re-establishment of extirpated populations (FWS 2004). Where migratory bull trout are not present, isolated populations cannot be replenished when a disturbance makes local habitats unsuitable (Rieman and McIntyre 1993; USDA and USDI 1997). Limited downstream movement was observed for resident bull trout in the Bitterroot River basin in Montana (Nelson 1999), suggesting that re-establishment of migratory fish and potential refounding of extirpated bull trout populations may be a slow process, if it occurs at all (FWS 2004). Migratory barriers such as culverted-road crossings can result in isolated populations and habitat fragmentation negatively affecting bull trout in several ways. These may include: (1) reducing geographic distribution, (2) increasing the probability of losing individual local populations, (3) increasing the probability of hybridization with introduced brook trout, and (4) reducing reproduction by eliminating the larger, more fecund migratory life-history form from local populations (FWS 2004).

Fish passage has been an important issue since it was first addressed by forest practices in 1975. With recent listings of various fish species as threatened and endangered including bull trout, it is now required in the FPHCP, that landowners review roads to determine if they have fish blockages. Large forest landowners are required to prioritize road maintenance and abandonment plans (RMAP) which are required to include the identification of fish blockages (culverts, bridges, other road crossings) under the "worst first" principle. This means that road-crossing structures will be inventoried and evaluated, and those acting as fish barriers are to be prioritized as to the amount of potential fish-bearing stream affected. Culverts affecting the most stream miles would be fixed first. The RMAP process is intended to bring all roads owned by large forest landowners into compliance with forest-practices standards including removing all fish barriers by the end of calendar year 2016. Small forest landowners are not held to the same schedule. See **Description of Activities that are Effects of the Permit** for additional information about small landowner requirements and fish-passage programs.

The effects of FPHCP implementation on bull trout habitat is to restore access to stream reaches that have otherwise been blocked to fish passage from a few years to decades (WDNR 2006). The goal of the FPHCP is to remove most if not all such passage barriers by 2016. Species most likely to benefit during the first several years of implementation are thought to be those inhabiting reaches lower in a system, as those barriers are more likely to be corrected first. Conversely though, it is likely that fish-passage blockages are more numerous in the headwater streams where the forest-road network is more concentrated. These barriers are generally expected to be replaced in later years as technology improves making such replacement options more economical (WDNR 2004). In the near-term this may disproportionately affect bull trout as they are more likely to spawn and rear in headwater streams as compared to other salmonids. However, culvert blockages that affect listed fish are ranked highest in the prioritization scheme established in the FPHCP. This means that many of the culverts that currently act as barriers in known bull trout habitat would actually be addressed sooner. The actual schedules for large landowners are landowner specific and much of the work under these RMAPs has already been completed.

The overall effect of the FPHCP on bull trout and bull trout habitat is expected to be beneficial. Removing fish-passage blockages will restore spatial and temporal connectivity of streams within and between watersheds where fish movement is currently obstructed. This, in turn, will permit bull trout to access areas critical for fulfilling their life-history requirements, especially foraging, spawning, and rearing. Since 2001, approximately 705 miles of previously blocked streams have been opened to fish passage and over 1,200 structures have been removed or replaced under the RMAP process (WFPA 2005). Approximately 58 of those stream miles resulted from the repair of just 36 barriers on small landowners' lands by the Family Forest Fish Passage Program. It is not known how many of the actions directly benefited bull trout and bull trout habitat, but the overall effect is an increase in amount of fish habitat. Sediment effects from these actions are discussed in another section of this Opinion.

In addition to allowing for fish passage for all age classes of bull trout, the replacement or removal of fish-blocking culverts should result in more-naturally maintained stream hydraulics, including bedload movement, sediment transport, and passage of moderately-sized woody debris. This will lead to more-natural stream dynamics, geometry, and improved habitat conditions both in quality and quantity. We also expect the new structures will result in fewer maintenance needs and better performance during high-precipitation events, resulting in near-normal sediment and bedload movement and debris conveyance and less sediment delivery to the stream system. Over time, this should result in improvements in the quality and quantity of suitable foraging, migrating, spawning, and rearing habitat for bull trout and improved reliability that new culverts will provide for fish passage.

This action will also address population and habitat fragmentation/isolation factors that have contributed to the Federal listing of bull trout in the Coastal-Puget Sound and Columbia River population segments. Connectivity has been identified by the FWS as a critical need for enhancing the likelihood of survival and recovery of bull trout (USFWS 2002, 2003). Restoring fish passage will provide access to historically important habitat, which could result in immediate expansions in the distribution of bull trout in some instances. In other cases, this action will restore connectivity between existing bull trout populations. We expect this action to improve the number, distribution, and reproductive potential of bull trout in all core areas despite anticipated short-term adverse effects to bull trout and bull trout habitat (see Sediment Effects). Short-term effects are expected to persist for up to 12 to 18 months after each project, with many projects occurring between 2006 and 2016.

Conclusion

Our GIS analysis identified over 130,000 road-stream crossings on FPHCP covered lands, including over 18,000 crossings on known fish-bearing streams. Of these 18,000 road crossings, approximately 570 cross known bull trout spawning and rearing habitat (190) or bull trout FMO habitat (380). An additional ten crossings are unknown. It is not known how many of these crossings may actual prevent or impede fish passage, but barriers are to be replaced by 2016 with priority emphasis placed on those barriers that occur in areas with federally listed fish. Fourteen of the twenty-eight core areas included in this analysis have at least one road crossing on FPHCP covered lands that intersects designated spawning and rearing habitat. The Nooksack core area has the most road crossings (43) of known spawning and rearing habitat. The Yakima (36), Walla Walla (20), Puyallup (14), and Stillaguamish (12) core areas all have greater than 10 road crossings that could be potential sources of sediment. The remaining ten core areas (Asotin, Pend Oreille, Lewis, Wenatchee, Snohomish /Skykomish, Lower Skagit, Elwha, Entiat, Hoh, and Tucannon) all have fewer than 10 road crossings on known bull trout spawning and rearing habitat.

Our GIS analysis did not identify road crossings of spawning and rearing habitat in any other core areas in Washington. Bull trout FMO habitat has nearly twice as many road crossings than spawning and rearing habitat, but since these habitats are larger streams and are identified as migration corridors it is more likely that these crossings are bridges and do not act as barriers under most flow regimes. Also since these crossings are lower in the watershed and are in areas of other listed fish, these road crossings are most likely to be replaced first during implementation (WDNR 2005). All FMO areas outside of core areas, and FMO habitat within core areas, have at least one identified crossing on FPHCP covered lands.

Only some of the identified crossings are barriers. According to WDFW (2003), approximately 25 percent of examined potential barriers require full replacement. A number of those culverts requiring replacement have already been replaced.

Fish Salvage and Handling

The salvage and handling of bull trout would not always occur in conjunction with the removal of a fish barrier. A site-specific assessment usually informs decisions about when a diversion of stream flow and fish salvage are necessary. During the diversion and prior to work commencing, bull trout (if present) along with other fish would be removed from the work area according to FWS-developed or FWS-adopted protocol Capture and handling of bull trout for these purposes by landowners or their contractors would require authorization such as a section 10(a)(1)(A) permit.

In an effort to reduce lethal impacts on bull trout from dewatering the stream, capture and relocation of bull trout from project construction sites would be attempted prior to the initiation of construction activities. Seines, dip nets, block nets, and electrofishing would be used. Although this effort would reduce the overall impact to bull trout, bull trout may in some cases experience immediate or delayed injury or death from the use of nets and/or electrofishing techniques. We expect bull trout injuries and death could occur from block nets and electrofishing, while mortality associated with handling stress, seines, and dip nets is less likely based upon our experience with these capture techniques. All captured fish and aquatic organisms would be released upstream from the dewatered stream.

Stream Reach Isolation

Prior to dewatering a stream section, block nets, sand bags, or other obstructions would be placed upstream and downstream from the culvert to prevent fish entering the stream segment that would be dewatered. The use of block nets poses a mortality risk to bull trout, even when monitored on a daily basis. The stream reach would usually be isolated on the same day that fish would be captured and relocated. The stream flow would be completely diverted around the project area in the same day. On rare occasions, block nets or obstructions may remain in the stream overnight when the fish capture and diversion activities require additional time to complete.

Seines, Dip Nets, and Traps

Seines and dip nets would be used as the first method of capture to remove any fish which may be trapped in the isolated reach. We anticipate that in most cases, bull trout would not be injured using this method, although it may disrupt foraging temporarily. Minnow traps, used in conjunction with seining, involve the use of wire-mesh traps placed in key instream fry habitat overnight prior to dewatering. Captured fish are removed and relocated upstream above the project area. Fry would be transported in large buckets (minimum 5 gallon) filled with stream water. The fish and water temperature would be monitored to ensure the health and condition of the fish until they are released. Given the low impact of these capture and relocation techniques, bull trout are not expected to be injured using these capture methods. Nonetheless, bull trout would be temporarily disrupted from their normal behavior during the capture and relocation activities.

In most cases, bull trout are unlikely to be present due to the timing and location of most projects. However, bull trout may in some cases be present as the allowable work windows primarily only limit the work to when bull trout are least likely to be present.

Electrofishing

Electrofishing for fish salvage has the potential to harm and kill bull trout even under FWS-approved protocols. In most, if not all circumstances, electrofishing would be attempted only after less harmful methods of fish removal have been used. In previous biological opinions, we have estimated that up to 25 percent of the fish within a project reach would not be removed by seining and dip-netting. These remaining fish could be affected by electrofishing. Based on studies conducted by Nielson (1998), we estimated in previous biological opinions that death and injury due to electrofishing would result in up to 25 percent of the bull trout remaining in the stream following the use of other removal methods. We judge this estimate may be conservative, yet reasonable given the wide range of water bodies and habitats where projects could occur. The actual effect of the capture and handling of bull trout using electrofishing is short-term in nature, occurring intermittently over one to several days. However, it may result in permanent, adverse effects. Not all flow diversions are likely to result in electrofishing effects as it may be used only when bull trout are least likely to be present in the affected area. This analysis also assumes that most if not all the bull trout subjected to electrofishing would be juveniles. It is expected that most if not all the adult bull trout would be removed using other methods of capture and release, because they are easier to see and capture than juveniles. This may not always be a correct assumption, as resident adult bull trout can be relatively small and, therefore, not readily seen or captured.

Stream Dewatering

During stream dewatering, including when sandbags are used to focus stream flows, there is a potential that a small number (up to 5 percent) of juvenile bull trout that are present may avoid being captured and relocated, and thus may die because they remain undetected in stream margins under vegetation or gravels. A gradual dewatering approach should enhance the efficacy of fish removal and thus reduce, but not eliminate this risk. We estimate the proposed capture methods would remove approximately 95 percent of the fish prior to dewatering. Stranding is only anticipated to affect fish which are less than 120 millimeters in length. In addition, due to the proposed timing of the activities, the risk to bull trout should be minimized because of the reduced likelihood of migratory and/or spawning bull trout being present in the stream reach during the construction period.

Expansion of Non-native Fish

Although the removal of fish-passage barriers are expected to benefit bull trout by re-opening suitable migrating, foraging, spawning, and rearing habitat; where non-native fish such as brook trout currently coexist with bull trout, there is the potential risk of introducing these species along with bull trout into habitat previously blocked by barriers. The effects of this action on bull trout are not easy to identify or quantify (see **Comprehensive Cumulative Effects – Invasive Species**). Because bull trout are associated with headwater streams, they may have a competitive advantage over other species when additional headwater habitat is opened to fish passage. Conversely, non-native fish are known to be a threat to bull trout in relatively secure, unaltered habitats, including roadless areas, wilderness, and national parks (USFWS 2004b). Since, in these situations, bull trout and one or more non-native species previously coexisted below the fish barrier, opening up additional habitat may not fundamentally change that relationship. If a particular bull trout population was healthy in the presence of a non-native species, adding additional habitat may not change that status. If a particular bull trout population was depressed because of the presence of one or more non-native species, reopening additional habitat is not necessarily going to improve the status of bull trout in those subpopulations unless the newly available habitat contains more-favorable (e.g., colder) conditions.

In some circumstances, restoring fish passage to a particular stream system may unintentionally expose a previously isolated population of bull trout to a non-native population of fish that resides below a barrier. In these situations, the removal of a fish barrier may have a more-profound effect on a local population of bull trout. Although the magnitude of threats from non-native fishes is highest for resident bull trout because they are typically isolated, have smaller body size than migratory forms, and usually exist in low abundance, we expect such situations to be extremely rare. In such rare events, we maintain the ability to request that the State not address fish-passage blockages where such projects would negatively affect bull trout (i.e., make additional habitat available to deleterious species or introduce a deleterious species to an isolated bull trout population).

8.6.3.6 CMER Research and Monitoring

Implementation of the FPHCP is expected to include several CMER-approved monitoring, evaluation, survey, and research efforts over the Permit term. A couple of these studies are currently on going and others are awaiting development. These activities are intended to support the monitoring and adaptive management components of the FPHCP and attendant reporting requirements. The monitoring of stream conditions, riparian conditions, performance and efficacy of road standards, baseline condition monitoring, and compliance monitoring are not expected to result in effects to covered species. Some general categories of monitoring and research may have the potential for adverse effects to bull trout and their habitat. Such effects are expected to occur over very limited stream reaches and could result in manipulations of riparian conditions below FPHCP standards.

Habitat Manipulation

In selected reaches, research could result in reduced canopy coverage negatively affecting the amount of shade coving the experimental stream reach. Less shade could, in turn, result in temperature increases in the studied stream. Where experimental stream reaches overlap with bull trout streams, adverse affects to bull trout may occur. Experimental reductions in shade would also result in less trees growing in the riparian buffer. Over time, fewer trees would result in less large wood available for recruitment to the affected reach. A reduction in large wood in bull trout streams has the potential to result in reduced pool formation, increased sediment loads, the loss of cover, and a reduction in stream diversity and complexity. With regard to the studied stream, we anticipate effects to stream temperatures and wood recruitment originating from the affected reaches to have limited affect on downstream habitat conditions.

Capture and Handling for Research Purposes

Species capture and handling under the proposed Permit may occur during studies proposed as part of the CMER process, as well as for validation of water-typing models. A variety of methods may be used to capture and handle fish for research purposes. Such studies may require repeated sampling to determine habitat use, growth rates, or other response variables. In general, we would expect seines, dip nets, blocknets, and electrofishing to be the more-common methods employed to capture fish. Where such research overlaps bull trout habitat, bull trout may be collected by one or more of these methods. In these circumstances, bull trout may be subject to handling stress, injury, and/or mortality as well as directly or indirectly contributing to disease transmission and increased susceptibility. Research proposals are anticipated to affect a very limited amount of stream habitat and only a fraction of this may coincide with bull trout streams. In addition, we would continue to participate in CMER and guide such studies to reduce unnecessary effects to listed and at-risk species including bull trout.

Summary

FWS participates with other stakeholders in the CMER process and would participate in the development and/or review of individual research proposals. Where impacts may occur to bull trout and bull trout spawning and rearing habitat, the FWS would review such proposals as to their potential to affect bull trout. If such research is independent of bull trout, we would work with other CMER members and researchers to help ensure that such research does not occur in bull trout streams. Should it be necessary to conduct such research in bull trout streams, we would work with other CMER members and researchers to minimize the effects to bull trout and bull trout habitat. In summary, we do not anticipate that research conducted under CMER will have significant effects to bull trout and bull trout habitat, and such effects would be further minimized by FWS continued participation on the CMER committee.

8.6.3.7 Summary of Effects to Bull Trout at the Individual Level

Within covered lands subjected to timber-related activities and road construction and maintenance over the term of the FPHCP, sub-lethal and lethal adverse effects to bull trout and adverse effects to bull trout habitat are likely to occur, as implementation of the FPHCP is not expected to eliminate all adverse effects associated with covered activities. Adverse effects would likely be limited to periodic and temporary increases in sediment and water temperatures and decreases in the availability of large woody in the affected stream miles. We expect that adverse effects from increases in sediment and water temperatures, and decreases in the availability of large wood, would result in some bull trout behaviors being significantly impaired or disrupted, and some bull trout being killed on some covered lands during the proposed 50-year permit term. The actual levels of impact that are likely to occur under the FPHCP are difficult to quantify because the point at which incremental increases in sediment and temperature and decreases in the amount of large woody debris actually lead to death, injury, or harm of individual fish in affected stream miles is extremely difficult to predict. It can also be difficult to determine the extent to which certain habitat modifications can be attributed to such activities due to site specific variables. The extent or contribution of FPHCP effects to a particular habitat modification leading to death, injury, or harm of individual fish is often further confounded by the presence of non-FPHCP activities occurring within a watershed.

We do expect some direct mortality to occur from capture and handling of bull trout when road crossing structures are being replaced. We do not expect all road-crossing structures in spawning and rearing habitat or FMO habitat to require the capturing and handling of bull trout and we do not anticipate that all capturing and handling of bull trout will lead to death or injury. We also expect that in some circumstances the capturing and handling of bull is appropriate and necessary as it will minimize the extent of death or injury that would otherwise occur from stranding or construction following stream dewatering.

On the Westside, potential ramification of adverse effects on individual bull trout discussed previously are expected to be reduced and/or minimized for the following reasons:

1. The FPHCP will reduce road-generated sediment as a result of improved maintenance, construction, and abandonment practices. Although sediment will continue to be generated by FPHCP road activities, the implementation of the FPHCP is intended to substantially reduce road-related erosion and sediment delivery to streams from current and future roads relative to current levels of sediment delivery, both in the near-term (< 10 years) and over the long-term (10-50 years).

2. The FPHCP will result in the restoration of previously inaccessible but suitable bull trout spawning, rearing and foraging habitat through the removal of all fish passage barriers on covered lands. One goal of FPHCP implementation on bull trout habitat is to restore access to stream reaches that have otherwise been blocked to fish passage from a few years to decades (WDNR 2006), with replacement of most if not all such barriers by 2016. This will expand the current amount of available spawning and rearing and FMO habitat for bull trout and potential forage species.

3. The no-harvest portions of RMZs and the shade rule will provide a higher level of protection than previous forest practice rules, because shade will be increased in areas where these RMZ practices are applied. However, potential increases in water temperature along Type Np and Ns streams may temporarily increase water temperatures on some Type S and F streams. Over the permit term, as riparian vegetation in previously or recently harvested areas in the core zone on all Typed waters matures, and portions of the inner zone are retained after harvest, improvements (further decreases) in the temperature regimes of fish-bearing streams are anticipated.

4. Riparian buffers along fish-bearing streams and buffered portions of non-fish-bearing streams will provide, over time, greater amounts of large wood than the previous forest practice rules. The predicted long-term reduction in “natural” recruitment of large wood to Typed streams will primarily be related to the current buffer strategies on Type Np and Ns streams and 20-acre exempt parcels. Overall, riparian buffers adjacent to fish-bearing streams prescribed in the FPHCP are predicted to maintain 91 to 100 percent (CH2MHill 2000) of the potential large wood that originates from FPHCP covered lands adjacent to fish-bearing streams. Where tree-retention buffers are located on Type Np streams, the current prescriptions would maintain unmanaged timber stands within the 50-foot no-harvest zone that are predicted to supply 62 to 79 percent of the potential large wood.

On the eastside, potential ramifications of adverse effects on individual bull trout, as discussed previously, are expected to be reduced and/or minimized for the following reasons:

1. The FPHCP will result in the reduction of sediment coming from existing roads and future roads as a result of improved maintenance, construction, and abandonment practices. Although sediment will continue to be generated by FPHCP road activities, the implementation of the FPHCP is intended to substantially reduce road-related erosion and sediment delivery to streams from current and future roads relative to current levels of sediment delivery, both in the near-term (< 10 years) and over the long-term (10-50 years).

2. The FPHCP will result in the restoration of previously inaccessible but suitable bull trout spawning, rearing and foraging habitat through the removal of all fish passage barriers on covered lands. The effects of FPHCP implementation on bull trout habitat are to restore access to stream reaches that have otherwise been blocked to fish passage from a few years to decades (WDNR 2006). The goal of the FPHCP is to replace most if not all such barriers by 2016. This will expand the current amount of available spawning and rearing and FMO habitat for bull trout and their potential forage species.

3. The no-harvest portions of RMZs, the shade rule, and the bull trout overlay will provide a higher level of protection than previous forest practice rules, because shade will be increased in areas where these RMZ practices are applied. However, potential increases in water temperature along Type Np and Ns streams may temporarily increase water temperatures on some Type S and F streams. Over the permit term, as riparian vegetation in previously or recently harvested areas in the core zone of all typed waters matures, and portions of the inner zone are retained after harvest, improvements (further decreases) in the temperature regimes of fish-bearing streams are anticipated. This shade rule includes streams adjacent to 20-acre exempt parcels.

4. Riparian buffers along fish-bearing streams and buffered portions of non-fish-bearing streams will provide, over time, greater amounts of large wood than the previous forest practice rules. The predicted long-term reduction in “natural” recruitment of large wood to Typed streams will primarily be related to the current buffer strategies on Type Np and Ns streams and 20-acre exempt parcels. The 30-foot core zone would maintain an unmanaged stand providing 66 to 82 percent of the potential stream-adjacent large wood, and the inner zone in some cases may supply an additional 12 to 30 percent. Core buffers when combined with inner zone tree retention on fish-bearing streams on the eastside are expected to retain 91 to 100 percent of the potential stream-adjacent large wood. The no-harvest reaches of the partial harvest and clear-cut units on Type Np streams are expected to supply 81 to 95 percent of the potential large wood (CH2MHill 2000).

8.6.4 GEOGRAPHIC RISK ANALYSIS: Analysis of Risk to Bull Trout Populations from FPHCP Effects

8.6.4.1 Overview

To assess overall risk to bull trout from potential effects of the FPHCP, a risk analysis integrating both spatial and non-spatial information was conducted. In this way we could evaluate where the effects could occur in relation to bull trout core areas and local populations within Washington, and what level of risk those potential effects presented to bull trout and their habitat given baseline conditions. This is a multi-scale analysis, focusing on the local population scale (i.e., smallest group of fish that is known to represent an interacting reproductive unit) and on the core area scale (i.e., the combination of one or more local populations and their associated foraging, migration, and overwintering habitat - FMO). Core areas require both habitat and bull trout to function, and the number (replication) and characteristics of local populations inhabiting a core area provide a relative indication of the core area's likelihood to persist. Local populations represent the bull trout spawning and early juvenile rearing habitat for a core area and are generally depicted as an area polygon (typically a subwatershed), while FMO habitat is all other habitat used by bull trout within the core area polygon.

This risk analysis can be summarized into four basic steps:

1. Evaluate core area (local population and FMO habitat) exposure risk.
2. Evaluate baseline habitat risk of exposed core areas.
3. Evaluate baseline population risk (i.e., at local population scale and core area scale) of exposed core areas.
4. Integrate all three risk evaluations to reach conclusion about the overall risk to core areas.

A spatial analysis using GIS was conducted on all bull trout core areas in Washington to help facilitate the risk analysis, and was used to identify the following information:

1. The location of FPHCP covered lands in relation to bull trout habitat and populations within core areas;
2. Both the percentage of FPHCP covered lands, and the percentage of FPHCP covered lands adjacent to bull trout streams, within these core areas' local populations (i.e., spawning and rearing habitat) and foraging, migration, and overwintering (FMO) habitat to help estimate and compare relative levels of "exposure risk" (i.e., low, medium, high) from FPHCP activities;
3. The potential degree of effect from existing and future roads to bull trout local populations and FMO habitats using key features (i.e., road crossings and road density) that are or will most likely be the primary sources of some of the adverse effects to bull trout and their habitat; and
4. The presence and underlying risk of existing stressors (e.g., brook trout, 303d impairments) to bull trout habitat within local populations and FMO habitat containing FPHCP covered lands to determine the "baseline habitat risk" (i.e., low, medium, high) to bull trout. As part of this determination, we integrated non-spatial information about the current condition of bull trout habitat within core areas and local populations. This ranking helps us understand the context of the potential effects from FPHCP on baseline bull trout habitat conditions.

As part of the risk analysis, the non-spatial population status parameters (i.e., adult spawner abundance and trend in abundance) of the local populations were evaluated to determine the "baseline population risk" ranking (i.e., low, medium, high). The analysis also evaluated similar population status parameters at the core area scale. This ranking helps one understand the resiliency of a local population and of a core area.

Exposure risk was used to narrow down the risk analysis and focus only on those bull trout core areas within Washington that could potentially be exposed to the majority of effects from the FPHCP activities. The risk analysis then integrated the two remaining risk categories (i.e., baseline habitat risk and baseline population risk) to estimate an overall relative risk to specific local populations and their core areas. From this analysis, it could be determined which local populations may be at risk, and of those, which were at highest risk from the effects from FPHCP activities. To summarize the overall risk at a core area level, the exposure risk and baseline habitat risk rankings of the corresponding FMO habitat were integrated with that core area's baseline population risk ranking.

Assumptions

The following major assumptions were used in this bull trout risk analysis:

1. Type N streams are generally distributed in a uniform manner within local populations, and some adverse effects to bull trout in Type S and F streams are likely to occur from FPHCP activities on Type N streams;
2. FPHCP covered lands will be harvested at approximately an average of 0.7 percent per year for areas east of the Cascade Crest and 1.3 percent for areas west of the Cascade Crest;
3. Harvest will be generally distributed in a uniform manner amongst core areas (i.e., all harvest in a given year will not all occur within an individual core area);
4. Spawning and rearing habitat is more sensitive to effects from FPHCP activities than FMO habitat; therefore a lower threshold for the percentage (i.e., >10 percent versus >20 percent) of bull trout streams on FPHCP covered lands is appropriate for assessing risk to local populations (i.e., spawning and rearing habitat);
5. Marine areas used by some bull trout populations are assumed to be insignificantly affected (i.e., any effects from FPHCP activities are not anticipated to significantly affect marine nearshore habitats for bull trout), and therefore are not included in the analysis; and
6. The effects of global climate change may have an effect on aquatic resources over the life of the FPHCP. Although the manifestations of global climate change on bull trout on FPHCP covered lands are reasonable to anticipate, the magnitude of effects cannot be specifically predicted. Therefore, this analysis may underestimate the long-term risk of some FPHCP covered activities to bull trout local populations and core areas.

Where additional assumptions were used, but were specific to a particular part of the analysis, they were stated and discussed in those specific sections of the document.

It should be noted that there are three core areas in Washington that are transboundary in nature. The Priest Lake core area spans Washington and Idaho, with only portions of two local populations lying within Washington. The Grande Ronde core area spans Washington and Oregon, with four local populations and a portion of its FMO habitat within Washington. The Umatilla-Walla Walla core area spans Washington and Oregon, with five local populations and a portion of its FMO habitat lying within Washington. We included the portions of habitat in Idaho and Oregon where necessary to complete our analysis (i.e., evaluation of baseline habitat risk and baseline population risk), since these habitats are functionally part of the respective core area.

8.6.4.2 Analysis of Exposure Risk

Using a spatial analysis of FPHCP covered lands in relationship to bull trout habitat, we were able to identify which of the core areas (n = 28) within or partially within Washington had relatively high percentages, ≥10 percent and ≥ 20 percent, of stream miles on FPHCP covered lands in “spawning and rearing” and “foraging, migration, and overwintering (FMO)” habitats, respectively.

Local Population Exposure

Core areas with less than 10 percent spawning and rearing stream miles on FPHCP covered lands were visually assessed to determine if the FPHCP covered lands encompassed critical spawning reaches, that may have been overlooked by the coarse percentage analysis. Because of the importance and sensitivity of spawning habitat, this additional level of evaluation was considered warranted. These determinations were made by visually reviewing the GIS map (*Washington Bull Trout Local Populations and Key Recovery Habitat with Forest Practices Lands*) and determining the location of FPHCP covered lands.

Ten core areas were identified as containing greater than 10 percent spawning and rearing streams miles on FPHCP covered lands (Appendix A1 “*Summary of Bull Trout Habitat on FPHCP Covered Lands by Bull Trout Core Area or Recovery Planning Unit”*). The core areas with greater than 10 percent spawning and rearing stream miles on FPHCP covered lands are listed below in descending order of percentage.

1. Lewis
2. Nooksack
3. Walla Walla
4. Entiat
5. Pend Oreille
6. Stillaguamish
7. Puyallup
8. Yakima
9. Snohomish/Skykomish
10. Wenatchee

Within these ten core areas (55 local populations), 11 local populations were determined to contain between 30 and 70 percent FPHCP covered lands (Appendix A2 *Acres of FP Lands by Local Population and FMO Areas in Washington*).

Two additional core areas, Priest Lake and Methow, had been overlooked by the coarse percentage analysis. Although these two core areas had less than 10 percent spawning and rearing stream miles on FPHCP covered lands, they were visually determined to have FPHCP covered lands encompassing critical spawning reaches within at least one of their local populations. These two additional core areas were added to the risk analysis.

FMO Habitat Exposure

Fourteen core areas were identified as containing greater than 20 percent FMO stream habitat on FPHCP covered lands (Appendix A1 “*Summary of Bull Trout Habitat on FPHCP Covered Lands by Bull Trout Core Area or Recovery Planning Unit”*). It should be noted that for some core areas, the amount of FMO stream habitat may be naturally limited, so although the percentage of stream habitat encompassed by FPHCP covered lands may appear large, the actual amount may be lower than a core area having less than 20 percent FMO stream habitat on FPHCP covered lands. For this risk analysis, it was judged that the percentage of stream habitat on FPHCP covered lands is the appropriate metric to evaluate. It is reasonable to assume the overall influence of FPHCP activities on the character/condition of available FMO habitat within an individual core area is generally based on the percent of the FMO stream habitat that FPHCP covered lands encompass.

Core areas containing greater than 20 percent FMO stream habitat miles on FPHCP covered lands are listed below in descending order of percentage:

1. Hoh
2. Lewis
3. Puyallup
4. Stillaguamish
5. Dungeness
6. Elwha
7. Snohomish/Skykomish
8. Klickitat
9. Nooksack
10. Walla Walla
11. Lower Skagit
12. Skokomish
13. Yakima
14. Wenatchee

Local population(s) with low or no exposure risk, but within a core area with greater than 20 percent FMO stream habitat (listed above) on FPHCP covered lands, were also evaluated in the latter steps of the risk analysis (i.e., baseline habitat risk and baseline population risk) if generally known to be in a depressed or severely declining status. Because core areas containing local populations with impaired habitat and/or population baselines will generally be less resilient to adverse effects to their FMO habitat, this additional level of assessment was considered warranted. The rationale for this premise is that a depressed migratory bull trout population must sufficiently sustain effects at two locations, their spawning and rearing habitat (i.e., local populations) and their FMO habitat (regardless if those effects are considered less than what might occur within spawning and rearing habitat).

It should be noted that evaluating only the percent of bull trout FMO stream habitat directly affected may underestimate the actual overall effect to bull trout from activities on FPHCP covered lands within FMO areas (i.e., the greater area of watershed or hydrologic network within which the actual FMO stream habitat is located). This approach does not look at the actual percent acreage of FPHCP covered lands within an FMO area. For contrast, if the amount of "FMO area" actually covered by FPHCP covered lands is calculated, we find some similarities to the 14 core areas listed above but also some differences (Appendix A2 *Acres of FP Lands by Local Population and FMO Areas in Washington*).

Core areas containing greater than 20 percent "FMO area" on FPHCP covered lands, but having only local populations with either low or no exposure risk, are listed below in descending order of percentage (ranges from 22 to 83 percent):

1. Coeur d'Alene Lake
2. Klickitat
3. Puyallup
4. Snohomish/Skykomish
5. Stillaguamish
6. Lake Pend Orielle
7. Pend Oreille
8. Lewis

Those core areas that had less than 20 percent FMO stream habitat on FPHCP covered lands and less than 10 percent spawning and rearing stream habitat on FPHCP covered lands (with low or no direct exposure) were removed from further analysis. These included the Grande Ronde, Tucannon, Chilliwack, Upper Skagit, Chester Morse Lake, Queets, and Quinault core areas.

It should be noted that freshwater FMO habitats "outside" of core areas (e.g., Chehalis River, Kalaloch Creek, Columbia River, Snake River) were not explicitly evaluated in this risk analysis due to the nature of these habitats and the limited information on their relationship to specific core areas. Bull trout from multiple core areas may use these habitats, making it extremely difficult to evaluate the overall effect to individual core areas. It is recognized that these FMO habitats outside of core areas are an important component of the overall habitat network for migratory populations of bull trout to complete their life history. However, given the limited information on specific relationships to core areas, all that can be stated is that some unknown amount of additional risk will likely be incurred for at least some unknown number of core areas, where these FMO habitats have moderate to high exposure to activities on FPHCP covered lands (see Appendix A1 "*Summary of Bull Trout Habitat on FPHCP Covered Lands by Bull Trout Core Area or Recovery Planning Unit"*).

Summary or Exposure Risk

Exposure risk was estimated using the quantity and location of bull trout stream habitat on FPHCP covered lands within a core area's local populations (i.e., spawning and rearing habitats) and FMO areas. This determination addressed the amount of bull trout stream habitat potentially exposed to the effects of FPHCP activities. It also helped weight the importance of the location of those FPHCP covered lands in relationship to spawning and rearing or FMO habitats. In those cases where the specific locations of spawning sites were unknown within the local population, the draft Bull Trout Recovery Plan or a bull trout biologist familiar with the area were consulted to identify/approximate the potential spawning locations.

The spatial analysis of all local populations partially or completely within Washington (n=124), determined that 35 local populations contained no FPHCP covered lands (i.e., no direct risk), while 49 local populations had a small percentage (< 3 percent) of FPHCP covered lands that encompassed or were adjacent to a low risk area (e.g., non-spawning reach) of the local population. Within six core areas, a total of 17 local populations contained less than 10 percent of FPHCP covered lands, however, these lands were located within increased risk areas (e.g., spawning reach) of the local population. The remaining local populations had greater than 10 percent FPHCP covered lands adjacent to portions of spawning and rearing habitat.

Exposure risk for local populations and FMO habitats are summarized for the relevant core areas in Table 8-38. For detailed assessment of exposure risk to local populations and FMO habitats see Appendix B1 (*Supporting Materials for Risk Analysis: Bull Trout Exposure Risk Analysis*).

Table 8-38. Exposure risk rankings for local populations and FMO habitats within the 12 core areas determined to have significant exposure risk (local populations containing no FPHCP lands are not displayed); and for the FMO habitats within core areas having greater than 20 percent bull trout FMO stream habitat on FPHCP covered lands (FMO habitats having "Low" exposure risk, and no associated at risk local populations, are not displayed).

Core Area	Local Population or FMO	Exposure Risk
	Columbia River Population Segment	
Lewis	Cougar Creek	L
	Pine Creek	H
	Lewis FMO	L
Walla-Walla	Mill Creek	H
	NF Touchet	H
	SF Touchet	H
	Wolf Fork Touchet	H
	Walla-Walla FMO	M
Pend Oreille	LeClerc Creek	H
	Pend Oreille FMO	L
Priest Lake	Gold Creek	L
	Granite Creek	M
	Kalispell Creek	L
	Priest Lake FMO	L
Yakima	Ahtanum Creek	H
	American River	M
	Bumping River	L
	Cle Elum River	M
	Gold Creek	H
	Kachess River	L
	NF Teanaway River	H
	NF Tieton	L
	Rattlesnake Creek	M

Table 8-38. Exposure risk rankings for local populations and FMO habitats within the 12 core areas determined to have significant exposure risk (local populations containing no FPHCP lands are not displayed); and for the FMO habitats within core areas having greater than 20 percent bull trout FMO stream habitat on FPHCP covered lands (FMO habitats having "Low" exposure risk, and no associated at risk local populations, are not displayed). (continued)

Core Area	Local Population or FMO	Exposure Risk
	South Fork Tieton	H
	Upper Yakima River	H
	Yakima River Mainstem FMO	H
Wenatchee	Chiwaukum Creek	H
	Chiwawa River	H
	Icicle Creek	M
	Little Wenatchee River	M
	Nason Creek	H
	Peshastin Creek	M
	White River	H
	Wenatchee FMO	H
Entiat	Entiat River	H
	Mad River	H
	Entiat FMO	H
Methow	Beaver Creek	L
	Chewuch River	L
	Early Winters Creek	M
	Goat Creek	M
	Gold Creek	M
	Lost River	M
	Twisp River	M
	Upper Methow River	L
	Wolf Creek	M
	Methow FMO	H
	Coastal-Puget Sound Population Segment	
Nooksack	Middle NF Nooksack River	H
	Glacier Creek	H
	Lower NF Nooksack River	H
	Lower MF Nooksack River	M
	Lower SF Nooksack River	H
	Nooksack FMO	M
Stillaguamish	NF Stillaguamish River	M
	Upper Deer Creek	M
	Canyon Creek	L
	Stillaguamish FMO	H
Snohomish-Skykokmish	NF Skykomish River	L
	SF Skykomish River	M
	Snohomish/Skykomish FMO	M

Table 8-38. Exposure risk rankings for local populations and FMO habitats within the 12 core areas determined to have significant exposure risk (local populations containing no FPHCP lands are not displayed); and for the FMO habitats within core areas having greater than 20 percent bull trout FMO stream habitat on FPHCP covered lands (FMO habitats having "Low" exposure risk, and no associated at risk local populations, are not displayed). (continued)

Core Area	Local Population or FMO	Exposure Risk
Puyallup	Upper White River	L
	WF White River	L
	Carbon River	H
	Upper Puyallup and Mowich Rivers	H
	Puyallup FMO	H
Dungeness	Dungeness River	L
	Dungeness FMO	M
Foraging, Migration, and Overwintering Habitats (>20% FPHCP covered lands, but not listed above)		
Hoh	Hoh FMO	H
	South Fork Hoh River	n/a
	Hoh River	n/a
Elwha	Elwha FMO	M
	Elwha River	n/a
Klickitat	Klickitat FMO	M
	West Fork Klickitat	n/a
Lower Skagit	Lower Skagit FMO	M
	19 local populations	n/a
Skokomish	Skokomish River FMO	M
	NF Skokomish River	n/a
	SF Skokomish River	n/a

The exposure risk for local populations was ranked based on the following criteria:

> *Low Risk*: FPHCP covered lands encompass or are adjacent to a minor amount of juvenile rearing habitat within the local population.
>
> *Moderate Risk*: FPHCP covered lands encompass or are adjacent to significant amounts of juvenile rearing habitat within the local population, or a small amount of known spawning habitat within the local population.
>
> *High Risk*: FPHCP covered lands encompass or are adjacent to significant amounts of known spawning habitat within the local population.

Exposure risk for FMO habitat was ranked based on the following criteria:

> *Low Risk*: FPHCP covered lands encompass or are adjacent to less than 20 percent of FMO stream habitat within the core area.
>
> *Moderate Risk*: FPHCP covered lands encompass or are adjacent to greater than 20 percent but less than 40 percent of FMO stream habitat within the core area.

High Risk: FPHCP covered lands encompass or are adjacent to greater than 40 percent of FMO stream habitat within the core area.

It should be noted that although some FMO habitat may be ranked at high exposure risk, this does not equate with the same level of risk to local populations (i.e., spawning and rearing habitat). FPHCP activities are not expected to affect FMO habitat to the same degree as spawning and rearing habitat when FPHCP covered lands overlap or are adjacent to these areas. Bull trout FMO habitats are 1) typically larger bodies of water, 2) generally contain streams with warmer water temperatures, and 3) typically used seasonally by bull trout life stages that have less sensitive or restrictive habitat requirements. Therefore, the effects of FPHCP activities on tributaries or stream reaches feeding into FMO streams will more likely be reduced to acceptable levels before reaching many, if not most, FMO streams, and will correspondingly have less impact to bull trout.

At this point in the risk analysis, local populations that were determined to have a low exposure risk (see Table 8-38) were eliminated from further analysis of risk. It was concluded that a low exposure risk indicated the population and its habitat would sufficiently avoid any significant effects generated from FPHCP covered lands within that local population. Those local populations that were determined to have moderate or high exposure risk were further analyzed for baseline habitat risk and baseline population risk described below.

8.6.4.3 Analysis of Baseline Habitat Risk

The 9.3 million acres of FPHCP covered lands and its associated infrastructure (e.g., roads, stream crossings, etc.) are not evenly distributed across core areas and local populations. About 18 percent of the mapped bull trout habitat (spawning and rearing [14%] and FMO [19%]) in Washington occurs on FPHCP covered lands. In some core areas, the percentage of covered lands can be as high as 40 percent. In other core areas, no covered lands occur. Even at the local population scale, the percentage of covered lands can vary widely.

Road densities and crossings vary at the core area and local population scales. Some local population areas have no crossings, while some have more than 1,000 crossings (Appendix A3 *Road Density, Stream Crossings, Stream Adjacent Road Summaries by Local Population and Core Area*). Road densities range from 0.0 miles per square mile (mi/mi^2) up to 5.4 mi/mi^2 at the local population scale. FPHCP covered lands currently have over 60,000 miles of mapped roads yielding an average road density of 4.1 mi/mi^2. Road densities on FPHCP covered lands are typically below 9 miles per square mile, but in one case it was 25 miles per square mile. About 9 percent of these roads occur within the riparian zone of Type S, F, and Np streams as determine by a site potential tree height (variable between west and east sides of the Cascade Crest). This road network also has over 130,000 road/stream crossings. The majority of these crossings are over Type Np and Ns streams. Approximately 18,000 road/stream crossing transect Type S and F (fish-bearing) streams. See Appendix A3 (*Road Density, Stream Crossings, Stream Adjacent Road Summaries by Local Population and Core Area*) for details on road density, stream crossings, and other spatial information by local population and FMO habitat.

Given this variability across local populations it was deemed warranted to individually assess and rank each local population and their corresponding FMO habitat. Baseline habitat risk was estimated (ranked) using spatial analysis of road density, number of road crossings on bull trout streams, 303d listings, and additional qualitative information on local population and FMO habitat condition. These rankings rate the condition of existing habitats within local populations that were determined to have moderate to high exposure risk, and their corresponding FMO habitat. FMO habitats that had moderate to high exposure risk, but no local populations with either moderate or high exposure risk, were also ranked but their rankings are not displayed in Table 8-39. Spatial and non-spatial information was assessed through the bull trout "Matrix of Pathways and Indicators" (Matrix) (USFWS 1998) to arrive at the baseline habitat risk ranking. Risk categories (i.e., low, medium, high) were essentially equated to the Matrix categories (i.e., functioning appropriately, functioning at risk, functioning at unacceptable risk). The draft Bull Trout Recovery Plan (USFWS 2002, 2004a, 2004b), Washington State limiting factors analyses, subbasin plans, other biological opinions, and/or a bull trout biologist familiar with the area were consulted in assessing the baseline habitat risk for local populations. Baseline habitat risk for local populations and FMO habitats is summarized in Table 8-39 below. See Appendix B2 (*Supporting Materials for Risk Analysis: Bull Trout Baseline Habitat Risk Analysis)* for complete analysis of baseline habitat risk.

Table 8-39. Baseline habitat risk ranking for local populations with moderate to high exposure risk, and for their corresponding FMO habitats.

Core Area	Local Population	Baseline Habitat Risk
	Columbia River Population Segment	
Lewis	Pine Creek	L
	Lewis FMO	L
Walla-Walla	Mill Creek	H
	NF Touchet	M
	SF Touchet	H
	Wolf Fork Touchet	M
	Walla-Walla FMO	H
Pend Oreille	LeClerc Creek	M
	Pend Oreille FMO	H
Priest Lake	Granite Creek	M
	Priest Lake FMO	H
Yakima	Ahtanum Creek	H
	American River	M
	Cle Elum River	H
	Gold Creek	M
	NF Teanaway River	H
	Rattlesnake Creek	M
	SF Tieton	M
	Upper Yakima River	H
	Yakima River Mainstem FMO	H
Wenatchee	Chiwaukum Creek	M
	Chiwawa River	L
	Icicle Creek	H
	Little Wenatchee River	H
	Nason Creek	H
	Peshastin Creek	H
	White River	M
	Wenatchee FMO	H

Table 8-39. Baseline habitat risk ranking for local populations with moderate to high exposure risk, and for their corresponding FMO habitats. (continued)

Core Area	Local Population	Baseline Habitat Risk
Entiat	Entiat River	H
	Mad River	M
	Entiat FMO	H
Methow	Early Winters Creek	M
	Goat Creek	H
	Gold Creek	H
	Lost River	M
	Twisp River	M
	Wolf Creek	M
	Methow FMO	H
	Coastal-Puget Sound Population Segment	
Nooksack	Middle NF Nooksack River	H
	Glacier Creek	L
	Lower NF Nooksack River	M
	Lower MF Nooksack River	M
	Lower SF Nooksack River	H
	Nooksack FMO	M
Stillaguamish	NF Stillaguamish River	M
	Upper Deer Creek	H
	Stillaguamish FMO	M
Snohomish/Skykomish	SF Skykomish River	M
	Snohomish/Skykomish FMO	M
Puyallup	Carbon River	L
	Upper Puyallup and Mowich Rivers	H
	Puyallup FMO	H

The baseline habitat risk analysis determined that only four of the local populations with moderate to high exposure risk (n = 40) had low (L) baseline habitat risk. A total of 17 local populations were determined to have high (H) baseline habitat risk within the Columbia River population (n = 13) and the Coastal-Puget Sound population (n = 4) segments; and the remaining 19 local populations were determined to have moderate (M) baseline habitat risk within the Columbia River population (n = 15) and the Coastal-Puget Sound population (n = 4) segments.

Although FMO habitat is critical for supporting migratory life history forms of bull trout, it is less sensitive to potential effects from FPHCP activities. In determining overall core area risk, FMO baseline habitat risk was integrated into the risk analysis for those core areas with local populations at moderate to high overall potential risk (see Summary of Overall Potential Risk section below). We judged that FMO baseline habitat risk becomes a much more relevant factor in these cases, since it is an indicator of what additional pressures are being placed upon a population already at a level of increased risk. By integrating baseline habitat risk for FMO habitat in these cases, it provides a more holistic and reliable risk condition of a core area with a local population(s) at moderate to high overall risk.

8.6.4.4 Analysis of Baseline Population Risk

Local Population Scale

Baseline population risk was estimated using the number of adult spawners and trend status within a local population. This determination addressed the current condition of population status parameters within local populations, which are an indicator of the potential sensitivity of a local population to adverse effects from activities on FPHCP covered lands. In those cases where population parameters were unknown, we ranked these as moderate risk by default. A moderate or intermediate risk ranking seemed reasonable to assume in these cases, although this could mischaracterize the true status of an unknown local population as either better or worse. Population data from the draft Bull Trout Recovery Plans (USFWS 2002, 2004a, 2004b) in conjunction with updated information from the core area templates (USFWS 2005) were used in ranking local populations. Baseline population risk for local populations is summarized in Table 8-40.

Table 8-40. Baseline population risk rankings for local populations with moderate to high exposure risk.

Core Area	Local Population	Baseline Population Risk
	Columbia River Population Segment	
Lewis	Pine Creek	L
Walla-Walla	Mill Creek	M
	NF Touchet	H
	SF Touchet	H
	Wolf Fork Touchet	H
Pend Oreille	LeClerc Creek	H
Priest Lake	Granite Creek	H
Yakima	Ahtanum Creek	H
	American River	H
	Cle Elum River	H
	Gold Creek	H
	NF Teanaway River	H
	Rattlesnake Creek	H
	SF Tieton	L
	Upper Yakima River	H
Wenatchee	Chiwaukum Creek	M
	Chiwawa River	L
	Icicle Creek	M
	Little Wenatchee River	H
	Nason Creek	H
	Peshastin Creek	H
	White River	H
Entiat	Entiat River	H
	Mad River	H
Methow	Early Winters Creek	H
	Goat Creek	H

Table 8-40. Baseline population risk rankings for local populations with moderate to high exposure risk. (continued)

Core Area	Local Population	Baseline Population Risk
	Gold Creek	H
	Lost River	M
	Twisp River	M
	Wolf Creek	H
	Coastal-Puget Sound Population Segment	
Nooksack	Middle NF Nooksack River	M
	Glacier Creek	L
	Lower NF Nooksack River	M
	Lower MF Nooksack River	M
	Lower SF Nooksack River	M
Stillaguamish	NF Stillaguamish River	L
	Upper Deer Creek	H
Snohomish/Skykomish	SF Skykomish River	M
Puyallup	Carbon River	M
	Upper Puyallup and Mowich Rivers	M

Baseline population risk for local populations was ranked using the following criteria, which was based on the bull trout population guidance and information from Rieman and Allendorf (2001):

Low Risk: Average, annual spawner abundance in the local population is greater than 100, and is stable or increasing (5-10 years data).

Moderate Risk: Average, annual spawner abundance in the local population is greater than 100, and population trend is declining; or average, annual spawner abundance in the local population is between between 50 and 100 and is stable or increasing; or population parameters are currently unknown.

High Risk: Average, annual spawner abundance in the local population is between between 50 and 100 and is declining; or average, annual spawner abundance in the local population is less than 50; or migratory form is or nearly absent.

Core Area Scale

Different parameter values are used to assess baseline population condition or risk at the core area scale. The ranking criteria reflect this, and are generally based on values described in the current bull trout literature and draft recovery plans (USFWS 2002, 2004a, 2004b). Analysis of baseline population risk at this scale also includes assessment of an additional parameter, the number of local populations. Because we did not necessarily evaluate all local populations (i.e., only those with moderate to high exposure risk) within a core area in the earlier parts of our analysis, we could not simply "sum up" the baseline population risk rankings for local populations and equate that with the baseline population risk ranking for the core area, nor would that have been necessarily appropriate. Population data from the draft Bull Trout Recovery Plans (USFWS 2002, 2004a, 2004b) in conjunction with updated information from the core area templates (USFWS 2005) were used in ranking core areas. Baseline population risk for core areas with local populations with moderate to high exposure risk is summarized in Table 8-41.

Table 8-41. Baseline population risk rankings for core areas with a least one local population at moderate to high exposure risk.

Core Area	Baseline Population Risk
Columbia River Population Segment	
Lewis	M
Walla-Walla	M
Pend Oreille	H
Priest Lake	H
Yakima	H
Wenatchee	M
Entiat	H
Methow	H
Coastal-Puget Sound Population Segment	
Nooksack	M
Stillaguamish	M
Snohomish/Skykomish	M
Puyallup	M

Baseline population risk for affected core areas was ranked using the following criteria which was based on the bull trout population guidance and information from Rieman and McIntyre (1993), and Rieman and Allendorf (2001):

> *Low Risk*: Average, annual spawner abundance in the core area is estimated to be greater than 1,000 and is stable or increasing (5-10 years data), and core area contains more than 5 local populations.
>
> *Moderate Risk*: Average, annual spawner abundance in the core area is estimated to be greater than 1,000 and is stable or increasing (5-10 years data), and core area contains less than 5 local populations; or average, annual spawner abundance in the core area is estimated to be at least 500 and is stable or increasing (5-10 years data); or population parameters are currently unknown.
>
> *High Risk*: Average, annual spawner abundance in the core area is estimated to be between 500 and 1,000 and is declining and has less than 5 local populations; or average, annual spawner abundance in the core area is less than 500.

8.6.4.5 Summary of Overall Potential Risk

Overall potential risk is presented at two scales, the local population and core area. Although the ranking results can be used independently to assess relative risk at the two scales, they should also be examined together to more fully assess the ultimate risk to a particular core area from FPHCP activities.

Local Population Scale

Integration of the two risk rankings (i.e., baseline habitat and baseline population) developed from the spatial analysis and non-spatial threat/stressor information indicated that over half of the local populations with moderate to high exposure risk were at an increased (moderate to high) level of overall potential risk from the effects of the FPHCP. Overall local population risk was ranked using a simple scoring system in the following matrix. A “high” ranking received a value of 3 points, a “moderate” ranking a value of 2 points, and a “low” ranking a value of 1 point (i.e., H=3, M=2, L=1). For each local population, its three resulting ranking values were summed together and then divided by three to determine its final score and its overall potential risk category. Since all local populations with low exposure risk were removed from further analysis by this point, the remaining local populations that were analyzed must either have a moderate or high exposure risk. This removal accordingly eliminated most of the potential “low” scores in the final rankings. We assumed that both habitat and population risk rankings were equally weighted/important to bull trout, and therefore, only a finite number of combinations are possible. These combinations are displayed in Table 8-42.

Table 8-42. Potential individual risk combinations and resultant overall risk ranking for a local population (i.e., spawning and rearing habitat).

Exposure Risk		Risk 1		Risk 2		Overall Potential Risk	
Ranking	**Pt value**	**Ranking**	**Pt value**	**Ranking**	**Pt value**	**Ranking**	**Score**
H	3	H	3	H	3	H	3
H	3	H	3	M	2	MH	2.7
H	3	H	3	L	1	M	2.3
H	3	M	2	M	2	M	2.3
H	3	L	1	M	2	M	2
H	3	L	1	L	1	ML	1.7
M	2	L	1	L	1	L	1.3
M	2	L	1	M	2	ML	1.7
M	2	M	2	M	2	M	2
M	2	H	3	L	1	M	2
M	2	H	3	M	2	M	2.3
M	2	H	3	H	3	MH	2.7

The overall potential risk rankings for local populations with a moderate to high exposure risk are summarized below in Table 8-43. Out of the 40 local populations analyzed to this point, a total of six local populations were scored in the high (H) risk category, all located on the eastside of the Cascade Crest within the Columbia River population segment. An additional 16 local populations were scored in the moderate-high (MH), or next highest risk category. Ten of these local populations where ranked as having a high (H) exposure risk. Four of the 16 local populations were located in the Coastal-Puget Sound population segment, with the remainder in the Columbia River population segment. The remaining 18 local populations ranked, were scored in the moderate (M) to moderate-low (ML) risk category. None of the local populations scored a low (L) overall potential risk.

Two additional “habitat” factors not explicitly integrated into the Matrix analysis and therefore not integrated into the overall baseline habitat risk results were the amounts of stream adjacent roads (Appendix A3) and the presence of brook trout (Appendix B2). The analysis results for these two additional factors can be overlayed with the results of the overall potential risk rankings to provide an even more comprehensive picture of relative risk for individual local populations.

Table 8-43. Overall potential risk rankings for local populations with moderate to high exposure risk. Rankings are in descending order, with high (H) exposure risk local populations listed first in each final ranking (rank 4) category.

		Exposure Risk		Habitat Risk		Population Risk		Overall Potential Risk	
Core Area	Local Population	rank 1	score 1	rank 2	score 2	rank 3	score 3	rank 4	score 4
Walla-Walla	SF Touchet	H	3	H	3	H	3	H	3.0
Yakima	Ahtanum Creek	H	3	H	3	H	3	H	3.0
Yakima	NF Teanaway River	H	3	H	3	H	3	H	3.0
Yakima	Upper Yakima River	H	3	H	3	H	3	H	3.0
Wenatchee	Nason Creek	H	3	H	3	H	3	H	3.0
Entiat	Entiat River	H	3	H	3	H	3	H	3.0
Nooksack	Middle NF Nooksack River	H	3	H	3	M	2	MH	2.7
Nooksack	Lower SF Nooksack River	H	3	H	3	M	2	MH	2.7
Puyallup	Upper Puyallup and Mowich Rivers	H	3	H	3	M	2	MH	2.7
Walla-Walla	Mill Creek	H	3	H	3	M	2	MH	2.7
Walla-Walla	NF Touchet	H	3	M	2	H	3	MH	2.7
Walla-Walla	Wolf Fork Touchet	H	3	M	2	H	3	MH	2.7
Pend Oreille	LeClerc Creek	H	3	M	2	H	3	MH	2.7
Yakima	Gold Creek	H	3	M	2	H	3	MH	2.7
Wenatchee	White River	H	3	M	2	H	3	MH	2.7
Entiat	Mad River	H	3	M	2	H	3	MH	2.7
Stillaguamish	Upper Deer Creek	M	2	H	3	H	3	MH	2.7
Yakima	Cle Elum River	M	2	H	3	H	3	MH	2.7
Wenatchee	Little Wenatchee River	M	2	H	3	H	3	MH	2.7
Wenatchee	Peshastin Creek	M	2	H	3	H	3	MH	2.7
Methow	Goat Creek	M	2	H	3	H	3	MH	2.7
Methow	Gold Creek	M	2	H	3	H	3	MH	2.7
Nooksack	Lower NF Nooksack River	H	3	M	2	M	2	M	2.3
Wenatchee	Chiwaukum Creek	H	3	M	2	M	2	M	2.3
Priest Lake	Granite Creek	M	2	M	2	H	3	M	2.3

Table 8-43. Overall potential risk rankings for local populations with moderate to high exposure risk. Rankings are in descending order, with high (H) exposure risk local populations listed first in each final ranking (rank 4) category (continued)

		Exposure Risk		Habitat Risk		Population Risk		Overall Potential Risk	
Core Area	**Local Population**	**rank 1**	**score 1**	**rank 2**	**score 2**	**rank 3**	**score 3**	**rank 4**	**score 4**
Yakima	American River	M	2	M	2	H	3	M	2.3
Yakima	Rattlesnake Creek	M	2	M	2	H	3	M	2.3
Wenatchee	Icicle Creek	M	2	H	3	M	2	M	2.3
Methow	Early Winters Creek	M	2	M	2	H	3	M	2.3
Methow	Wolf Creek	M	2	M	2	H	3	M	2.3
Puyallup	Carbon River	H	3	L	1	M	2	M	2.0
Yakima	SF Tieton	H	3	M	2	L	1	M	2.0
Nooksack	Lower MF Nooksack River	M	2	M	2	M	2	M	2.0
Methow	Lost River	M	2	M	2	M	2	M	2.0
Methow	Twisp River	M	2	M	2	M	2	M	2.0
Snohomish/ Skykomish	SF Skykomish River	M	2	M	2	M	2	M	2.0
Nooksack	Glacier Creek	H	3	L	1	L	1	ML	1.7
Lewis	Pine Creek	H	3	L	1	L	1	ML	1.7
Wenatchee	Chiwawa River	H	3	L	1	L	1	ML	1.7
Stillaguamish	NF Stillaguamish River	M	2	M	2	L	1	ML	1.7

Four local populations (Lower South Fork Nooksack River, Ahtanum Creek, Upper Puyallup and Mowich Rivers, and North Fork Teanaway River) have greater than 10 miles of stream adjacent roads on FPHCP covered lands. These four local populations were all scored at either moderate-high (MH) or high (H) overall potential risk. Another 11 local populations have between 5 and 10 miles of stream adjacent roads on FPHCP covered lands. Three of these (South Fork Touchet, Nason Creek, and Entiat River) were scored at high (H) overall potential risk, three (North Fork Touchet, LeClerc Creek, and Cle Elum River) were scored at moderate-high (MH) overall potential risk, and the remaining 5 at moderate (M) overall potential risk (Lower North Fork Nooksack River, Lower Middle Fork Nooksack River, and South Fork Skykomish River) to moderate-low (ML) overall potential risk (Pine Creek and North Fork Stillaguamish). Unlike the local population road density analysis, the stream adjacent roads analysis only accounted for those roads within riparian management zones of stream segments on FPHCP covered lands. Therefore, the results should generally be considered an underestimate of the actual extent of the effects of stream adjacent roads from FPHCP activities. For example, stream adjacent haul roads used for FPHCP activities generally extend beyond FPHCP covered lands, especially in fragmented or "checkerboard" ownerships.

Three (Ahtanum Creek, Upper Yakima River, and Entiat River) of the 6 local populations that scored a high (H) overall potential risk, also have a high risk ranking associated with the presence of brook trout, and the remaining three local populations (South Fork Touchet River, North Fork Teanaway River and Nason Creek) have a moderate risk ranking associated with the presence of brook trout. Of the 16 local populations that scored a moderate-high (MH) overall potential risk ranking, six (LeClerc Creek, White River, Cle Elum River, Peshastin Creek, and Gold Creek-Methow) have a high risk ranking associated with the presence of brook trout, eight (Lower South Fork Nooksack River, Upper Puyallup and Mowich Rivers, Mill Creek, North Fork Touchet River, Wolf Fork Touchet River, Gold Creek-Yakima River, Upper Deer Creek, and Goat Creek) have a moderate risk ranking associated with the presence of brook trout, and only two (Middle North Fork Nooksack River and Mad River) have a low risk ranking because of the general absence of brook trout.

Core Area Scale

To estimate the overall potential risk for the core area containing local population(s) with moderate to high exposure risk, we integrated the baseline habitat risk ranking for corresponding FMOs (Table 8-39) with the baseline population risk for core areas (Table 8-41). We also integrated FMO exposure risk into this final ranking. However, since the exposure risk can be variable between local populations and FMO habitat within a core area, the results of this combined ranking should be evaluated with some degree of caution. In addition, baseline habitat conditions may also vary between local populations and FMO habitat within a core area, so bias may lean toward the FMO baseline habitat conditions in the core area ranking. However, bias is minimized by the fact that only those core areas with local populations with moderate to high exposure risk were evaluated, and that FMO habitat is typically an equal or greater portion of a core area's landscape when compared to its local populations.

The overall potential risk rankings for the core areas with local populations with a moderate to high exposure risk are summarized in Table 8-44. The three core areas determined to be at high (H) overall potential risk were the Yakima, Entiat, and Methow. The Wenatchee and Puyallup core areas were determined to be at a moderate-high (MH) overall potential risk, or the next highest risk category. The remaining seven core areas had a moderate (M) or moderate-low (ML) overall potential risk ranking.

Integrating the results of the core area and local population overall potential risk rankings would indicate that the Yakima and Entiat core areas are at greatest risk from FPHCP activities, with the Wenatchee, Puyallup, and Methow core areas also at high risk, but with that risk being more variable across their core areas.

Table 8-44. Overall potential risk rankings for core areas with at least one local population at moderate to high exposure risk.

	FMO Exposure Risk		FMO Habitat Risk		Core Area Population Risk		Overall Potential Risk	
Core Area	**rank 1**	**score 1**	**rank 2**	**score 2**	**rank 3**	**score 3**	**rank 4**	**score 4**
Yakima	H	3	H	3	H	3	H	3.0
Entiat	H	3	H	3	H	3	H	3.0
Methow	H	3	H	3	H	3	H	3.0
Wenatchee	H	3	H	3	M	2	MH	2.7
Puyallup	H	3	H	3	M	2	MH	2.7
Walla-Walla	M	2	H	3	M	2	M	2.3
Pend Oreille	L	1	H	3	H	3	M	2.3
Priest Lake	L	1	H	3	H	3	M	2.3
Stillaguamish	H	3	M	2	M	2	M	2.3
Nooksack	M	2	M	2	M	2	M	2.0
Snohomish/ Skykomish	M	2	M	2	M	2	M	2.0
Lewis	L	1	L	1	M	2	ML	1.3

8.6.4.6 Overall Risk for Core Areas Not Included in Overall Potential Risk Ranking

In the analysis of exposure risk, FMO habitats within six core areas were identified as having moderate to high exposure (i.e., containing greater than 20 percent FMO stream habitat on FPHCP covered lands), but no or low exposure risk to their corresponding local populations (Table 8-38). These areas were located within the Hoh, Dungeness, Elwha, Klickitat, Lower Skagit, and Skokomish core areas. These core area populations can still have risk from FPHCP activities on covered lands, especially for those core areas currently in a significantly impaired condition.

To evaluate the risk to the six core areas containing these FMO habitats, their exposure to FPHCP activities, baseline habitat condition, and core area baseline population condition were evaluated. The overall risk to these six core areas from FPHCP activities is considered to be generally less compared to the core areas ranked above in Table 8-44 due to the lack of exposure to their associated local populations. Because none of their local populations are directly affected, the primary risk to these six core populations is from potential impacts to their FMO habitats. As stated earlier, these habitats are generally less sensitive to the effects from activities on FPHCP covered lands. This does not mean that adverse effects from FPCHP activities will not occur to habitat in these FMO areas or that adverse effects will not occur to bull trout within these areas, but rather the adverse effects to a core population's more sensitive spawning and rearing habitats and more sensitive life stages will largely be avoided.

The overall potential risk rankings for these core areas with local populations with low to no exposure risk are summarized in Table 8-45. None of the six core areas were determined to be at a high (H) overall potential risk. Two core areas, Klickitat and Skokomish, were determined to be at moderate-high (MH) overall potential risk. The Hoh, Dungeness, and Elwha core areas were determined to be at a moderate (M) overall potential risk, and the Lower Skagit core area was determined to have a moderate-low (ML) overall potential risk ranking. The Klickitat core area and Skokomish core area risk rankings are driven by their poor baseline habitat conditions and depressed population status. The Klickitat core area primarily consists of a resident population of bull trout with apparently only a few remnant fluvial migrants. The Skokomish core area, while still containing a primarily migratory population, has been fragmented and suffers from low and declining abundances.

Table 8-45. Overall potential risk rankings for core areas with FMO habitats with moderate to high exposure, with local populations with low or no exposure risk.

	FMO Exposure Risk		FMO Habitat Risk		Core Area Population Risk		Overall Potential Risk	
Core Area	**rank 1**	**score 1**	**rank 2**	**score 2**	**rank 3**	**score 3**	**rank 4**	**score 4**
Klickitat	M	2	H	3	H	3	MH	2.7
Skokomish	M	2	H	3	H	3	MH	2.7
Hoh	H	3	M	2	M	2	M	2.3
Dungeness	M	2	M	2	M	2	M	2.0
Elwha	M	2	M	2	M	2	M	2.0
Lower Skagit	M	2	M	2	L	1	ML	1.7

8.6.4.7 Potential Local Population Risk

"Potential local populations" were identified in the draft Bull Trout Recovery Plan as important for recovery. Potential local population is defined in the draft recovery plan as, "A local population that does not currently exist, but that could exist, if spawning and rearing habitat or connectivity were restored in that area, and contribute to recovery in a known or suspected unoccupied area. Alternatively, a potential local population may be a population that is suspected to exist, but that has not yet been adequately documented (USFWS 2002, 2004a, 2004b)." In some cases, bull trout may have been observed in the potential local population area, but it is unknown whether they represent a spawning population due to the current lack of data demonstrating spawning and juvenile rearing, or due to the limited observations of individuals in the area. In other cases, these areas were identified as necessary for recovery because they were historically occupied by bull trout, but they are now either extirpated or presumed extirpated.

According to Rieman and McIntyre (1993), core areas with multiple local populations (ideally 5 or more) have a lower risk of local extirpation from stochastic events. They ultimately advise that it will be necessary to maintain multiple local populations within a core area to ensure conservation of bull trout populations. In some cases, habitats that could sustain local populations may require more intensive management and monitoring to ensure that their desirable characteristics are protected, enhanced, or restored (Rieman and McIntyre 1993).

Potential local populations were not included in the initial risk rankings because specific location of spawning sites is basically unknown and no population parameters (i.e., adult abundance and trend) are available for these populations. However, a coarse analysis of exposure risk can be conducted, especially if substantial amounts of the available habitat within a potential local population are encompassed by FPHCP covered lands or there are rough estimates of where spawning could likely occur. General baseline habitat risk can be evaluated for these areas since it looks at the potential local population as a whole (i.e., subwatershed scale). There are a total of nine potential local populations that contain FPHCP covered lands. We combined the two available risk categories (i.e., exposure risk and baseline habitat risk) to get a coarse estimate of the overall potential risk ranking for these potential local populations. These rankings are summarized below in Table 8-46.

Table 8-46. Combined exposure and baseline habitat risk rankings for potential local populations.

		Exposure Risk		Habitat Risk		Overall Potential Risk	
Core Area	**Potential LP**	**rank 1**	**score 1**	**rank 2**	**score 2**	**rank 4**	**score 4**
Asotin	Wormell Gulch	M	2	H	3	MH	2.5
Pend Oreille	Indian Creek	H	3	M	2	MH	2.5
Yakima	Taneum Creek	M	2	H	3	MH	2.5
Puyallup	Clearwater River	H	3	M	2	MH	2.5
Pend Oreille	Cedar Creek	M	2	M	2	M	2.0
Pend Oreille	Harvey Creek	M	2	M	2	M	2.0
Pend Oreille	SF Tacoma Creek	M	2	M	2	M	2.0
Pend Oreille	Small Creek	M	2	M	2	M	2.0
Elwha	Little River	L	1	M	2	ML	1.5

The results of the potential local population risk rankings suggest that with respect to recovery risk, the Yakima and Puyallup core areas incur an additional increment of risk to their overall potential core area risk ranking. It should be noted that the Pend Orielle core area is in an unusual situation. It currently contains only one known local population, LeClerc Creek, which was ranked at moderate-high (MH) overall potential risk. This fact, combined with the significant number of Pend Oreille potential local populations ranked at moderate (M) to moderate-high (MH) risk, places this core area at a more elevated risk from the perspective of recovery than its overall potential risk ranking might initially indicate.

8.6.5 MEASURE OF ADVERSE EFFECTS TO BULL TROUT

Tables 8-47 8-48, and 8-49 below display the measure of adverse effects to bull trout at the core area level in both their spawning and rearing habitat and FMO habitat. The tables also display the measure of adverse effects to bull trout FMO habitats located outside of core areas. Adverse effects may range from sub-lethal to lethal. In spawning and rearing habitats, egg, alevin, juvenile, and potentially sub-adult and adult life stages may be adversely affected, while in FMO habitats only sub-adult and adult life stages are anticipated to be affected. Actual effects to individual bull trout will vary from activity to activity depending on the specific riparian prescription applied, the location, historic management practices, geological characteristics of the watershed, and the biotic community present.

Table 8-47. Quantification of effects in bull trout core areas.

Core Area	Number of Stream Crossings	Miles of Stream Adjacent Roads Type S Streams	Miles of Stream Adjacent Roads Type F Streams	Miles of Stream Adjacent Roads Type Np Streams	Spawning and Rearing Stream Miles Adjacent to FPHCP Lands (equivalent acres of RMZs)
Columbia River DPS					
Asotin Creek	0	.10	.06	.92	0.8 (11.64)
Entiat	2	.56	1.56	2.48	7.3 (106.18)
Grande Ronde	0	0	0	0	0
Klickitat	0	0	0	0	0
Lewis	15	.60	4.75	4.39	15.4 (326.67)
Methow	0	1.07	.30	0	0
Pend Oreille	26	1.87	3.13	1.16	35.5 (516.36)
Priest Lakes	0	0	0	.10	0.9 (14.18)
Tucannon	1	0	.34	.06	1.5 (21.82)
Walla Walla	20	2.55	10.8	4.07	19.8 (288.00)
Wenatchee	7	8.99	6.63	5.22	12.9 (187.64)
Yakima	36	10.28	23.98	20.21	55.2 (802.91)
Coastal-Puget Sound DPS					
Chester Morse	0	0	0	0	0
Chilliwack	0	0	0	0	0
Dungeness	0	0	.81	.07	1.6 (33.94)
Elwha	3	0	0	0	0
Hoh	1	.86	0	0	2.7 (57.27)
Lower Skagit	5	1.19	1.42	4.72	7.7 (163.33)
Nooksack	44	16.84	14.41	25.46	57.1 (1211.21)
Puyallup	14	8.84	8.66	13.18	40 (848.49)
Queets	0	0	0	0	0
Quinault	0	0	0	0	0
Skokomish	0	0	.05	0	0.3 (6.36)
Snohomish/Skykomish	5	4.25	3.56	2.19	8.3 (176.01)
Stillaguamish	12	5.74	3.45	1.95	22.2 (470.91)
Upper Skagit	0	0	0.55	0	0.5 (10.61)

Table 8-48 Quantification of effects inside bull trout FMO habitat.

FMO inside of Core Area	Number of Stream Crossings of FMO	Miles of Stream Adjacent Roads Type S and F Streams	Miles of Stream Adjacent Roads Type F Streams	Miles of Stream Adjacent Roads Type Np Streams	Acres of RMZs adjacent to FMO habitat
			Columbia River DPS		
Asotin Creek	0	0.53	1.25	1.09	878.00
Entiat	4	7.26	1.11	5.39	1807.42
Grande Ronde	0	.07	1.87	1.53	524.80
Klicitat	2	18.01	21.60	44.28	13996.80
Lewis	2	17.76	55.22	18.86	16351.73
Methow	7	4.38	4.00	3.68	2502.4
Pend Oreille	3	9.18	26.01	17.27	12078.84
Priest Lakes	0	0.0	0.0	0	197.02
Tucannon	0	0.17	9.23	1.40	502.98
Walla Walla	29	2.29	26.70	13.70	4601.6
Wenatchee	17	9.96	12.46	28.35	2749.96
Yakima	22	28.58	38.88	63.77	22569.89
			Coastal-Puget Sound DPS		
Chester Morse	0	0	0	0	0
Chilliwack	5	3.06	6.19	2.25	2323.20
Dungeness	10	4.8	5.25	0.11	1553.26
Elwha	5	3.24	2.73	1.03	1273.60
Hoh	18	5.83	13.54	6.2	8441.93
Lower Skagit	42	40.57	90.53	43.1	32252.67
Nooksack	23	8.00	23.23	6.88	20471.99
Puyallup	22	35.6	58.92	35.48	33026.71
Queets	2	3.19	7.82	1.10	4716.80
Quinault	3	0.35	4.38	0.57	1958.40
Skokomish	4	2.45	5.25	0.18	1913.64
Snohomish/Skykomish	44	80.02	142.35	58.11	52534.39
Stillaguamish	22	21.13	50.86	18.92	21890.69
Upper Skagit	1	0.16	54.5	0.0	277.39

Table 8-49. Quantification of effects outside bull trout FMO habitat.

FMO outside of Core Areas	Number of Stream crossing	Miles of Stream Adjacent Roads Type S Streams	Miles of Stream Adjacent Roads Type F Streams	Miles of Stream Adjacent Roads Type Np Streams	Acres of RMZ adjacent to FMO habitat
Bell	1	0.0	4.9	179.24	512
Cedar/Steamboat	9	0.01	2.53	1.71	957.2
Chehalis	0	29.95	85.56	7.71	8249.6
Goodman	5	2.02	7.63	1.11	3136
Humtulips	8	9.97	26.41	4.40	6675.2
Kalalock	3	0.80	3.20	0.56	1075.20
Moclips/Copalis	13	5.47	20.03	2.85	8332.8
Morse	6	1.88	8.81	1.85	3667.20
Satsop	1	9.74	15.32	2.53	4051.20
Wishkah	9	7.73	113.09	3.60	4902.40
Wynoochee	2	9.29	8.85	1.58	3264.00
Lake Washington	4	23.09	55.05	6.98	11430.40
Lower Green	3	22.32	22.02	5.83	7571.20
Lower Nisqually	3	28.97	43.12	18.74	18745.60
Samamish	23	9.31	15.66	4.80	4563.20

8.6.6 EFFECTS OF THE ACTION ON POPULATIONS

8.6.6.1 Framework of Analysis

As discussed in the status of the species section for bull trout, the core areas assist in developing the basis for our conclusions in this analysis. Draft Bull Trout Recovery Plans have been developed for the Klamath and Columbia River population segments (USFWS 2002) and the Coastal-Puget Sound population segment (USFWS 2004a, 2004b), defined as interim recovery units, and we have grouped core areas into a series of Management Units to facilitate their management and recovery. Within the Coastal-Puget Sound population segment, we identified the Puget Sound and the Olympic Peninsula Management Units, and within the Columbia River population segment, we identified the Lower Columbia River, Middle Columbia River, Upper Columbia River, Clark Fork River, Umatilla-Walla Walla River, Grande Ronde River, Northeast Washington, and Snake River Management Units.

In general, core areas meet a set of biological criteria proposed by Rieman and McIntyre (1993) (see Lohr et al. 2001). A core area is defined as the combination of suitable habitat and one or more local populations (the smallest group of fish that are known to represent an interacting, reproductive unit) that function as one demographic unit with occasional gene flow between them. Generally, these groups of local populations are presumed to function as a metapopulation at the core area scale. The criteria have been expanded by the bull trout recovery planning team to focus on restoration of conditions and activities that are necessary for recovery. A core area represents the closest approximation of a biologically functioning unit for bull trout, and is the basic unit for measuring recovery.

The intent of the FWS's draft Bull Trout Recovery Plan was to protect the metapopulation structure. Bull trout in local populations have the chance to mate with individuals outside an individual local population but within a group of local populations (core area) (Whitesel et al. 2004). The basic unit for ensuring long-term sustainability is the aggregation of local populations into core areas (Whitesel et al. 2004). Therefore, to facilitate and more accurately analyze effects to core areas our analysis focused on evaluating those primary elements that make up a core area, local populations (spawning and rearing habitat) and foraging, migration and overwintering habitats.

As previously described, we consider each bull trout local population an important phenotypic, genetic, and distributional component of its respective population segment. Adverse effects that impact the integrity of a bull trout local population and/or its habitat may appreciably reduce the likelihood of survival and recovery of the entire population segment (i.e., may contribute to jeopardy to the species, as defined by the ESA). This is determined through a multi-scale analysis, with the primary emphasis on the local population to discern impacts to the overall metapopulation (i.e., the core area scale). Generally, impacts to one or more local populations that result in a measurable metapopulation effect (i.e., in terms of numbers, reproduction, or distribution), may correspond to an impact at the core area scale. If core area-scale impacts are sufficiently severe, they may contribute to an appreciable reduction in the likelihood of survival and recovery of the population segment and the coterminus listed entity.

8.6.6.2 Summary of Geographic Risk Analysis Results

The geographic risk analysis evaluated the 25 core areas and their 124 local populations that are within or partially within Washington State. The geographic risk analysis determined that there were seven of 25 core areas that had less than 20 percnet FMO stream habitat and less than 10 percent spawning and rearing stream habitat (with low or no direct exposure) on FPHCP covered lands. These included the Grande Ronde, Tucannon, Chilliwack, Upper Skagit, Chester Morse Lake, Queets, and Quinault core areas. These core area’s local populations (spawning and rearing habitats) and FMO habitats were determined to have no risk or extremely low risk of any adverse affects from the action. Therefore, it was determined that there were no resultant effects in these core areas that would contribute to an appreciable reduction in the likelihood of survival and recovery of either the entire Coastal-Puget Sound or entire Columbia River population segments.

The geographic risk analysis further determined that the remaining 18 core areas had either spawning and rearing stream habitat (12 core areas) or FMO stream habitat (6 core areas) on FPHCP covered lands that warranted further analysis. Our geographic risk analysis focused particularly on local populations (spawning and rearing habitats) given the greater sensitivity and greater relative value of these areas. Our coarse exposure analysis of the 124 local populations, determined 35 local populations contained no FPHCP covered lands (i.e., no direct risk), while 49 local populations had a small percentage (<3 %) of FPHCP covered lands that encompassed or were adjacent to a low risk area (e.g., non-spawning reach) of the local population. This determination further reduced the core areas of concern to 12 (40 local populations). Within these 12 core areas, the local populations that ranked with moderate to high exposure of FPCHP activities were further evaluated for baseline habitat risk and baseline population risk. We determined that three of the core areas only had local populations at low to moderate overall risk rankings, while the remaining nine core areas had some local populations at moderate-high to high overall potential risk rankings (see Table 8-43 under Bull Trout Geographic Risk Analysis section). We further concluded that of the local populations with a moderate-high overall potential risk ranking, the local populations with a high population risk ranking were of greatest relative concern. A total of 18 local populations meeting these criteria were identified in seven of the nine core areas (Table 8-50). These nine core areas are the Entiat, Methow, Pend Oreille, Walla-Walla, Wenatchee, and Yakima core areas in the Columbia River population segment, and the Nooksack, Puyallup, and Stillaguamish core areas in the Coastal-Puget Sound population segment.

Table 8-50. Risk rankings for local populations with moderate-high to high overall potential risk.

Core Area	Local Population	Exposure Risk rank 1	Exposure Risk score 1	Habitat Risk rank 2	Habitat Risk score 2	Population Risk rank 3	Population Risk score 3	Overall Potential Risk rank 4	Overall Potential Risk score 4
Walla-Walla	SF Touchet	H	3	H	3	H	3	H	3.0
Yakima	Ahtanum Creek	H	3	H	3	H	3	H	3.0
Yakima	NF Teanaway River	H	3	H	3	H	3	H	3.0
Yakima	Upper Yakima River	H	3	H	3	H	3	H	3.0
Wenatchee	Nason Creek	H	3	H	3	H	3	H	3.0
Entiat	Entiat River	H	3	H	3	H	3	H	3.0
Walla-Walla	NF Touchet	H	3	M	2	H	3	MH	2.7
Walla-Walla	Wolf Fork Touchet	H	3	M	2	H	3	MH	2.7
Pend Oreille	LeClerc Creek	H	3	M	2	H	3	MH	2.7
Yakima	Gold Creek	H	3	M	2	H	3	MH	2.7
Wenatchee	White River	H	3	M	2	H	3	MH	2.7
Entiat	Mad River	H	3	M	2	H	3	MH	2.7
Stillaguamish	Upper Deer Creek	M	2	H	3	H	3	MH	2.7
Yakima	Cle Elum River	M	2	H	3	H	3	MH	2.7
Wenatchee	Little Wenatchee River	M	2	H	3	H	3	MH	2.7
Wenatchee	Peshastin Creek	M	2	H	3	H	3	MH	2.7
Methow	Goat Creek	M	2	H	3	H	3	MH	2.7
Methow	Gold Creek	M	2	H	3	H	3	MH	2.7
Nooksack	Middle NF Nooksack River	H	3	H	3	M	2	MH	2.7
Nooksack	Lower SF Nooksack River	H	3	H	3	M	2	MH	2.7
Puyallup	Upper Puyallup and Mowich Rivers	H	3	H	3	M	2	MH	2.7
Walla-Walla	Mill Creek	H	3	H	3	M	2	MH	2.7

The geographic risk analysis also identified five core areas (Klickitat, Skokomish, Hoh, Dungeness, Elwha, and Lower Skagit) with significant risk of exposure to their FMO habitats from FPHCP activities, however, they had no to low exposure risk to their corresponding local populations. These FMO areas were further evaluated based on their baseline habitat risk and core area population risk.

8.6.6.3 FPHCP Conservation Measures that Minimize and Mitigate Effects

As discussed previously, the FPHCP has a number of conservation measures that help to reduce, minimize, and mitigate the potential and anticipated adverse effects from FPHCP activities. These features include the riparian buffers, ELZs, RMAPs, best management practices (BMPs) for roads, LHZ/RLIP and FPA screening, FFFPP, and SEPA Class 4 Special evaluations. Riparian buffer strategies strive to conserve adequate wood recruitment, and to minimize temperature increases and sediment inputs. RMAPS, road BMPs, and FFFPP strive to minimize sediment inputs directly related to roads and failing culverts. LHZ/RLIP and FPA screening and SEPA Class 4 Special evaluations strive to prevent FPHCP activity triggered slope failures and mass wasting, which will help conserve LWD recruitment and minimize temperature increases and sediment inputs to bull trout habitats. These conservation measures work collectively to reduce and/or minimize potential and anticipated adverse effects from sediment, loss of LWD, and increases in temperature to bull trout and their habitats. For more information about these conservation measures, refer to **Description of the Rule**.

The Section 10(a)(1)(A) recovery permit conditions for direct take associated with the capture and handling of bull trout during culvert replacements will minimize the level of direct injury or death of individuals related to this FPHCP activity. In addition, issuance of HPAs by WDFW for these particular activities may include project-specific permit conditions that are designed to further reduce the risk of direct injury or death.

8.6.6.4 Effects of the Action on Foraging, Migration, and Overwintering Habitat (FMO)

As stated in the geographic risk analysis, some FMO habitat may be ranked at high exposure risk; however, this does not equate with the same level of risk to local populations (i.e., spawning and rearing habitat). FPHCP activities are not expected to affect FMO habitat to the same degree as spawning and rearing habitat when FPHCP covered lands overlap or are adjacent to these areas. Bull trout FMO habitats are 1) typically larger bodies of water, 2) generally contain streams with warmer water temperatures, and 3) typically used seasonally by bull trout life stages that have less sensitive or restrictive habitat requirements. Therefore, the effects of FPHCP activities on tributaries or stream reaches feeding into FMO streams will more likely be reduced to acceptable levels before reaching many, if not most, FMO streams, and will correspondingly have more limited impacts to bull trout.

There were six core areas with FMO habitats ranked at moderate to high exposure risk, but they had no corresponding local populations with moderate to high exposure risk. Because none of their local populations are directly affected, the primary risk to populations in these six core areas is from potential impacts to their FMO habitats. As stated earlier, these habitats are generally less sensitive to the effects from activities on FPHCP covered lands. This does not mean that adverse effects from FPCHP activities would not occur to habitat in these FMO areas or that adverse effects would not occur to bull trout within these areas, but rather the adverse effects to the core population’s more sensitive spawning and rearing habitats and more sensitive life stages are largely avoided. The geographic risk analysis, ultimately determined that none of the six core areas were at a high (H) overall potential risk from FPHCP activities.

Given the less sensitive nature of FMO stream habitat and the less sensitive or restrictive habitat requirements of the life stages at the time they are using this habitat, and because there are more limited effects of FPHCP activities to FMO stream habitat expected, we expect no resultant effects to any of the core areas that would contribute to an appreciable reduction in the likelihood of survival and recovery of bull trout.

8.6.6.5 Effects of the Action on Local Populations/Core Areas

In general, effects of the action to local populations (and consequently core areas) are anticipated to deliver sediment, increase temperature, and decrease large woody debris. This will likely correspond to a variety of sub-lethal effects, and in some cases (i.e., sediment in particular) may lead to lethal effects to individual bull trout. In addition, sediment, temperature, and large woody debris will likely be impacted irrespective of species presence. However, the severity of these effects will depend on the level of exposure to FPHCP activities, on site-specific conditions, and on the frequency, timing, duration, and intensity of forest practices in these local population areas.

Low to Moderate Overall Potential Risk Local Populations

The geographic risk analysis determined that 18 of the 40 local populations determined to be at moderate to high exposure risk from FPHCP activities were at a low to moderate overall potential risk relative to the other local populations (see Table 8-43 under Bull Trout Geographic Risk Analysis section). Four additional local populations were determined to be at a moderate-high overall potential risk, however, they only had a moderate baseline population risk.

Two key factors that determine the resiliency of local populations (and core areas) to potential adverse effects are population and habitat conditions. Local populations with either low to moderate baseline population and/or habitat risk were considered resilient enough to withstand any short-term adverse effects from FPHCP activities. Having low or moderate baseline risk for both conditions is not necessarily required to ensure resiliency, but this can substantially increase it. In addition, the level of exposure to FPHCP activities (as described by the exposure risk ranking) also informs the degree of potential effect that the local population must be resilient against. Through the results of the geographic risk analysis and after evalutating the effects of the FPHCP conservation measures, we do not anticipate the effects of the action to contribute to an appreciable reduction in the likelihood of survival and recovery at the local population scale for these 22 local populations. However, at the core area scale, we need to further evaluate the local populations that were ranked at higher risks. This analysis is presented below.

With respect to the Nooksack and Puyallup core areas, they were determined to have no other local populations with a high baseline population risk ranking and therefore we do not anticipate any appreciable reduction in the likelihood of survival and recovery from effects of FPHCP activities in these two core areas.

Moderate-High to High Overall Potential Risk Local Populations (w/High Population Risk)

Columbia River Population Segment

Entiat

The Entiat River core area is comprised of the Entiat and Mad Rivers local populations, both of which were characterized by a high risk rating in the geographic risk analysis. As previously described, the effects of the action are anticipated to result in varying amounts of increased sedimentation, increased stream temperature, and decreased large woody debris. The severity of these effects depends on the site-specific baseline conditions and the resiliency of the local population.

The Entiat River local population was ranked as high risk due to low numbers and few years of redd survey data to determine a trend. Although fairly long-term data were available in the core area for the Mad River local population, they were not directly comparable because the Mad River survey reach was shortened due to a log jam that may be a barrier, and the Entiat River local population was not discovered until 2000. Spawning is known to occur in the mainstem Entiat River with annual redd counts numbering from 1 to 7 redds, averaging about 4 redds since 2000. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at high risk. Generally, the population has low resiliency and the overall habitat conditions suggest a low resiliency to the effects of the action.

The Mad River local population was ranked as high risk due to low numbers in redd survey data (1989-2004). Annual redd counts have ranged from 37 to 52, exceeding 50 only once since 1989, but overall suggesting a fairly stable trend. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at moderate risk. Generally, the population has low resiliency and the overall habitat conditions suggest a moderate resiliency to the effects of the action.

Effects of the action to these two local populations are anticipated to deliver more sediment, and to a lesser degree increase temperature, and decrease large woody debris in some locations across the local population area. This will likely correspond to a variety of sub-lethal effects and in some cases (i.e., sediment in particular) lethal effects to individual bull trout. In addition, sediment, temperature, and large woody debris will likely be adversely affected irrespective of species presence. The severity of these effects will depend on site-specific factors and the frequency, timing, duration, and intensity of forest practices in these local population areas.

At the core area scale, the effects of the action to the aforementioned habitat indicators are generally anticipated to be moderate, depending on site-specific factors and the frequency, timing, duration, and intensity of forest practices. This suggests habitat conditions and processes are generally resilient enough to sustain the effects of the proposed action. However, population resiliency to the effects of the action is low for both local populations, and having only two local populations suggests an elevated risk to stochastic events. In addition, FMO habitats are also at high risk and these local populations spend at least six months in that FMO; this has the effect of subjecting bull trout to adverse effects in both their migratory and spawning and rearing habitats, potentially year-round. The population trend for the core area is not clear, but may be slightly decreasing based on redds counts (1989-2004). Currently, the size of these local populations is far below goals developed by the recovery team. Overall, this suggests that the Entiat core area is generally at high risk and is anticipated to experience varying amounts of adverse effects due to FPHCP activities over the next 50 years. However, FPHCP conservation measures and the conservation measures in Section 10(a)(1)(A) recovery permits required for any activity involving capture and handling of fish in association with fish salvage in these local populations, should reduce or minimize the likelihood of lethal effects and reduce the uncertainty associated with the unknown site-specific conditions.

Methow

The Methow core area is comprised of 10 local populations and is the most upstream core area on the Columbia River basin below Grand Coulee Dam. Two of the local populations, Gold Creek and Goat Creek, were characterized by a high risk rating in the geographic risk analysis. As previously described, the effects of the action are anticipated to result in varying amounts of increased sedimentation, increased stream temperature, and decreased large woody debris. The severity of this effect depends on the site-specific baseline conditions and the resiliency of the local population.

The Gold Creek local population was ranked as high risk due to very low numbers of redds in survey data (1996-2003), poor habitat, and moderate exposure adjacent to the spawning and rearing area. The Gold Creek local population is located lowest in the Methow basin and has recently had a large fire burn in its upper watershed. Spawning is known to occur in the upper portion of Gold Creek with an average of only one redd a year. In addition, the habitat risk analysis indicates temperature and large woody debris indicators are at high risk while sediment is at moderate risk. Generally, the population and the habitat has low resiliency to the effects of the action.

The Goat Creek local population was ranked as high risk due to low numbers of redds in survey data (2000-2004), poor habitat conditions, and moderate exposure adjacent to the spawning and rearing area. Goat Creek is located further up in the Methow but is subjected to limited access during summer low flows with some reaches of the Methow completely dewatering. Spawning was not identified until 2000 and annual redd counts have ranged between 0 and 12, with an average of 6. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at moderate risk. Generally, the population has very low resiliency and the overall habitat conditions suggests moderate resiliency to the effects of the action.

Effects of the action to these two local populations are anticipated to deliver more sediment, and to a lesser degree increase temperature, and decrease large woody debris in some locations across the local population areas. This will likely correspond to a variety of sub-lethal effects and in some cases (i.e., sediment in particular) lethal effects to individual bull trout. In addition, sediment, temperature, and large woody debris habitat indicators will likely be adversely affected irrespective of species presence. The locations of project activities within the local populations are uncertain. The severity of these effects will depend on site-specific factors and the frequency, timing, duration, and intensity of forest practices in these local population areas.

At the core area scale, the effects of the action to the aforementioned habitat indicators are anticipated to range from moderate to high, depending on site-specific factors and the frequency, timing, duration, and intensity of forest practices. Additionally, there are four other local populations at moderate risk and FMO habitat which is at high risk due to exposure and habitat conditions, but are considered to be more resilient or less sensitive to the effects of the activities. When combined with the local populations that are at high risk, the core area will likely experience adverse effects in over half of the local populations and in much of the FMO habitat. Population resiliency to the effects of the action is very low in two of the local populations. Additionally, in the other four local populations discussed earlier there is a moderate to high resiliency, however, the exposure to the activities is also moderate. In addition, FMO habitats are also at high risk and these local populations spend at least six months in that FMO; this has the effect of subjecting bull trout to adverse effects in both migratory and spawning and rearing habitats, potentially year-round. The population trend for the core area is not clear, but may be slightly decreasing based on redds counts (1995-2004). Currently, the size of these local populations is far below goals developed by the recovery team. Overall, this suggests that the Methow core area is generally at high risk and is anticipated to experience varying amounts of adverse effects due to FPHCP activities over the next 50 years. However, FPHCP conservation measures and the conservation measures in Section 10(a)(1)(A) recovery permits required for any activity involving capture and handling of fish in association with fish salvage in these local populations, should reduce or minimize the likelihood of lethal effects and reduce the uncertainty associated with the unknown site-specific conditions.

Pend Oreille

The Pend Oreille core area is comprised of 1 local population and 10 potential local populations; only the LeClerc Creek local population was characterized by a high risk rating in the geographic risk analysis. The mainstem Pend Oreille has three major dams in the U.S. portion and two more in Canada; none provide fish passage suggesting poor connectivity between local and potential local populations. As previously described, the effects of the action are anticipated to result in varying amounts of increased sedimentation, increased stream temperature, and decreased large woody debris. The severity of these effects depends on the site-specific baseline conditions and the resiliency of the local population.

The LeClerc Creek local population is characterized as a small, remnant population with very few recent documented observations. Although spawning is presumed to occur based on past observations of juvenile bull trout in LeClerc Creek, the location and extent of spawning and rearing is unknown. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are at high, moderate, and high risk, respectively. Generally, the population has very low resiliency but the overall habitat conditions suggest moderate resiliency to the effects of the action.

Effects of the action to the LeClerc local population are anticipated to deliver more sediment, and to a lesser degree increase temperature, and decrease large woody debris in some locations across the local population area. This will likely correspond to a variety of sub-lethal effects and in some cases (i.e., sediment in particular) lethal effects to individual bull trout. In addition, sediment, temperature, and large woody debris will likely be adversedly affected irrespective of species presence. The severity of these effects will depend on site-specific factors and the frequency, timing, duration, and intensity of forest practices in the local population area.

The Pend Oreille core area also has 10 potential local populations, including Cedar, Harvey, Indian, Mill, Ruby, Slate, Small, South Fork Tacoma, Sullivan, and Tacoma Creeks. However, none of these areas ranked as high risk due to their low to moderate exposure and habitat risk ratings. As a result, they are generally anticipated to be resilient to habitat effects of the proposed action. However, bull trout presence in these potential local populations is not well understood, and may vary from extremely low numbers to absent. As a result, these potential local population areas, if occupied, are anticipated to have very low resiliency to the effects of the action.

At the core area scale, the effects of the action to the aforementioned habitat indicators are anticipated to be moderate, depending on site-specific factors and the frequency, timing, duration, and intensity of forest practices. This suggests habitat conditions and processes are generally resilient enough to sustain the effects of the proposed action. However, population resiliency to the effects of the action is very limited and relies on a single, remnant population. By its very nature, the risk of impact or extirpation of this local population from stochastic events is also high. Loss of the LeClerc Creek local population would likely shrink the distribution of bull trout in Northeast Washington. In addition, FMO habitats are also at high risk and these local populations spend at least six months in that FMO; this has the effect of subjecting bull trout to adverse effects in both their migratory and spawning and rearing habitats, potentially year-round. Currently, the size of these local populations is far below goals developed by the recovery team. Overall, this suggests that the Pend Oreille core area is generally at very high risk and is anticipated to experience varying amounts of adverse effects due to FPHCP activities over the next 50 years. However, FPCHP conservation measures and the conservation measures in Section 10(a)(1)(A) recovery permits required for any activity involving capture and handling of fish in association with fish salvage in these local populations, should reduce or minimize the likelihood of lethal effects and reduce the uncertainty associated with the unknown site-specific conditions.

Walla Walla

The Walla Walla core area is comprised of 4 local populations, but only the North Fork Touchet, South Fork Touchet, and Wolf Fork Touchet Rivers were characterized by a high risk rating in the geographic risk analysis. The Mill Creek population, a tributary of the Walla Walla River, is disjunct from the other three local populations of the Touchet River in the core area. As previously described, the effects of the action are anticipated to result in varying amounts of increased sedimentation, increased stream temperature, and decreased large woody debris. The severity of these effects depends on the site-specific baseline conditions and the resiliency of the local population.

The North Fork Touchet River local population was ranked as high risk due to low numbers and high variability in redd survey data (1994-2004). Spawning is known to occur in the upper portions of the North Fork Touchet River, with redd counts numbering from the mid-40's in the 1990's through 2001, but has since declined to a low of 22 in 2004. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at moderate risk. Generally, the population has low resiliency but the overall habitat conditions suggest a moderate resiliency to the effects of the action.

The South Fork Touchet River local population was ranked as high risk due to very low numbers and high variability in redd survey data (2000-2004). Spawning is known to occur in a single tributary and was not identified until 2000. After 16 redds were observed in the South Fork Touchet River in 2001, the redd count dropped to one in 2002, and no redds were seen in 2003 and 2004 surveys. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at high to moderate risk. Generally, the population has very low resiliency and the overall habitat conditions suggest a low to moderate resiliency to the effects of the action.

The Wolf Fork Touchet River local population was ranked as high risk due to low numbers and high variability in redd survey data (1994-2004). Spawning is known to occur in the upper potions of the Wolf Fork Touchet River and supports the largest population in Touchet River. However, annual redd counts have fluctuated widely, from 71 in 1994, down to 4 in 1997, then as high as 101 in 2003. Despite the high variability, the overall trend in redds have been upward in the Wolf Fork since 1998. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at moderate risk. Generally, the population has low resiliency but the overall habitat conditions suggest a low to moderate resiliency to the effects of the action.

Effects of the action to these three local populations are anticipated to deliver more sediment, and to a lesser degree increase temperature, and decrease large woody debris in some locations across the local population areas. This will likely correspond to a variety of sub-lethal effects and in some cases (i.e., sediment in particular) lethal effects to individual bull trout. In addition, sediment, temperature, and large woody debris will likely be adversely affected irrespective of species presence. The severity of these effects will depend on site-specific factors and the frequency, timing, duration, and intensity of forest practices in these local population areas.

The Mill Creek local population is the remaining local population in the core area, but was not determined to be at high risk by the geographic risk analysis. The available data suggest a moderate population risk rating. Despite some annual variability, redd totals have generally been stable in Mill Creek since 1994. Annual redd counts have ranged between 118 and 220, with an average of 170, and with no discernible trend. As a result, the Mill Creek local population is generally anticipated to be resilient to the effects of the proposed action. Habitat effects, however, may be a more sensitive pathway due to the high exposure risk and high habitat risk of the local population. Overall, the population may have moderate resiliency but habitat conditions suggest low to moderate resiliency to the effects of the action.

At the core area scale, the effects of the action to the aforementioned habitat indicators are generally anticipated to be moderate, depending on site-specific factors and the frequency, timing, duration, and intensity of forest practices. This suggests habitat conditions and processes are generally resilient enough to sustain the effects of the proposed action. However, population resiliency to the effects of the action is low to very low in three of four local populations. In addition, FMO habitats are also at high risk and these local populations spend at least six months in that FMO; this has the effect of subjecting bull trout to adverse effects in both their migratory and spawning and rearing habitats, potentially year-round. Currently, the size of these local populations is far below goals developed by the recovery team. Overall, this suggests that the Walla Walla core area is generally at high risk and is anticipated to experience varing amounts of adverse effects due to FPHCP activities over the next 50 years. However, FPCHP conservation measures and the conservation measures in Section 10(a)(1)(A) recovery permits required for any activity involving capture and handling of fish in association with fish salvage in these local populations, should reduce or minimize the likelihood of lethal effect and reduce the uncertainty associated with the unknown site-specific conditions.

Wenatchee

The Wenatchee core area is comprised of 7 local populations. Four of the local populations, Nason Creek, White River, Little Wenatchee River, and Peshastin Creek were characterized by a high risk rating in the geographic risk analysis. As previously described, the effects of the action are anticipated to result in varying amounts of increased sedimentation, increased stream temperature, and decreased large woody debris. The severity of these effects depends on the site-specific baseline conditions and the resiliency of the local population.

The Nason Creek local population was ranked as high risk due to very low numbers of redds in the survey data (1999-2004), poor habitat, and high exposure adjacent spawning and rearing areas. The Nason Creek local population is the most upstream tributary to the Wenatchee River. It has been subjected to two large scale rain on snow events in the size of >100 year floods. It has been extensively harvested and several wildfires have occurred in the last 15 years. Spawning is known to occur in the upper portion of Nason Creek with annual redd count data showing 0 to 15 redds, with an overall average of 7 redds. In addition, the habitat risk analysis indicates sediment, temperature, and large woody debris indicators are at high risk. Generally, the population and the habitat has low resiliency to the effects of the action.

The White River local population was ranked as high risk due to low numbers and unstable or variable redd counts from 1986-2004, moderate habitat conditions, and high exposure of spawning and rearing areas. The White River local population is located in the only all glacial fed river and flows into Lake Wenatchee. Annual redd counts range from 2 to 90, with an average of 39. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are at moderate to low risk from project activities. Generally, the population has low resiliency but the overall habitat conditions suggests a moderate to high resiliency to the effects of the action.

The Little Wenatchee local population was ranked as high risk due to very low numbers in spawning data from 1999-2004, poor habitat, and moderate exposure of spawning and rearing areas. Spawning was not identified until 1999 and annual redd counts have ranged between 0 and 5, with an average of 3. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at high risk. Generally, the population and habitat conditions have very low resiliency to the effects of the action.

The Peshastin Creek local population was ranked as high risk due to very low numbers in the spawning data from 2000-2004, poor habitat, and moderate exposure of spawning and rearing areas. Spawning was not identified until 2000 and annual redd counts have ranged between 0 and 9, with an average of 4. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at high risk. Generally, the population has very low resiliency and the overall habitat conditions suggests low resiliency to the effects of the action.

Effects of the action to these four local populations are anticipated to deliver more sediment, and to a lesser degree increase temperature, and decrease large woody debris in some locations across the local population areas. This will likely correspond to a variety of sub-lethal effects and in some cases (i.e., sediment in particular) lethal effects to individual bull trout. In addition, sediment, temperature, and large woody debris habitat indicators will likely be adversely affected irrespective of species presence. The locations of project activities within the local populations are uncertain. The severity of these effects will depend on site-specific factors and the frequency, timing, duration, and intensity of forest practices in these local population areas.

At the core area scale, the effects of the action to the aforementioned habitat indicators are anticipated to range from moderate to high, depending on site-specific factors and the frequency, timing, duration, and intensity of forest practices over the course of 50 years. Additionally, there are two other local populations at moderate risk and one other at a low risk to adverse effects, and FMO habitat is also at high risk to adverse effects due to exposure and habitat conditions, but these are thought to be more resilient and less sensitive to the effects of the activities. When combined with the local populations that are at high risk, the core area is anticipated to experience moderate to high levels of adverse effects in over half of the local populations and in much of the FMO habitat. Population resiliency to the effects of the action is very low in four of the local populations, but is moderate to high for the other three local populations. In addition, FMO habitats are also at high risk and these local populations spend at least six months in that FMO; this has the effect of subjecting bull trout to adverse effects in both their migratory and spawning and rearing habitats, potentially year-round. The core area population trend appears to be stable based on redd counts, but is heavily weighted on a single, large local population in the Chiwawa River. However, redd counts are highly variable and low in the other 6 local populations. Currently, the counts in all but one of the local populations are far below expected recovery numbers developed by the recovery team, and only the Chiwawa River local population is rated at low risk to adverse effects from project activities. Overall, this suggests that the Wenatchee core area is generally at high risk and is anticipated to experience varying amounts of adverse effects due to FPHCP activities. However, FPCHP conservation measures and the conservation measures in Section 10(a)(1)(A) recovery permits required for any activity involving capture and handling of fish in association with fish salvage in these local populations, should reduce or minimize the likelihood of lethal effects and reduce the uncertainty associated with the unknown site-specific conditions.

Yakima

The Yakima core area is comprised of 15 local populations and 1 potential local population. However, only the Ahtanum Creek, Cle Elum River, Gold Creek, Teanaway River, and Upper Yakima River local populations were characterized as having a high risk rating in the geographic risk analysis. The Yakima may also represent a unique and distinct genotype and life history forms. Preliminary data suggest Yakima bull trout have few similarities between upper and lower Columbia bull trout. The Yakima basin is highly modified and has numerous partial and absolute fish-passage barriers. Five major water storage dams (for irrigation) fragment the metapopulation and prevent demographic and genetic exchange between local populations. In addition, numerous in channel irrigation diversion structures and diversions reduce instream flows by up to 80 percent. High temperatures and chemical contaminants are severe and prevalent enough to constitute barriers to passage. As previously described, the effects of the action are anticipated to result in varying amounts of increased sedimentation, increased stream temperature, and decreased large woody debris. The severity of this effect depends on the site-specific baseline conditions and the resiliency of the local population.

The Ahtanum Creek local population was ranked as high risk due to very low numbers, variability in redd counts (comparable data exists from 1999-2004), and a lack of a migratory life form. Spawning of resident fish is known to occur in the upper portions of the watershed, but annual redd counts number as few as 8 redds. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at high risk. It is also noteworthy that the Ahtanum has a very high exposure risk, with as much as 59 percent of the local population within or adjacent to FPHCP covered lands. Generally, the population has very low resiliency and the overall habitat conditions also suggest a low resiliency to the effects of the action.

The Cle Elum River local population was ranked as high risk due to very low numbers and high variability in redd survey data (1994-2004). Spawning is presumed to occur in the watershed but data has not been reliably collected to provide numbers or locations of key habitats. Generally, population size is thought to be very small. Evidence of hybridization with brook trout is also of concern in terms of population effects, with F2 hybrids documented in the mainstem Cle Elum. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are at high, high, and moderate risk, respectively. Generally, the population has low resiliency but the overall habitat conditions suggest a low to moderate resiliency to the effects of the action.

The Gold Creek local population was ranked as high risk due to very low numbers and high variability in redd survey data (1984-2004). Redd counts are variable but numbers have ranged from 20 to 52, with an average of 20 over the last 20 years. Spawning is known to occur in Gold Creek, but seasonal passage barriers due to stream dewatering from low flows restricts and isolates the spawning distribution above and below these barriers. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at moderate risk. Generally, the population has low resiliency but the overall habitat conditions suggest a moderate resiliency to the effects of the action.

The Teanaway River local population was ranked as high risk due to extremely low population numbers. Spawning is known to occur in the North Fork Teanaway, but the data are incomplete. Only six years of redd data have been reported in the last ten years, and never more than two redds have been reported. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at high risk. Generally, the population has very low resiliency and the overall habitat conditions suggest a low resiliency to the effects of the action.

The Upper Yakima River local population was ranked as high risk due to very low numbers. Spawning is known to occur in the watershed, but redd counts data are limited to four years (2000 through 2003). Two redds were identified in 2000, 1 in 2001, but none were observed in 2002 or 2003. In addition, the habitat risk analysis suggests sediment, temperature, and large woody debris indicators are all at high risk. Generally, the population has low resiliency and the overall habitat conditions suggest a low resiliency to the effects of the action.

Effects of the action to these five local populations are anticipated to deliver more sediment, and to a lesser degree increase temperature, and decrease large woody debris in some locations across the local population areas. This will likely correspond to a variety of sub-lethal effects and in some cases (i.e., sediment in particular) lethal effects to individual bull trout. In addition, sediment, temperature, and large woody debris will likely be adversely affected irrespective of species presence. The severity of these effects will depend on site-specific factors and the frequency, timing, duration, and intensity of forest practices in these local population areas.

Beyond these five local populations above, 10 additional local populations and one potential local population are located in the Yakima core area, but these were not determined to be at high risk by the geographic risk analysis. These include the American River, Box Canyon Creek, Bumping River, Crow Creek, Deep Creek, Indian Creek, Kachess River, North Fork Tieton, Rattlesnake Creek, and South Fork Tieton local populations and the Tanuem Creek potential local populations. Nonetheless, the available data suggest a moderate population risk rating. Overall, the redd counts at the core area scale are relatively stable at about 525 since 1998, but are strongly influenced by the Indian Creek and South Fork Tieton local populations. As a result, these local populations and potential local population are generally anticipated to be resilient to the effects of the proposed action. Overall, the population may have moderate resiliency but habitat conditions suggest low to moderate resiliency to the effects of the action.

Impacts to the Taneum potential local population is anticipated to be moderate due to its low exposure risk rating. As a result, this potential local population is generally anticipated to be resilient to habitat effects of the proposed action. Bull trout distribution in the Taneum potential local population however, is not well understood, and the species may be absent. As a result, this potential local population area, if occupied, is anticipated to have very low resiliency to the effects of the action.

At the core area scale, the effects of the action to the aforementioned habitat indicators are anticipated to be moderate, depending on site-specific factors and the frequency, timing, duration, and intensity of forest practices. This suggests habitat conditions and processes are generally resilient enough to sustain the effects of the proposed action. However, population resiliency to the effects of the action is low to very low in 7 of 15 local populations, is moderate in 7, and is high in only 1. In addition, FMO habitats are also at high risk and these local populations spend at least six months in that FMO; this has the effect of subjecting bull trout to adverse effects in both migratory and spawning and rearing habitats, potentially year-round. The population trend for the core area appears to be declining based on redds counts (1984-2004). Currently, the size of these local populations is far below goals developed by the recovery team. Overall, this suggests that the Yakima core area is generally at high risk and is anticipated to experience varying amounts of adverse effects due to FPHCP activities. However, FPCHP conservation measures and the conservation measures in Section 10(a)(1)(A) recovery permits required for any activity involving capture and handling of fish in association with fish salvage in these local populations, should reduce or minimize the likelihood of lethal effect and reduce the uncertainty associated with the unknown site-specific conditions.

Coastal-Puget Sound Population Segment

Stillaguamish Core Area

The Stillaguamish core area is comprised of 4 local populations, but only the Upper Deer Creek local population was characterized by a high risk rating in the geographic risk analysis. The Upper Deer Creek local population is one of two within the North Fork of the Stillaguamish River system. As previously described, the effects of the action are anticipated to result in varying amounts of increased sedimentation, increased stream temperature, and decreased large woody debris. The potential for and severity of these effects depends on the site-specific baseline conditions and the resiliency of the local population.

The Upper Deer Creek local population was ranked as high risk due to low numbers of adult spawners. Although no accurate counts have been made, current adult spawner abundance is estimated to be well below 100 individuals. In addition, the baseline habitat risk analysis suggests temperature and large woody debris indicators are at high risk, and sediment at a moderate risk. However, the habitat within this local population is considered to be recovering. Generally the population has low resiliency, but exposure risk to the effects is considered to be only moderate.

Effects of the action to this local population are anticipated to deliver additional sediment, and to a lesser degree increase temperature, and decrease large woody debris in primarily the most downstream portion of the local population. This will likely correspond to a variety of sub-lethal effects and in some cases (i.e., sediment in particular) may lead to lethal effects to individual bull trout. In addition, sediment, temperature, and large woody debris will likely be adversely affected irrespective of species presence. However, the severity of these effects will depend on site-specific conditions, and on the frequency, timing, duration, and intensity of forest practices in these local population areas.

At the core area scale, the effects of the action to the aforementioned habitat indicators are generally anticipated to be moderate, depending on site-specific factors and the frequency, timing, duration, and intensity of forest practices. This suggests habitat conditions and processes are generally resilient enough to sustain the effects of the proposed action. However, population resiliency to the effects of the action is likely low in the affected local population. In addition, FMO habitats are at moderate risk and this local population may spend at least six months in that FMO habitat depending on life history; this has the effect of subjecting bull trout to adverse effects in both their migratory and spawning and rearing habitats, potentially year-round. Overall, this suggests that the Stillaguamish core area is generally at moderate risk and is anticipated to experience varying amounts of adverse effects due to FPHCP activities. However, FPCHP conservation measures and the conservation measures in Section 10(a)(1)(A) recovery permits required for any activity involving capture and handling of fish in association with fish salvage in these local populations, should reduce or minimize the likelihood of lethal effects and reduce the uncertainty associated with the unknown site-specific conditions.

8.6.7 CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the FPHCP Action Area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Numerous non-Federal actions that could affect listed species are reasonably certain to occur within the FPHCP Action Area. These will typically include mining, agricultural activities, grazing, wildfire, and rural and residential development. Each of these future activities could contribute to cumulative effects on listed species or their habitat in the FPHCP Action Area.

In western Washington, 83 percent of the land is presently forested, 5 percent is in agriculture, 4 percent is urban and industrial lands, and the remaining 8 percent are comprised of water and wetlands, ice, snow and bare rock, shrubland, and grassland. Most of the development has occurred along Puget Sound and along major river systems.

In contrast, eastern Washington is 36 percent forested, 35 percent shrubland/grassland, 26 percent agriculture, 1 percent industrial and urban, and the remaining 3 percent water, wetlands, ice, snow, and bare rock. Major hydroelectric and irrigation developments along the Columbia River system have resulted in the greatest change to the eastern Washington landscape, particularly in the non-forested areas.

8.6.7.1 Population and Development

A rapidly expanding urban and industrial footprint will continue to impact bull trout and bull trout habitat. In western Washington, most of the growth is not only projected to continue to occur in and around Puget Sound, but also along major river systems. As development increases, aquatic habitats outside of protected areas will probably continue to decline. The rate of decline will depend on the amount of growth occurring in a particular area. Anadromous bull trout will continue to be affected by growth-induced impacts to habitat and water quality in Puget Sound and the lower reaches of many of the river systems entering Puget Sound. As growth continues to spread up these rivers, growth-associated impacts are also expected to move further upstream. These impacts are more likely to affect foraging, overwintering, and migration habitat within major river systems than spawning and rearing habitat nearer to the headwaters. Future growth in eastern Washington will probably occur near existing population centers, such as Spokane, Wenatchee, Yakima, and the Tri-cities area. While limited developable space is available within the cities themselves, growth around their peripheries is likely to be high.

8.6.7.2 Transportation

Major transportation projects including highway expansion and upgrades, new highways, and port expansions likely will have a Federal nexus and, therefore, are not part of this cumulative effects discussion. Smaller transportation networks may not fall under the same purview. These projects although on a smaller scale, could have a cumulative effect on bull trout habitat when the two intersect.

8.6.7.3 Forest Activities

Outside of tribal forestlands, federally owned and managed forest lands, and forest lands covered by an existing HCP, there is little forested acreage that is not part of this proposed action. The negative effects from activities associated with timber harvest on bull trout have been reduced over time through the implementation of the Northwest Forest Plan on Federal lands and landscape-scale HCPs on State and private lands. The remaining threats to bull trout and bull trout habitat related to forest activities includes the conversion of forested lands to other uses such as industrial and urban development, agriculture, and highway infrastructure. In addition to conversion, other activities may occur with or without the consent of the landowner. These activities include off-road-vehicle use, harvest of plant materials, dumping of trash, and other activities. As the population of Washington continues to grow, the rate of forestland conversion is likely to increase. More people also tend to place a greater demand on forested lands for the other activities listed above. In the near-term, forestland conversion would likely continue to occur more rapidly along existing transportation corridors and major river systems and in those counties with the major population centers. Rural counties with relatively small populations are less likely to experience substantial growth in the near future and the need to convert forestlands will be somewhat less. However, improved communications and other technologies make it possible for many people to conduct business across broad geographic areas from relatively remote areas. These people draw development of support services to rural areas.

8.6.7.4 Mining

Mining will have localized impacts to bull trout and bull trout habitat. Continued growth will result in an increasing demand for materials such as sand, gravel, and rock. Although instream mining for these resources was the norm, extraction of these materials has occurred more recently in the floodplain of rivers or upland areas. The impacts associated with these methods of mineral-resource extractions may not be as direct, but they still can result in adverse effects to aquatic habitats. Outside where known mining operations occur, predicting where new mining might occur is speculative. It is likely that the majority of such mining will occur in somewhat close proximity to the ongoing development that forms the demand for sand, rock, and gravel. Floodplain mines within the active channel migration zone are at risk of capture by the river. Run-off from uplands mines can affect water quality and spawning and rearing habitat. In addition, recreational gold mining occurs in Washington especially in parts of eastern Washington. Impacts from such activities are expected to occur at some rate, but such activities are not likely to increase over time. Recreational gold mining can be localized, but with potential negative effects on spawning and rearing bull trout and habitat.

8.6.7.5 Agriculture and Grazing

Agricultural and grazing practices in riparian areas are generally less regulated than forest practices and, like unregulated forest practices, can have a profound effect on bull trout and bull trout habitat. Agricultural and grazing practices can degrade riparian conditions, destabilize streambanks, introduce sediment leading to increased water temperatures, streambed embeddedness, and the loss of cover including pools, woody debris, and overhanging vegetation. Water diversion and irrigation activities associated with agricultural activities are expected to continue, contributing to water quality and water quantity impacts. Diversions can also create barriers to bull trout migration by physically blocking the stream, by drying up portions of the stream, or creating a temperature barrier. Agriculture and grazing tend to be a greater threat to bull trout on the eastside of the Cascades where it accounts for over 25 percent of the land use. Only 5 percent of the land use in western Washington is attributed to agriculture.

8.6.7.6 Fire

Bull trout evolved under historic fire regimes in which disturbance to streams from forest fires resulted in a mosaic of diverse habitats. However, forest management and fire suppression over the past century have increased tree stocking levels, off-site species, moisture stress, and ladder and other fuels within terrestrial and riparian forests, increasing the likelihood of large, intense forest fires in some areas. The most-severe effects of fire on native fish populations can be expected where populations have become fragmented by human activities or natural events (Gresswell 1999).

Rieman and Clayton (1997) discussed relations among the effects of fire and timber harvest, aquatic habitats, and sensitive species. They noted that spatial diversity and complexity of aquatic habitats strongly influence the effects of large disturbances on salmonids. For example, Rieman et al. (1997b) studied bull trout and redband trout responses to large, intense fires that burned three watersheds in the Boise National Forest in Idaho. Although the fires were the most intense on record, there was a mix of severely burned to unburned areas left after the fires. Fish were apparently eliminated in some stream reaches, whereas others contained relatively high densities of fish. Within a few years after the fires and after areas within the watersheds experienced debris flows, fish had become reestablished in many reaches, and densities increased. In some instances, fish densities were higher than those present before the fires or in streams that were not burned (Rieman et al. 1997b). These responses were attributed to spatial habitat diversity that supplied refuge areas for fish during the fires, and the ability of bull trout and the redband trout to move among stream reaches. For bull trout, the presence of migratory fish within the system was also important (Rieman and Clayton 1997, Rieman et al.1997b).

The risk of fires on bull trout habitat will vary based on current trajectories of forest conditions. In core areas where emphasis has been on the restoration of watershed processes that create and maintain habitat diversity, provide bull trout access to habitats, and protect or restore migratory life-history forms of bull trout, the effects of fire are expected to become less severe to these populations over time. Both passive (e.g., encouraging natural riparian vegetation and floodplain processes to function appropriately) and active (e.g., reducing road-related effects, removing barriers to fish movement, and improving habitat complexity) management responses would offer the best approaches to protect bull trout from the effects of large fires.

8.6.7.7 Other Activities

Other activities, including those described earlier in the **Comprehensive Environmental Baseline** section, will continue to degrade Washington’s ecosystems. Some of these activities are more pertinent to bull trout and/or bull trout forage species. The accidental or purposeful introduction of non-native species will continue to occur and these species will continue to expand their ranges. These species will directly compete with bull trout for space and forage, prey upon bull trout, or will alter the habitats on which bull trout depend. Of these, brook trout may pose the biggest threat to bull trout. Brook trout are in the char family and are known to interbreed with bull trout. There are also more aggressive and tend to grow faster. Brook trout compete with bull trout for food and habitat and are more tolerant of warm water temperatures. And like bull trout, they thrive in cold water.

Recreational activities will increase as the population expands placing additional demands on the forested landscape where bull trout occur. Such demands can lead to habitat alteration or direct effects to bull trout via poaching or incidental catching of bull trout.

Habitat restoration and/or enhancement projects designed to improve habitat conditions may continue to increase in number, complexity, and scale. Although the effectiveness of some of these projects is not well known, monitoring of others continues to improve the science. Such projects have been effective and can have localized benefits for bull trout by improving habitat or connectivity between habitats. Many enhancement and restoration projects, and other corrective activities, are in the planning and/or implementation process. The success of those projects that have already been implemented is not always accurately known, but some monitoring is occurring. With continuing advances in understanding natural watershed processes and anticipated improvements to restoration science, we anticipate that future restoration projects will be better designed, provide more quality habitat, and be a better fit for the environment in which they are placed. As a whole, these restoration actions are expected to improve natural-resource conditions in the future, even in consideration of some short-term adverse effects.

8.6.7.8 Conclusion

Many of the existing activities described in the environmental baseline are expected to continue in Washington in the future and where such activities intersect bull trout and bull trout habitat, adverse effects can still be expected. Certain timber harvest, mining, and agricultural practices have improved over time, and are not anticipated to result in the extreme effects that occurred in the more-distant past. Ongoing, incremental adverse effects from these activities may be most severe to high risk populations, where habitats are still recovering from the legacy of more extreme adverse effects and bull trout abundances are currently depressed. Non-native, invasive species will continue to compete with bull trout and under some circumstances out-compete bull trout for forage and space. This will most likely occur where bull trout habitats are currently degraded or recovering, and where the migratory life history form of bull trout has been lost or is currently low in numbers. The increased human population growth and development within bull trout watersheds is likely to result in adverse effects to bull trout foraging, migratory, and spawning behaviors through degraded water quality, reduced flows, habitat changes, and migratory blockages. In turn, the degradation of the water quality and quantity and habitat alterations can make conditions more favorable for exotic species. The most severe development impacts to bull trout would be where development intersects with their local populations (i.e., spawning and rearing habitats).

8.6.8 CONCLUSION

We have reviewed the current status of the bull trout, the environmental baseline, the effects of the proposed FPHCP, and cumulative effects. Based on this review, it is our biological opinion that the FPHCP, as proposed, is not likely to jeopardize the continued existence of bull trout in the coterminous range.

The environmental baseline indicates that although bull trout are widely distributed within Washington, abundance is generally low to moderate within core areas of the Columbia River population segment and Coastal-Puget Sound population segment with some exceptions, and productivity is highly variable across core areas. Fragmentation and reduced distribution of the migratory life history form is generally more prevalent within core areas in the Columbia River population segment than within core areas in the Coastal-Puget Sound population segment. Baseline habitat conditions are generally poorer in spawning and rearing habitats of core areas within the Washington portion of the Columbia River population segment compared to the Coastal-Puget Sound population segment. At the core area scale, numerous historical and ongoing factors continue to limit the potential for population recovery within many of the core areas across the two population segments; however, there are a number of core areas with substantial bull trout habitat within relatively protected areas (e.g., wilderness areas and national parks). In some core areas, habitat is largely protected (e.g., Wilderness Areas and National Parks) and the presence of non-native fish species (i.e., brook trout and lake trout) may be the only significant factor of concern.

The proposed action will have short- to long-term adverse effects on bull trout through sediment, large woody debris, and temperature habitat indicators, but overall baseline habitat conditions should generally improve over the life of the FPHCP. The potential for severe short-term adverse effects is likely highest in core areas with local populations with low abundances and baseline habitat conditions that are currently poor. Where baseline habitat conditions are at low to moderate risk, the potential for severe short-term adverse effects is significantly reduced. Direct injury and death to bull trout may occur during some road crossing construction (e.g., stream dewatering and fish rescue and relocation, blockage of upstream migration during construction). The FPCHP conservation measures reduce the extent of such impacts, and Section 10(a)(1)(A) recovery permits required for any activity involving eletrofishing and handling of fish in association with fish salvage in high risk local populations, should reduce or minimize the likelihood of lethal effects in these cases. Beneficial effects of the FPHCP, especially improved access to spawning and rearing habitat, overall improved riparian conditions, and overall reduction of sediment impacts to streams, should continue through the life of the HCP.

8.7 BULL TROUT CRITICAL HABITAT

8.7.1 STATUS OF BULL TROUT CRITICAL HABITAT (Rangewide)

8.7.1.1 Legal Status

The FWS published a final critical habitat designation for the coterminous United States population of the bull trout on September 26, 2005 (70 FR 56212); the rule became effective on October 26, 2005. The scope of the designation involved the Klamath River, Columbia River, Coastal-Puget Sound, and St. Mary-Belly River population segments (also considered as interim recovery units). Rangewide, the FWS designated 143,218 acres of reservoirs or lakes and 4,813 stream or shoreline iles as bull trout critical habitat (Table 8-51).

Table 8-51. Stream/shoreline distance and acres of reservoir or lakes designated as bull trout critical habitat by state.

	Stream/shoreline Miles	Stream/shoreline kilometers	Acres	Hectares
Idaho	294	474	50,627	20,488
Montana	1,058	1,703	31,916	12,916
Oregon	27,322	11,057	27,322	11.057
Oregon/Idaho	17	27		
Washington	1,519	2,445	33,353	13,497
Washington (marine)	985	1,585		

Although critical habitat has been designated across a wide area, some critical habitat segments were excluded in the final designation based on a careful balancing of the benefits of inclusion versus the benefits of exclusion (see Section 3(5)(A) and Exclusions under Section 4(b)(2) in the final rule). This balancing process resulted in all proposed critical habitat being excluded in 9 proposed critical habitat units: Unit 7 (Odell Lake), Unit 8 (John Day River Basin), Unit 15 (Clearwater River Basin), Unit 16 (Salmon River Basin), Unit 17 (Southwest Idaho River Basins), Unit 18 (Little Lost River), Unit 21 (Upper Columbia River), Unit 24 (Columbia River), and Unit 26 (Jarbidge River Basin). The remaining 20 proposed critical habitat units were designated in the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation.

8.7.1.2 Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (70 FR 56212). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses.

Critical habitat units generally encompass one or more core areas and may include foraging, migration, and overwintering areas, outside of core areas, that are important to the survival and recovery of bull trout.

Because there are numerous exclusions that reflect land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments. These individual critical habitat segments are expected to contribute to the ability of the stream to support bull trout within local populations and core areas in each critical habitat unit.

The primary function of individual critical habitat units is to maintain and support core areas which (1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993); (2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993; MBTSG 1998); (3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Rieman and McIntyre 1993; Hard 1995; Healey and Prince 1995; MBTSG 1998); and (4) are distributed throughout the historical range of the species to preserve both genetic and phenotypic adaptations (Rieman and McIntyre 1993; Hard 1995; MBTSG 1998; Rieman and Allendorf 2001).

The Olympic Peninsula and Puget Sound Critical Habitat Units are essential to the conservation of amphidromous bull trout, which are unique to the Coastal-Puget Sound bull trout population. These critical habitat units contain marine nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain PCEs that are critical to adult and sub-adult overwintering, migration, and foraging.

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, and sheltering. Note that only the PCEs described in paragraphs (1), (2), (3), and (4) apply to marine nearshore waters identified as critical habitat; and all except PCE (3) apply to foraging, migration, and overwintering habitat identified as critical habitat.

The PCEs are as follows:

1. Water temperatures that support bull trout use. Bull trout have been documented in streams with temperatures from 32 to 72 ºF (0 to 22 ºC) but are found more frequently in temperatures ranging from 36 to 59 ºF (2 to 15 ºC). These temperature ranges may vary depending on bull trout life-history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence. Stream reaches with temperatures that preclude bull trout use are specifically excluded from designation;

2. Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures;

3. Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. This should include a minimal amount of fine substrate less than 0.25 inch (0.63 centimeter) in diameter;

4. A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a biological opinion that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day

fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation. This rule finds that reservoirs currently operating under a biological opinion that addresses bull trout provides management for PCEs as currently operated;

5. Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source;
6. Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows;
7. An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish; and
8. Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

Critical habitat includes the stream channels within the designated stream reaches, the shoreline of designated lakes, and the inshore extent of marine nearshore areas, including tidally influenced freshwater heads of estuaries.

In freshwater habitat, critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line. In areas where ordinary high-water line has not been defined, the lateral extent would be defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series. For designated lakes, the lateral extent of critical habitat is defined by the perimeter of the water body as mapped on standard 1:24,000 scale topographic maps.

In marine habitat, critical habitat includes the inshore extent of marine nearshore areas between mean lower low-water (MLLW) and minus 33 feet (10 meters) mean higher high-water (MHHW), including tidally influenced freshwater heads of estuaries. This refers to the area between the average of all lower low-water heights and all the higher high-water heights of the two daily tidal levels. The offshore extent of critical habitat for marine nearshore areas is based on the extent of the photic zone, which is the layer of water in which organisms are exposed to light. Critical habitat extends offshore to the depth of 33 feet (10 meters) relative to the MLLW.

Adjacent stream, lake, and shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat can have major effects on physical and biological features of the marine environment.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to “destroy or adversely modify” critical habitat by altering the PCEs to such an extent that critical habitat would not remain functional to serve the intended conservation role for the species (70 FR 56212; FWS 2004). Our evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (USFWS and NMFS 1998). Therefore, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Columbia River, Coastal-Puget Sound, and St. Mary-Belly River population segments.

8.7.1.3 Current Condition Rangewide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). This condition reflects the condition of bull trout habitat.

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: (1) Fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Rieman and McIntyre 1993; Dunham and Rieman 1999); (2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989; MBTSG 1998); (3) the introduction and spread of non-native species as a result of fish stocking and facilitated by degraded habitat conditions, particularly for brook trout and lake trout, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993; Rieman et al. 2006); (4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and (5) degradation of foraging, migration, and overwintering habitat resulting from reduced prey base, roads, agriculture, development, and dams.

8.7.2 ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR § 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the FPHCP Action Area (see **Action Area** description). Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the FPHCP Action Area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress.

Common to all the critical habitat units are past logging operations and the infrastructure necessary to carry out these activities. Such operations were mostly unregulated until the 1970’s, although reforestation has been required since 1946. In 1974, the Washington Forest Practices Act was passed into law providing the start of comprehensive regulations on State and private forestry operations. Federal management on national forest lands incorporated the aquatic conservation strategy of Northwest Forest Plan, PACFISH, and INFISH beginning in 1993 through 1995. These management strategies have improved management on national forest lands in Washington and reduced the impact of forest management, which has resulted in a reduced rate of degradation within the FPHCP Action Area. Legacy effects from past logging and road building on Federal and non-Federal lands will likely continue for decades. Habitat conditions needed for bull trout recovery will require additional habitat restoration and threat abatement from land- and water-management practices affecting freshwater, estuarine, and/or marine habitats. The descriptions below describe the condition of designated critical habitat within individual critical habitat units within the FPHCP Action Area of this Opinion.

8.7.2.1 Status of Coastal-Puget Sound and Columbia River Critical Habitat Units in the FPHCP Action Area

Critical habitat was excluded in waterbodies adjacent to lands subject to the current Washington Forest Practices Rules. These are the same lands now being assessed with respect to the proposed FPHCP (absent conversion of non-forestlands to forestlands). However, stream segments within the FPHCP Action Area, that were not adjacent to FPHCP covered lands, were designated as critical habitat. Critical habitat is interspersed with and immediately downstream of FPHCP covered lands and could be affected by FPHCP implementation. Even though riparian and upland areas may not be within a stream's bankfull width, and therefore were not included in the critical habitat designation, actions affecting these riparian and upland areas may affect PCEs within bull trout critical habitat.

This environmental baseline analysis is based on information provided in the proposed and final critical habitat rules, and the Washington Bull Trout Critical Habitat map dated January, 2006, which uses a scale of 1:100,000 (see Administrative Record for this Opinion). It is important to note that there are excluded stream segments within waterbodies designated as critical habitat on this map. Interspersed, excluded stream segments are not consistently identifiable on this map due to limitations related to scale and land ownership information. Therefore, this map should be considered a coarse approximation of final critical habitat locations. Exclusions can be more accurately identified using a finer resolution analysis.

We evaluated the exposure risk to bull trout critical habitat from the potential effects of the FPHCP, and current habitat baseline conditions in the FPHCP Action Area, by integrating both spatial and non-spatial information included in the bull trout Geographic Risk Analysis. Because areas designated as critical habitat are occupied by bull trout, we also used the species' exposure analysis to identify areas of critical habitat most likely to be affected by the FPHCP covered activities.

Where the information was available, the condition of PCEs were further described using our Bull Trout Matrix of Pathways and Indicators (Matrix), which includes the following habitat parameters: water quality, habitat access, habitat elements, channel conditions and dynamics, flow/hydrology, and watershed conditions. The bull trout baseline habitat assessment in the Geographic Risk Analysis summarized information from multiple indicators or similar information when describing each pathway in the Matrix. An additional evaluation of forage base was included in the critical habitat analysis, since this element was not specifically addressed by the baseline habitat assessment in the Geographic Risk Analysis. See Table I in Appendix C (Critical Habitat) for the crosswalk between the Matrix pathways and the PCEs to further understand how the habitat baseline for critical habitat was developed. For more detailed information describing the relationship between the Matrix pathways and indicators and the PCEs, see Appendix D (Critical Habitat). Table J and K summarize the exposure analysis of critical habitat segments to potential effects downstream of FPHCP covered lands.

In summary, PCE #1 (temperature) is addressed primarily by the Matrix water quality pathway; PCE #2 (complex stream channels) is addressed primarily by the Matrix habitat elements and channel conditions and dynamics pathways; PCE #3 (substrate) is addressed primarily by the Matrix water quality and habitat elements pathways; PCE #4 (natural hydrograph) is addressed primarily by the Matrix flow/hydrology and watershed conditions pathways; PCE #5 (springs, seeps, groundwater) is addressed primarily by the Matrix flow/hydrology and watershed conditions pathways; PCE #6 (migratory corridors) is addressed primarily by the Matrix habitat access pathway; PCE #7 (abundant food base) is addressed by assessing all pathways together and evaluating the capacity for adequate forage to be present; and PCE #8 (permanent water) is addressed primarily by the flow/hydrology pathway. In addition, PCE #7 (abundant food base) may also be assessed by looking at connectivity, presence of productive foraging areas (e.g., lake or estuary), presence of anadromous fish, and presence of non-native fish.

8.7.2.2 Summary of Critical Habitat Unit Status

Columbia River Interim Recovery Unit

Clark Fork: Unit 2

Although no critical habitat in the Clark Fork Critical Habitat Unit has been designated within the FPHCP Action Area (State of Washington), there are FPHCP covered lands within this Critical Habitat Unit. Designated critical habitat segments within the Priest Lake and Lake Pend Oreille core areas in the State of Idaho are located a significant distance downstream of FPHCP covered lands, and beyond where effects are expected. In addition, these FPHCP covered lands are located outside of the riparian zone and are not adjacent to streams that flow into bull trout occupied habitat. Therefore, FPHCP forest management activities on these lands are not anticipated to have any affect on the PCEs in the designated critical habitat in Idaho, and the status of that critical habitat unit does not need to be further addressed.

Umatilla-Walla Walla: Unit 9

The Umatilla-Walla Walla Critical Habitat Unit covers lands in both Washington and Oregon. Within this Critical Habitat Unit, the Walla Walla River is the only tributary to the Columbia River Basin in Washington. It is also the only core area within this Critical Habitat Unit in Washington. Critical habitat in the Walla Walla core area supports four local populations. FPHCP covered lands are generally interspersed and upslope of critical habitat areas used by bull trout for both spawning and rearing habitat and FMO habitat. The majority of designated critical habitat lies within areas where non-FPHCP covered lands occur in lower portions of the larger river systems. Critical habitat has been designated within the Mill Creek, North Fork Touchet, and South Fork Touchet local populations. It is also designated in FMO habitat in Mill Creek, Yellowhawk Creek, North Fork Touchet, South Fork Touchet, Wolf Fork Touchet, and the Walla Walla mainstem.

Within the Walla Walla Critical Habitat Unit, historical and current land-use practices have affected critical habitat in bull trout local populations and FMO areas. Such practices include construction and operation of dams, construction and maintenance of roads, logging, agricultural development and associated water withdrawals, and mining. Some of these historical activities that caused passage barriers may have significantly reduced abundance of important fluvial populations. Lasting effects of some of these activities may still limit bull trout abundance and distribution in the Walla Walla Critical Habitat Unit. Existing activities that continue to contribute to fish-habitat problems, such as increased temperatures and elevated sediment levels, include the operation and maintenance of dams, riparian road construction and use, riparian grazing, agricultural and residential development, recreational use of riparian areas, illegal harvest, and the introduction of non-native species. It is likely that within critical habitat segments in the Walla Walla River Critical Habitat Unit, PCEs 1, 2, 4, 5, 6, and 7 have been degraded, although the severity of degradation varies on a site-specific basis.

In the Walla Walla Critical Habitat Unit, spawning and rearing critical habitat segments were ranked at high risk of becoming non-functional in the following local populations: Mill Creek and South Fork

Touchet. Segments of critical habitat were ranked at moderate risk of becoming non-functional in the Wolf Fork Touchet and North Fork Touchet. Segments of FMO critical habitat in the Walla Walla core area are ranked at high risk of becoming non-functional. Table I in Appendix C (Critical Habitat) displays the PCEs overlaid with the habitat analysis and the additional forage base category. The exposure risk summary indicates spawning and rearing critical habitat is at high risk of exposure to the potential effects from activities on FPHCP covered lands in North Fork Touchet and at a moderate risk of exposure in Mill Creek and Sorth Fork Touchet. In addition, FMO critical habitat is at high risk of exposure for Mill Creek and South Fork Touchet, and at a moderate risk of exposure for North Fork Touchet and Wolf Fork Touchet. There are no FPHCP covered lands interspersed or upslope of FMO critical habitat in Yellowhawk Creek and the Walla Walla mainstem. No critical habitat was designated in spawning and rearing streams in the Wolf Fork Touchet local populations. See Table J and K in Appendix C (Critical Habitat) for summaries of the exposure rankings.

Grande Ronde River: Unit 10

Designated critical habitat segments within this Critical Habitat Unit, and in the FPHCP Action Area, are located within FMO areas of the lower Grande Ronde River and extends to its confluence with the Snake River. Based on exclusions described in the final critical habitat rule, there are no critical habitat segments located in local populations within the Washington portion of this Critical Habitat Unit. Spawning and rearing streams have all been excluded. Only stream habitats within one of the two core areas, the Grande Ronde core area, are located in Washington. The Grande Ronde River, extending from its confluence with the Snake River upstream to Meadow Brook Creek, provides key foraging, migration, and overwintering habitat for sub-adult and adult fluvial bull trout (67 FR 71235). It is the primary migration corridor that supports and links eight local populations in the Grande Ronde River and Wallowa River basins.

Within the Grand Ronde Critical Habitat Unit, historical and current land-use practices have affected bull trout critical habitat in local populations and FMO areas. Such practices include construction and operation of dams, construction and maintenance of roads, logging, agricultural development and associated water withdrawals, and mining. These have resulted in reduced connectivity, altered flows, elevated stream temperatures, and increased sediment levels. Some of these historical activities that have caused passage barriers may have significantly reduced abundance of important fluvial populations. Lasting effects of some of these activities may still limit bull trout abundance and distribution in the Grande Ronde Critical Habitat Unit. Existing activities that continue to contribute to fish-habitat problems include the operation and maintenance of dams, riparian road construction and use, riparian grazing, agricultural and residential development, recreational use of riparian areas, and the introduction of non-native species. It is likely that within critical habitat segments in the Grande Ronde River Critical Habitat Unit, PCEs 1, 2, 4, 5, 6, and 7 have been degraded, although the severity of degradation varies on a site-specific basis. The Wenaha River may be the only low elevation watershed in the Columbia Basin that is almost completely protected by designated wilderness and is virtually unaltered by human activity (Baxter 2002), and therefore all the PCEs are functional.

In the Grande Ronde Critical Habitat Unit, FMO critical habitat segments were ranked at a moderate to high risk of becoming non-functional. Because the designated FMO critical habitat stream segments are not directly adjacent to FPHCP covered lands or are located within Oregon, risk of exposure to the potential effects from activities on FPHCP covered lands is expected to be low.

Coeur d'Alene Lake Basin: Unit 14

For the portion of this Critical Habitat Unit within the FPHCP Action Area, there are no stream segments that are designated as critical habitat or that flow into designated critical habitat stream segments. Streams within the FPHCP Action Area that originate in Washington flow into Idaho's Lake Pend Oreille, which is designated as critical habitat. Due to the long downstream distance between FPHCP covered lands and designated critical habitat in Lake Pend Oreille, FPHCP activities are not anticipated to affect the PCEs in this designated critical habitat, and the status of this critical habitat unit does not need to be further addressed.

Lower Columbia River Basin: Unit 19

Critical habitat has been designated in Lewis and Klickitat core areas, and White Salmon core habitat. In the Lower Columbia River Critical Habitat Unit, all spawning and rearing habitat was excluded in the final designation, except for within the Klickitat core area. In the Lewis River core area, critical habitat has been designated in the lower Lewis River upstream from its confluence with the Columbia River. This segment of the Lewis River is anticipated to provide important FMO habitat and connectivity to the Columbia River once fish passage is restored at Merwin, Yale, and Swift Dams. In the White Salmon core habitat, critical habitat has been designated in the mainstem White Salmon River. Once passage is fully restored at Condit Dam, this section of the river will provide an important migratory corridor to and from the Columbia River and provide important FMO habitat for migratory bull trout. In the Klickitat core area, critical habitat has been designated in the Klickitat River, Clearwater Creek, Fish Lake Stream, Little Muddy Creek, Trappers Creek, Two Lakes Stream, an unnamed tributary to Fish Lake Stream, and the WF Klickitat River. The WF Klickitat River and the above-named tributaries support the only known bull trout local population in the Klickitat core area. However, spawning and rearing critical habitat within the Klickitat core area is located upstream of FPHCP covered lands and therefore has no exposure to FPHCP activities. FMO critical habitat within the Klickitat River provides habitat essential for maintaining connectivity between the Kickitat core area and the Columbia River FMO habitat. FPHCP covered lands are located upstream of and are interspersed with FMO critical habitat segments in the Klickitat River.

Within the Lower Columbia River Critical Habitat Unit, historic and current land-use activities have affected bull trout habitat critical habitat. Dams have fragmented bull trout habitat, isolated local populations, and prevented access to historical foraging and overwintering habitat. Recent settlement agreements for hydropower projects on the Lewis River will reduce the magnitude of the threat posed by dams in this Critical Habitat Unit. Past forest-management activities have also altered habitat conditions in portions of the Critical Habitat Unit. The effects to bull trout habitat result from impassable culverts, excessive erosion and sedimentation, reduced recruitment of large wood, channel changes, and altered water temperatures, instream flows, and runoff patterns. Grazing in the Klickitat core area has resulted in eroded streambanks, increased sedimentation, and incised stream channels. Water withdrawals for agriculture have reduced instream flows and resulted in increased water temperatures. The known bull trout spawning and rearing streams (portions of Cougar, Pine, Rush Creeks, and WF Klickitat River) within this Critical Habitat Unit are impacted by a variety of land-management activities associated with a mosaic of land ownership including Federal, State, tribal, private residential and forestry, and PacifiCorp lands. Portions of the bull trout habitat in the Pine Creek were also impacted by the eruption of Mt. St. Helens. It is likely that within critical habitat segments in the Lower Columbia Critical Habitat Unit all of the PCEs except three have experienced some degradation, with PCEs 1, 2, and 6 being most severely impacted.

In the Lower Columbia River Critical Habitat Unit, FMO critical habitat segments in the Klickitat core area were ranked at high risk of becoming non-functional. This core area also has a high risk of exposure to potential effects from activities on FPHCP covered lands. FMO critical habitat segments on the Lewis and White Salmon Rivers were ranked at moderate risk of becoming non-functional, but have a low risk of exposure to the potential effects from activities on FPHCP covered lands.

Middle Columbia River Basin: Unit 20

Critical habitat has been designated in streams and rivers both upstream and downstream of FPHCP covered lands throughout the Yakima River basin, which is the only core area within this Critical Habitat Unit. Critical habitat in the Yakima River core area supports 16 local populations, one potential local population, and FMO habitat throughout the core area. The majority of designated critical habitat lies within the lower portions of the larger river systems where non-FPHCP covered lands occur. Spawning and rearing critical habitat has been designated within the following local populations: Ahtanum Creek, Box Canyon Creek, Bumping River, Cle Elum River, Gold Creek, Kachess River, Naches River, North Fork Tieton River, Rattlesnake Creek, Teanaway River, Tieton River, and the mainstem Yakima River. It has also been designated in FMO habitat in the mainstem Ahtanum Creek, Naches River, Tieton River, Teanaway River, Cle Elum River, Kachess River, and mainstem Yakima River. FPHCP covered lands are upstream of and interspersed with the designated segments of critical habitat.

Bull trout in the Middle Columbia Critical Habitat Unit may have been extirpated from some former habitats and remaining populations are fragmented and isolated due to a variety of factors. Critical habitat is degraded due to isolation by dams, agricultural practices, and associated water withdrawals that have affected stream temperatures, passage, sediment, and flows. Multiple Bureau of Reclamation irrigation reservoirs currently lack fish passage and block access to most spawning and rearing habitat. Additional activities affecting critical habitat in the basin include forestry practices, grazing, roads, mining, non-native species, contaminants, and residential development. In addition, drought conditions have increased the potential for fire impacts within most forested areas. The updated State Forest Practice Rules and the Northwest Forest Plan are expected to reduce the level of future timber harvest impacts to bull trout streams on private and public lands. However, most legacy threats from past forest practices will likely continue to be a threat for decades. Within the Yakima Critical Habitat Unit, PCEs 1, 2, 4, 5, 6, 7, and 8 have experienced some degree of degradation.

In the Middle Columbia River Basin Critical Habitat Unit, spawning and rearing critical habitat segments were ranked at high risk of becoming non-functional in the following local populations: Ahtanum Creek, Teanaway River, the Mainstem Yakima River, and Cle Elum River. Critical habitat segments in the following local populations were ranked at moderate risk of becoming non-functional: Gold Creek, Rattlesnake Creek, and North Fork Tieton. All FMO critical habitat segments in this core area were ranked at high risk of becoming non-functional (see Table I in Appendix C (Critical Habitat)). The exposure risk summary in Appendix C, Table B indicates spawning and rearing critical habitat is at high risk of exposure to potential effects from activities on FPHCP covered lands in Ahtanum Creek, Teanaway River, and upper Yakima River mainstem; is at moderate risk of exposure in Gold Creek and Rattlesnake Creek areas; and at low risk of exposure in Cle Elum River and North Fork Tieton. In addition, FMO critical habitat is at high risk of exposure in Ahtanum Creek, Teanaway River, upper Yakima River mainstem, Cle Elum River, Kachess River, Tieton River, and Naches River; and is at a low risk of exposure in Bumping River. See Table J and K in Appendix C (Critical Habitat) for summaries of the exposure rankings.

Northeast Washington River Basins: Unit 22

Critical habitat has been designated in streams and rivers either upstream or downstream from FPHCP covered lands throughout the Northeast Washington River Basins Critical Habitat Unit. The Pend Oreille River is the only tributary to the Columbia River basin and the only core area within this Critical Habitat Unit. Critical habitat in the Pend Oreille core area supports one local population and 10 potential local populations. The majority of designated segments of critical habitat lie within areas where non-FPHCP covered lands occur in lower portions of the larger river systems. FPHCP covered lands are generally interspersed and upslope of critical habitat stream segments used by bull trout for spawning and rearing, or for foraging, migration and overwintering. The majority of designated critical habitat lies within areas where non-FPHCP covered lands occur in lower portions of the larger river systems. Critical habitat has been designated within the LeClerc Creek local population and the following potential local populations: Cedar Creek, Indian Creek, Mill Creek, Ruby Creek, Slate Creek, Small Creek, Sorth Fork Tacoma Creek, and Tacoma Creek. It has also been designated in FMO habitat in Calispell Creek, LeClerc Creek, Sorth Fork Tacoma Creek, Small Creek, Sullivan Creek, and Tacoma Creek.

Within the Northeast Washington Critical Habitat Unit, historical and current land-use activities have impacted the habitat in local populations and foraging, migration and overwintering areas. The construction and operation of Albeni Falls, Box Canyon, and Boundary dams on the Pend Oreille River have fragmented habitat and negatively affected bull trout. Other dams and diversions without fish-passage facilities in tributaries to the Pend Oreille River have further fragmented habitat and reduced connectivity. Effects from past logging have altered habitat conditions in portions of the Critical Habitat Unit. The legacy of these activities still persists where poorly constructed roads, impassible culverts, and channel changes remain. Livestock grazing has degraded both upland and riparian areas of most tributaries in the watershed on public and private land. In addition, drought conditions have increased the potential for fire impacts within most forested areas. The introduction of non-native species has continued to effect bull trout populations through predation, competition, and hybridization. PCEs 1, 2, 4, 5, 6, 7, and 8 have experienced varying degrees of degradation.

In the Northeast Washington River Basins Critical Habitat Unit, spawning and rearing critical habitat segments in the LeClerc Creek local population, and Mill Creek and Tacoma Creek potential local populations were ranked at high risk of becoming non-functional. Spawning and rearing critical habitat segments in Indian Creek, Small Creek, East Fork Small Creek, South Fork Tacoma Creek, and Cedar Creek potential local populations were ranked at moderate risk of becoming non-functional. FMO critical habitat segments were ranked at high risk of becoming non-functional within this core area. Table I in Appendix C (Critical Habitat) displays the PCEs overlaid with the habitat analysis and the additional forage base category. The exposure risk summary indicates spawning and rearing critical habitat is at high risk of exposure to potential effects from activities on FPHCP covered lands in Tacoma Creek, at low risk of exposure in Mill Creek, and is at moderate risk of exposure in all other spawning and rearing areas. In addition, FMO critical habitat segments are at high risk of exposure in Calispell Creek, and Small Creek, and are at a moderate risk of exposure in all other FMO habitat. See Table J and K in Appendix C (Critical Habitat) for summaries of the exposure rankings.

Snake River Washington: Unit 23

FPHCP covered lands are located in the upper portion of George Creek in the Wormell Gulch potential local population in the Asotin core area and in the Cummings Creek local population in the Tucannon River core area. George Creek has been identified as a priority stream in the Wormell Gulch potential local population in the Asotin Creek core area and is considered essential to the recovery of bull trout. The Cummings Creek and North Fork Asotin Creek local populations contains spawning and rearing critical habitat.

Within the Snake River Washington Critical Habitat Unit, historical and current land-use practices have degraded bull trout critical habitat designated in spawning and rearing, and FMO areas. Some historical activities, especially the construction of low-head dams in the early 1900's, may have significantly reduced connectivity for important fluvial populations of bull trout. A combination of human-induced factors have degraded bull trout critical habitat, including till-crop production and irrigation withdrawals, livestock grazing, logging, hydropower production, introduction and management of non-native species, urbanization, and transportation networks. Lasting effects from some of these early land and water developments still limit bull trout habitat in both the Tucannon and Asotin Creek core areas. Three flood events have occurred in these core areas since 1964. The degraded conditions of the stream corridors prior to the floods, especially the conversion of floodplains into agricultural lands and road networks, resulted in even greater flood-related damage than otherwise would have been expected. This reduced the ability of the streams to recover their natural fluvial processes. Due to historical and current land use practices PCEs 1, 2, 4, 5, and 6 have experienced varying degrees of degradation in Wormell Gulch.

In the Snake River Washington Critical Habitat Unit, there are no FPHCP covered lands interspersed with or directly upstream of critical habitat segments in the Wormell Gulch potential local population; therefore, there is no risk of exposure. Information about critical habitat conditions in Cummings Creek local population was not available and by default, the habitat condition was ranked at low-moderate. It is at low risk of exposure to potential effects from activities on FPHCP covered lands. See Table J and K in Appendix C (Critical Habitat) for summaries of the exposure rankings.

Coastal-Puget Sound Interim Recovery Units

Olympic Peninsula: Unit 27

Critical habitat has been designated in streams and rivers in all core areas within this unit. In all core areas except for the Dungeness, FPHCP covered lands are downstream of local populations and interspersed throughout or upstream from designated FMO critical habitat segments. In the Elwha core area, critical habitat has also been designated in the Little River potential local population. In the Dungeness River core area, a small amount of FPHCP covered lands are located within one local population. All designated critical habitat in this core area is located downstream of or interspersed with areas in FMO habitat. Critical habitat has also been designated in the following FMO habitat outside of core areas where FPHCP covered lands are either interspersed, upstream, or immediately adjacent: Bell, Cedar, Ennis, Goodman, Joe, Kalaloch, Morse, Mosquito, and Steamboat Creeks; Canyon, Chehalis, Copalis, Humptulips, Moclips, Satsop, and WF Satsop Rivers; and Grays Harbor, Hood Canal, Pacific Coast, and Strait of Juan de Fuca marine FMO habitats.

On the Olympic Peninsula, a significant portion of the major river basins, particularly the upper river portions where most bull trout spawning and rearing occurs, lie within the Olympic National Park. Spawning and rearing critical habitat has been designated in these areas within the Park. However, FMO critical habitat conditions are degraded downstream of the park boundary (WSCC 2000a, 2001c). In the largely rural setting of the Olympic Peninsula, habitat effects are primarily related to past logging and associated roading and, to a lesser degree, dams and agricultural practices. Habitat conditions have improved to some extent over the past decade with more-protective forest practices and declining timber harvest on public lands. Although migratory corridors are still functional, especially on the westside of the Olympic Peninsula, critical habitat conditions related to suitable temperatures, floodplain connectivity, substrate, timing and magnitude of flows, and habitat complexity related to large woody material have been degraded by historical land-management practices. PCEs 1, 2, 4, 5, 6, and 7 within the designated critical habitat have likely been degraded, although the severity of degradation varies on site specific basis.

Spawning and rearing critical habitat in the Quinault, Queets, Hoh, and Elwha Rivers core areas is located within the Olympic National Park boundary, and habitat is functioning appropriately. There is no critical habitat designated within spawning and rearing areas in the Skokomish and Dungeness River core areas. In the Olympic Peninsula Critical Habitat Unit, FMO critical habitat segments were ranked at high risk of becoming non-functional in the Skokomish core area, and at moderate risk of becoming non-functional in the Hoh, Dungeness, and Elwha Rivers core areas. Most spawning and rearing critical habitat is located upstream within Olympic National Park, and FMO critical habitat is generally not directly adjacent to FPHCP covered lands. Therefore, exposure to potential effects from activities on FPHCP covered lands is expected to be low in this Critical Habitat Unit.

Puget Sound: Unit 28

Critical habitat has been designated in streams and rivers both upstream and downstream from FPHCP covered lands throughout the Puget Sound Critical Habitat Unit. Most FPHCP covered lands are downstream of local populations and interspersed throughout designated segments of FMO critical habitat. The majority of designated critical habitat is FMO stream segments on non-FPHCP covered lands in lower mainstem river segments that flow into the estuarine/nearshore waters of Puget Sound. In the Nooksack, Lower Skagit, Stillaguamish, Snohomish-Skykomish, and Puyallup core areas, FPHCP covered lands fall within the Lower North Fork Nooksack, Lower Middle Fork Nooksack, Upper Middle Fork Nooksack, Lower South Fork Nooksack, Upper Deer Creek, North Fork Stillaguamish, Canyon Creek, South Fork Skykomish, Carbon, and Upper White River local populations, and the mainstem Nooksack, Skagit, Stillaguamish, Snohomish, Skykomish, Snoqualmie, and White River FMO habitats. FPHCP covered lands have the potential to affect designated critical habitat stream segments within these local populations and within these mainstem segments. Critical habitat has also been designated in the following FMO habitat outside of core areas where FPHCP covered lands are either interspersed or upstream: Lower Nisqually, Lower Green, and Samish Rivers.

The urban rivers of Puget Sound have effects comparable to those on the Olympic Peninsula from past logging and logging roads in the upper reaches, but critical habitat has been further degraded in the lower floodplains. Intensive channelization to protect urban development and agricultural areas has resulted in permanent loss of floodplain functions in most of the lower rivers. The loss of riparian vegetation, increasing discharge of municipal and industrial wastewater and urban stormwater runoff, has resulted in degraded water quality. The Washington Department of Ecology (WDOE) has placed a large number of waterways throughout Puget Sound on the 303(d) list of impaired waters. In addition to affecting water quality through flow alterations, hydroelectric dams block migration and have isolated bull trout populations in several core areas while water-control structures in the floodplains have effectively eliminated most of the estuaries and wetlands that historically provided rearing and foraging areas. PCEs 1, 2, 3, 4, 5, 6 and 7 within the designated critical habitat have likely been degraded, although the severity of degradation varies on a site specific basis.

In the Puget Sound Critical Habitat Unit, spawning and rearing critical habitat segments were ranked at high risk of becoming non-functional in the Lower South Fork Nooksack River, Upper Puyallup and Mowich Rivers, and Upper Deer Creek local populations. Spawning and rearing critical habitat segments were ranked at moderate risk of becoming non-functional in the following local populations: Lower North Fork Nooksack River, Upper and Lower Middle Fork Nooksack River, North Fork Stillaguamish River and South Fork Skykomish River. Critical habitat segments were also ranked at moderate risk of becoming non-functional in the Clearwater River potential local population, and ranked a low risk of becoming non-functional in the Glacier Creek and Carbon River local populations. FMO critical habitat segments were ranked at high risk of becoming non-functional in the Puyallup core area (Puyallup and Carbon Rivers), and ranked at moderate risk of becoming non-functional in the Puyallup (White River), Nooksack, Lower Skagit, Stillaguamish, and Snohomish/Skykomish Rivers core areas. FMO critical habitat segments outside of core areas, within the Lower Nisqually, Lower Green, and Samish Rivers FMO areas, were ranked at moderate risk of becoming non-functional. Table I in Appendix C (Critical Habitat) displays the PCEs overlaid with the habitat analysis and the additional forage base category. The exposure risk summary indicates spawning and rearing critical habitat segments are at high risk of exposure to potential effects of activities on FPHCP covered lands within the Lower South Fork Nooksack River, North Fork Stillaguamish River, and Lower Middle Fork Nooksack River local populations; and are at moderate risk of exposure in the Lower North Fork Nooksack River, Upper Middle Fork Nooksack River, and South Fork Skykomish River local populations; and are at low risk of exposure in the Carbon River local population. Segments in upper Deer Creek were ultimately determined to be at very low risk of exposure because nearly all lands adjacent to the stream are covered under the FPHCP, and therefore are excluded from critical habitat designation. FMO critical habitat segments are at high risk of exposure in the Nooksack, Stillaguamish, and Puyallup FMO; and at a moderate risk of exposure in Kendell Creek, Deer Creek, Canyon Creek, and Snohomish/Skykomish Rivers FMO areas. Critical habitat segments in the Lower Nisqually, Lower Green, Samish, and Skagit Rivers are likely at moderate exposure. See Table J and K in Appendix C (Critical Habitat) for summaries of the exposure rankings.

8.7.3 EFFECTS OF THE ACTION ON CRITICAL HABITAT

Issuance of an incidental take permit for the FPHCP is based on continued application of the current Washington Forest Practices Rules. In some situations, these forest practices are expected to result in effects to bull trout critical habitat. Activities covered by the FPHCP that have the potential to generate effects which may reach sections of streams designated as critical habitat include activities in the riparian area, operation of heavy equipment, construction and maintenance of roads (including stream crossings), and upgrading and abandonment of roads on covered lands. This analysis assesses the effects of the proposed FPHCP on those interspersed and downstream waters that are designated as critical habitat. For additional discussion on the effects to bull trout habitat from forest management activities on FPHCP covered lands, please refer to the section titled "**Effects of the Action on the Individual.**"

The PCEs apply to areas designated as either foraging, migrating, and overwintering habitat or spawning and rearing habitat. The only exception is that PCE #3 (substrate) addresses substrates needed for spawning and rearing habitat and does not address or is not applicable to bull trout foraging, migrating, and overwintering habitat requirements. Only the PCEs described in paragraphs (1), (6), (7), and (8) of the final rule (70 FR 56212) apply to marine nearshore waters identified as critical habitat.

Implementation of the proposed action has the potential to adversely affect up to seven PCEs, depending on the location of the critical habitat and its relation to the location of the FPHCP covered lands. Although effects are likely to be site specific, the PCEs most likely to be directly affected by the FPHCP are PCEs 1, 2, 3, 4, 5, and 6, with a likelihood of indirect affects to PCE 7. Referring to the **Effects of the Action on the Individual** section, the effects to PCE 1 are similar or equivalent to the analysis of effects to stream temperature; effects to PCE 2 are similar or equivalent to the analysis of effects to large wood; effects to PCE 3 are similar or equivalent to the analysis of effects of elevated sediment; effects to PCEs 4 and 5 are related to combined or interrelated effects from elevated sediment and reductions in large wood; effects to PCE 6 and 7 are similar or equivalent to the interrelated and combined effects of temperature increases, reduction of large wood, and elevated sediment levels. No additional impacts to PCE 8 are aniticapted beyond those addressed in our analysis of PCEs 1, 3, 4, and 5.

To determine the "overall risk" to critical habitat from FPHCP covered activities analyzed in this Opinion, we combined the estimates of (1) critical habitat exposure risk and (2) critical habitat function risk, both of which are described in the critical habitat Environmental Baseline section above. Anticipated downstream effects were evaluated in light of the overall risk to determine the likelihood and severity of adverse effects to critical habitat. A range of effects are expected to occur over the 50-year term of the Permit on a variable and site specific basis. The FPHCP covered activities are anticipated to result in elevated sediment delivery, increased temperatures, and reduced large wood recruitment in some areas.

Baseline habitat condition was used to estimate the resiliency of critical habitat segments to support viable core area populations and to appreciably contribute to the conservation value of all critical habitat. The reslience of critical habitat to adverse effects from the action is assumed to be inversely proportional to the overall risk. For example, in Critical Habitat Units where critical habitat segments were ranked at a high or moderate-high overall risk, there is less resilience and greater potential for downstream effects to severely alter PCE function. We conducted a more extensive analysis of baseline habitat conditions in Critical Habitat Units with moderate-high and high overall risks. It is important to note that critical habitat exposure risk is related to downstream effects of FPHCP covered activities. These effects are assumed to be less in magnitude than effects to streams directly adjacent to the activities because fish-bearing streams have wider RMZs than non-fish-bearing streams.

All FMO areas, with critical habitat segments are downstream of or interspersed with FPHCP covered lands, are ranked at moderate-high or high overall risk due to generally poor habitat conditions and/or moderate or high risk of exposure. However, critical habitat segments in these FMO areas are expected to be more resilient than spawning and rearing habitats due to different physical features that include larger stream channels, greater channel/habitat depths, larger volumes of water.

8.7.3.1 Clark Fork: Unit 2

In this Critical Habitat Unit, the FPHCP covered lands are located beyond a distance that could affect designated critical habitat segments within the Priest Lake and Lake Pend Oreille core areas in Idaho or Washington. FPHCP covered lands are located outside of the Riparian Zone and are not adjacent to streams that flow into bull trout occupied habitat, and the potential effects of FPHCP covered activities on these lands are not anticipated to affect the PCEs in the designated critical habitat in Idaho.

8.7.3.2 Umatilla - Walla Walla: Unit 9

FPHCP covered lands are upstream of or interspersed with critical habitat segments designated for the North Fork Touchet, South Fork Touchet, Wolf Fork Touchet Rivers, and Mill Creek. The FPHCP includes covered lands adjacent to many non-fish-bearing streams, fish-bearing tributaries, and mainstem rivers, which have the potential to adversely affect downstream critical habitat. Although critical habitat segments were designated in Yellowhawk Creek and the Walla Walla River mainstem FMO, there are no FPHCP covered lands directly adjacent or interspersed with these segments and exposure to potential effects of covered activities is expected to be minimal. Spawning and rearing habitat in the Wolf Fork Touchet River local population was excluded from the critical habitat designation.

Spawning and rearing critical habitat segments in Mill Creek and the North Fork Touchet River are at a moderate-high overall potential risk to potential adverse effects from the FPHCP, and the South Fork Touchet is at a moderate risk. In terms of FMO critical habitat's overall potential risk from adverse effects, all areas are at moderate-high or high risk (see Appendix C Table F for the overall scoring of these segments). Potential adverse effects to critical habitat in this Critical Habitat Unit include reduced connectivity, reduced quality or quantity of cold water refugia, diminished large wood recruitment, and elevated sediment. Indirect effects from activities on FPHCP covered lands may also result in a decrease in forage or prey base, because adverse effects to habitat also reduce available prey.

In the local populations and FMO areas that were at an overall moderate-high risk or high risk of being adversely affected, a more extensive analysis of the baseline habitat conditions is presented below.

<u>Critical habitat in local populations at moderate to high risk:</u>

In the South Fork Touchet River local population, where there is a moderate overall potential risk to critical habitat segments, the habitat conditions or PCEs are expected to have some resiliency to adverse effects resulting from the FPHCP covered activities.

The overall risk for critical habitat in the Mill Creek and North Fork Touchet River local populations was moderate-high and high, respectively. The baseline habitat assessment indicates that sediment, temperature, and large wood in Mill Creek are functioning at a moderate risk while in the North Fork Touchet River they are functioning at a high risk. Generally, the critical habitat segments in these local populations have low resiliency to potential adverse effects.

<u>Critical habitat in FMO habitat at moderate-high to high risk:</u>

Most FMO critical habitat segments designated in the upper Walla Walla River River core area may experience adverse affects. Potential adverse effects to FMO critical habitat segments in this unit include reduced quality or quantity of cold water refugia, diminished large wood recruitment, and elevated sediment. Indirect effects from forest management activities on FPHCP covered lands may also result in a decrease in forage or prey base, because adverse effects to habitat can also reduce prey availability.

<u>Additional analysis for critical habitat in local populations and FMO habitat:</u>

Because there is a moderate-high or high overall potential risk to critical habitat in the Mill Creek and North Fork Touchet River local populations and in all FMO areas in this Critical Habitat Unit, additional analysis was conducted to evaluate more site-specific watershed conditions related to rain-on-snow, soils, slope steepness and slope hazards, geology, and roads using additional GIS analysis (see Appendix C, Table H). Based on this analysis, it is anticipated that the severity of potential effects from activities on

FPHCP covered lands would likely be higher due to these watershed conditions. The baseline habitat conditions in conjunction with these watershed conditions tend to increase the likelihood that potential downstream adverse effects would be severe. These effects may contribute to the alteration of riparian and channel conditions, including changes in stream temperatures, sediment routing, and large wood recruitment.

Summary of effects at the Critical Habitat Unit scale:

In the Umatilla-Walla Walla Critical Habitat Unit, all critical habitat segments downstream or interspersed with FPHCP covered lands are at an overall risk that ranges from moderate to high. Potential downstream effects of the action may result in variable delivery of sediment, increases in temperatures, and decreases in recruitment of large wood to critical habitat segments. It is likely that PCEs in the critical habitat unit and core area would be adversely affected due to the the proposed action. Although the location of project activities is uncertain, moderate to high baseline habitat conditions suggest potential adverse effects are likely to be severe to several PCEs on a site-specific basis. The magnitude of effects to PCEs 1, 2, 3, 4, 5, and 6 would be variable and site-specific. Indirect effects from activities on FPHCP covered lands may result in a decrease in forage base (PCE 7). Although site-specific effects to PCEs could be severe, it is important to note that downstream effects are likely to be less in magnitude than effects to streams directly adjacent to the activities. We do not expect that the proposed action would alter the function and conservation role of the Critical Habitat Unit. The FPHCP conservation measures are expected to reduce and minimize the likelihood of adverse effects and reduce the risks associated with the unknown site-specific conditions in the moderate-high and high risk local populations.

8.7.3.3 Grande Ronde River: Unit 10

FPHCP covered lands are adjacent to tributary streams that flow into the lower Grande Ronde River, which is designated as FMO critical habitat. At the confluence of these tributaries, there is the potential for effects from activities on FPHCP covered lands on both fish-bearing and non-fish-bearing streams to adversely affect designated critical habitat segments. Potential adverse effects to critical habitat in this unit could include reduced quality and quantity of cold water refugia, diminished large wood recruitment, and elevated sediment. Although effects are likely to be site specific and related to the proximity of the FPHCP covered lands to the critical habitat, it is likely that PCEs 1, 2, 5, and 6 may be adversely affected to some extent, while PCE 4 could also be affected. Indirect effects from activities on FPHCP covered lands may include a decrease in forage base (PCE 7). Because all spawning and rearing segments within local populations are excluded from critical habitat designation, and FMO critical habitat is not directly adjacent to FPHCP covered lands, exposure risk would be low. All PCEs in FMO critical habitat may be affected to some extent on a site-specific basis, but the low exposure risk indicates these effects would be minimal and would not affect the function and conservation role of the Critical Habitat Unit.

8.7.3.4 Coeur d’Alene Lake Basin: Unit 14

Only a minor portion of the Critical Habitat Unit is in Washington. No bull trout spawning and rearing habitat is within this portion of the Critical Habitat Unit. Due to the long downstream distance between FPHCP covered lands and designated critical habitat in Lake Pend Oreille, Idaho, the potential effects from activities on FPHCP covered lands are not anticipated to affect the PCEs in this designated critical habitat.

8.7.3.5 Lower Columbia River Basin: Unit 19

All FPHCP covered lands within this Critical Habitat Unit are located below local populations; therefore, activities on FPHCP covered lands are not anticipated to affect spawning and rearing critical habitat segments in this Critical Habitat Unit. However, FPHCP covered lands are adjacent to and interspersed with many non-fish-bearing streams, fish-bearing tributaries, and the mainstem Lewis, White Salmon, and Klickitat Rivers, and have the potential to affect designated critical habitat segments downstream of covered lands. Critical habitat segments in the Critical Habitat Unit are important for the conservation of FMO habitat. Potential adverse effects to critical habitat in this Critical Habitat Unit include reduced quality or quantity of cold water refugia, diminished large wood recruitment, and elevated sediment.

Critical habitat in FMO habitat at moderate-high to high risk:

Klickitat River FMO habitat has a high overall potential risk due to the high exposure to FPHCP covered lands. Adverse effects to PCEs in the FMO habitat are anticipated. Potential adverse effects to FMO critical habitat segments in this unit include reduced quality or quantity of cold water refugia, diminished large wood recruitment, and elevated sediment. Indirect effects from forest management activities on FPHCP covered lands may also result in a decrease in forage or prey base, because adverse effects to habitat can also reduce prey availability.

Summary of effects at the Critical Habitat Unit scale:

In the Lower Columbia Critical Habitat Unit, FMO critical habitat segments within the Klickitat River that are downstream or interspersed with FPHCP covered lands are at a high overall potential risk. Potential downstream effects of the action may result in variable delivery of sediment, increases in temperatures, and decreases in recruitment of large wood to critical habitat segments. This suggests that habitat conditions and processes in the critical habitat unit and core area could be adversely affected due to the potential effects of the proposed action, which may affect the functional suitability of the PCEs. Although the location of project activities is uncertain, moderate to high baseline habitat conditions suggest potential adverse effects are likely to result in severe effects to several PCEs. Effects are likely to be site specific, and it is likely that PCEs 1, 2, 3, 5, and 6 would be adversely affected to some extent, while PCE 4 could also be affected. Indirect effects from activities on FPHCP covered lands may result in a decrease in forage base (PCE 7). Although site-specific effects to PCEs could be severe, it is important to note that downstream effects are likely to be less in magnitude than effects to streams directly adjacent to the covered activities. We do not expect that the proposed action would alter the function and conservation role of the Critical Habitat Unit. The FPHCP conservation measures are expected to reduce and minimize the likelihood of adverse effects and reduce the risks associated with the unknown site-specific conditions in the moderate-high and high risk local populations.

8.7.3.6 Middle Columbia River Basin: Unit 20

FPHCP covered lands are upstream or interspersed with critical habitat segments designated in the Ahtanum Creek, Teanaway River, and Upper Yakima River, Rattlesnake Creek, Gold Creek, Cle Elum River, and North Fork Tieton River local populations. The FPHCP includes covered lands adjacent to many non-fish-bearing streams, fish-bearing tributaries, and mainstem rivers, which have the potential to adversely affect downstream critical habitat. All spawning and rearing segments in the Bumping River were excluded and all FMO habitat segments in Rattlesnake Creek were excluded from critical habitat designation.

Critical habitat segments designated in the Ahtanum Creek, Teanaway River, and Upper Yakima River local populations are at a high overall potential risk; Rattlesnake Creek, Gold Creek, and Cle Elum River local populations are at a moderate risk; and North Fork Tieton River is at a low risk. The analysis showed that in Box Canyon Creek and Kachess River local populations, spawning and rearing critical habitat segments did not have FPHCP covered lands that were directly adjacent or interspersed so exposure to effects of the activities is expected to be minimal. Potential adverse effects to critical habitat in this Critical Habitat Unit include reduced connectivity, reduced quality and quantity of cold water refugia, diminished large wood recruitment, and elevated sediment. Indirect effects from forest management activities on FPHCP covered lands may also result in a decrease in forage or prey base, because adverse effects to habitat also reduce available prey.

Critical habitat in local populations at moderate to high risk:

In Rattlesnake and Gold Creeks, and Cle Elum River, local populations where there is an overall moderate risk to critical habitat, adverse effects are expected to occur. However, habitat conditions or PCEs are expected to have some resiliency to adverse effects resulting from the FPHCP covered activities.

The overall potential risk is high for critical habitat segments in the Ahtanum Creek, the Teanaway River, and the upper Yakima River local populations. The Geographic Risk Analysis indicates that sediment, temperature, and large wood in these areas are functioning at high risk. Generally critical habitat in these locations has low resiliency to any potential adverse effects.

Critical habitat in FMO habitat at moderate to high risk:

In terms of the overall potential risk to adverse effects, the Bumping River FMO critical habitat is at a moderate risk and the FMO critical habitat in Ahtanum Creek, Cle Elum, Kachess, Naches, Teanaway, Tieton, and upper Mainstem Yakima Rivers are at high risk. Potential adverse effects to FMO critical habitat segments in this unit include reduced quality or quantity of cold water refugia, diminished large wood recruitment, and elevated sediment. Indirect effects from forest management activities on FPHCP covered lands may also result in a decrease in forage or prey base, because adverse effects to habitat can also reduce prey availability.

Additional analysis for critical habitat in local populations and FMO habitat:

Because there is a high overall potential risk to critical habitat in the Ahtanum Creek, Teanaway River, and upper Mainstem Yakima local populations, and FMO areas in this Critical Habitat Unit, additional analysis was conducted to evaluate more site specific watershed conditions related to rain-on-snow, soils, slope steepness and slope hazards, geology, and roads using additional GIS analysis (see Appendix C, Table H). Based on this analysis, it is anticipated that the severity of potential effects from activities on FPHCP covered lands would likely be higher due to these watershed conditions. The baseline habitat conditions in conjunction with these watershed conditions tend to increase the likelihood that potential adverse effects would be severe. These effects may contribute to the alteration of riparian and channel conditions, including changes in stream temperatures, sediment routing, and large wood recruitment.

Summary of effects at the Critical Habitat Unit scale:

In the Middle Columbia River Critical Habitat Unit, the effects of the action to the habitat conditions or PCEs are anticipated to range from low to high, depending on site-specific factors and the frequency, timing, duration, and intensity of forest practices over the course of 50 years. There are critical habitat segments in two local populations that are at minimal or low risk; three local populations at moderate risk; and all FMO areas are at a high risk to adverse effects due to exposure and habitat conditions, but as discussed earlier they are anticipated to be more resilient to potential effects from FPHCP activities. However, when combined with the critical habitat segments that are at moderate-high and high risk, the Critical Habitat Unit may experience adverse effects in eight (or half) of the local populations and in almost all FMO areas designated in the Yakima River core area. The best functioning habitat within the Yakima core area is upstream of five dams which have significantly reduced connectivity among local populations. Spawning and rearing critical habitat segments functioning at high risk, and that are at high risk of exposure within the local populations, are located downstream of these dams. These critical habitat segments are necessary in supporting the function of the core areas below these dams. This suggests that habitat conditions and processes in the Critical Habitat Unit and core area may be more severely affected by potential downstream effects of the proposed action, or that the functional suitability of the PCEs at the Critical Habitat Unit scale may be affected. Although effects are likely to be site-specific, it is likely that PCEs 1, 2, 3, 5, and 6 would be adversely affected to some extent, while PCE 4 could also be affected. Indirect effects from forest management activities on FPHCP covered lands may result in a decrease in forage base (PCE 7). As noted above, all FPHCP covered lands were excluded from critical habitat designation and effects to critical habitat from the FPHCP would only occur downstream of the FPHCP covered lands. Although site-specific effects to PCEs could be severe, the magnitude of these downstream effects is anticipated to be less than effects to streams directly adjacent to the FPHCP covered activities. In addition, the FPHCP conservation measures are expected to reduce and minimize the likelihood of adverse effects and reduce the risks associated with the unknown site-specific conditions in the moderate-high and high risk local populations. We do not expect that the proosed action would alter the function and conservation role of the Critical Habitat Unit.

8.7.3.7 Northeast Washington: Unit 22

FPHCP covered lands are upstream or interspersed with critical habitat segments designated in the LeClerc Creek local population and the Tacoma, Cedar, Indian, Mill, Ruby, Slate, Small and South Fork Tacoma Creek potential local populations. The FPHCP includes covered lands adjacent to many non-fish-bearing streams, fish-bearing tributaries, and mainstem rivers, which have the potential to adversely affect downstream critical habitat. All spawning and rearing habitat in Sullivan Creek potential local populations were excluded.

Critical habitat segments designated in the Tacoma Creek potential local population are at high overall potential risk and LeClerc Creek local population is at a moderate-high risk, while Cedar, Indian, Mill, Ruby, Slate, Small and South Fork Tacoma Creeks potential local populations are all at a moderate overall potential risk.

Potential adverse effects to critical habitat in this Critical Habitat Unit include reduced connectivity, reduced quality and quantity of cold water refugia, diminished large wood recruitment, and elevated sediment. Indirect effects from forest management activities on FPHCP covered lands may also result in a decrease in forage or prey base, because adverse effects to habitat also reduce prey availability.

Critical habitat in local populations at moderate to high risk:

There were no critical habitat segments in local populations or FMO habitats ranked at an overall low risk for effects. However, in Cedar, Indian, Mill, Ruby, Small and South Fork Tacoma Creeks, potential local populations with an overall moderate risk, adverse effects are expected to occur. However, habitat conditions or PCEs are expected to have some resiliency to adverse effects resulting from the FPHCP covered activities.

The overall potential risk for critical habitat segments in the LeClerc Creek local population and the Tacoma Creek local population is moderate-high and high, respectively, to adverse effects. The Geographic Risk Analysis indicates that sediment, temperature, and large wood in LeClerc Creek and Tacoma Creek are functioning at moderate to high risk. Generally, the critical habitat in these local populations has the lowest resiliency to any potential adverse effects.

Critical habitat in FMO habitat at moderate-high to high risk:

In terms of the overall potential risk to adverse effects, FMO critical habitat in Calispell Creek and Small Creek is at a high risk, and LeClerc, Sullivan, and Tacoma Creeks are at a moderate-high risk. Further review of South Fork Tacoma Creek and Ruby Creek indicated there was no FMO critical habitat segments contained within these potential local populations.

Additional analysis for critical habitat in local populations and FMO habitat:

Because there is a moderate-high or high overall potential risk to critical habitat in the LeClerc Creek and Tacoma Creek local populations and FMO areas in this Critical Habitat Unit, additional analysis was conducted to evaluate more site specific watershed conditions related to rain on snow, soils, slope steepness and slope hazards, geology, and roads using additional GIS analysis (see Appendix C, Table H). Based on this analysis, it is anticipated that the severity of potential effects from activities on FPHCP covered lands would likely be higher due to these watershed conditions. The baseline habitat conditions in conjunction with these watershed conditions tend to increase the likelihood that potential adverse effects would be severe. These effects may contribute to the alteration of riparian and channel conditions, including changes in stream temperatures, sediment routing, and large wood recruitment.

Summary of effects at the Critical Habitat Unit scale:

In the Northeast Washington Critical Habitat Unit, the effects of the action to the habitat conditions or PCEs are anticipated to range from moderate to high, depending on site specific factors and the frequency, timing, duration, and intensity of forest practices over the course of 50 years. There are critical habitat segments in six potential local populations ranked at moderate overall potential risk; and all FMO areas are ranked at a moderate-high or high overall risk to adverse effects due to exposure and baeline habitat conditions. Moderate risk populations are anticipated to be more resilient to potential effects from FPHCP activities. However, when combined with the critical habitat segments that are at moderate-high and high risk, the Critical Habitat Unit may experience adverse effects in the only known local population (LeClerc Creek), all seven potential local populations with critical habitat segments, and in all FMO areas designated in the Pend Oreille core area.

The critical habitat in the Pend Orielle core area is designated for recovery of the potential local populations. Bull trout are in low abundance and habitat in the core area is in poor condition, has fish passage barriers, and contains non-native predatory fish. Critical habitat segments that are functioning at moderate-high or high risk and are at high risk of exposure within the local populations or potential local populations, are necessary in supporting the function of the core areas. This suggests that habitat conditions and process in the Critical Habitat Unit and core area may be more severely affected by potential downstream effects of the proposed action, or that the functional suitability of the PCEs at the critical habitat unit scale may be affected. Although effects are likely to be site specific, it is likely that PCEs 1, 2, 3, 5, and 7 would be adversely affected, while PCE 4 could also be affected. Indirect effects from forest management activities on FPHCP covered lands may result in a decrease in prey base (PCE 7). Although effects are likely to be site specific, it is likely that PCEs 1, 2, 3, 5, and 6 would be adversely affected to some extent, while PCE 4 could also be affected. Indirect effects from forest management activities on FPHCP covered lands may result in a decrease in forage base (PCE 7). As noted above, all FPHCP covered lands were excluded from critical habitat designation and effects to critical habitat from the FPHCP would only occur downstream of the FPHCP covered lands. Although site-specific effects to PCEs could be severe, the magnitude of these downstream effects is anticipated to be less than effects to streams directly adjacent to the FPHCP covered activities. In addition, the FPHCP conservation measures are expected to minimize the likelihood of adverse effects and reduce the risks associated with the unknown site-specific conditions in the moderate-high and high risk local populations. We do not expect that the proosed action would alter the function and conservation role of the Critical Habitat Unit.

8.7.3.8 Snake River Washington: Unit 23

There is a small amount of FPHCP covered lands interspersed with or directly upstream of critical habitat in the Cummings Creek local population in the Tucannon core area. The FPHCP includes covered lands adjacent to many non-fish-bearing streams, adjacent to fish-bearing tributaries, and adjacent to the streams and mainstem rivers, which have the potential to adversely affect FMO critical habitat segments that are present downstream. Adverse effects to critical habitat in this Critical Habitat Unit could include reduced quality and quantity of cold water refugia, diminished large wood recruitment, and elevated sediment. Although effects are likely to be site specific, it is likely that PCEs 1, 2, 5, and 6 may be adversely affected, while PCE 4 could also be affected. Indirect effects from forest management activities on FPHCP covered lands may result in a decrease in forage base (PCE 7). There are few FPHCP covered lands located within the Cummings Creek local population and, therefore, there is a very low exposure risk. This low exposure risk indicates that effects from the FHPCP would be minimal and would not affect the function and conservation role of the Critical Habitat Unit.

8.7.3.9 Olympic Peninsula: Unit 27

FPHCP covered lands are located in FMO habitat in all core areas and in the lower portion of the Dungeness River local population. All designated FMO critical habitat in the Critical Habitat Unit is located downstream of FPHCP covered lands and has the potential to be impacted by activities carried out on FPHCP covered lands. The FPHCP includes covered lands adjacent to and interspersed with many non-fish-bearing streams, and fish-bearing tributaries, which have the potential to affect designated critical habitat segments that are present downstream. Adverse effects to critical habitat in this Critical Habitat Unit include reduced quality and quantity of cold water refugia, diminished large wood recruitment, and elevated sediment. Although effects are likely to be site-specific, it is likely that PCEs 1, 2, 5, and 6 may be adversely affected, while PCE 4 could be affected. Indirect effects from forest management activities on FPHCP covered lands may result in a decrease in forage base (PCE 7). Most spawning and rearing critical habitat segments are located upstream within Olympic National Park, and FMO habitat is generally not directly adjacent to FPHCP covered lands. All PCEs may be affected to some extent on a site specific basis. Therefore, due to low exposure to FPHCP covered activities and moderate risk baseline habitat conditions in spawning and rearing and FMO critical habitat segments in the Hoh, Dungeness, and Elwha Rivers, the overall effects are expected to be low. In the Skokomish

FMO, where the exposure is low and the habitat baseline conditions are functioning at high risk, effects are expected to be moderate. Even with the potential of low to moderate downstream effects from FPHCP covered activities, they are expected to be minimal and would not affect the functional suitability of the PCEs. All spawning and rearing segments within local populations are excluded, and FMO critical habitat exposure risk is low. Although PCEs in FMO critical habitat may be affected to some extent on a site-specific basis, the low exposure risk indicates these effects would be minimal and would not affect the function and conservation role of the Critical Habitat Unit.

8.7.3.10 Puget Sound: Unit 28

FPHCP covered lands have the potential to affect spawning, rearing, foraging, migration and overwintering habitat in this Critical Habitat Unit. FPHCP covered lands are adjacent and interspersed with spawning and rearing critical habitat segments in four of the six core areas in this Critical Habitat Unit including the Nooksack, Stillaguamish, Snohomish-Skykomish, and Puyallup Rivers core areas. The remaining FPHCP covered lands within this Critical Habitat Unit are located in FMO areas outside of these core areas including the Lower Nisqually, Lower Green, and Samish Rivers. In these FMO areas, activities on FPHCP covered lands would not affect spawning and rearing critical habitat segments. Except in the four core areas described above, the remaining FPHCP covered lands within this Critical Habitat Unit are located below local populations (i.e., Lower Skagit River core area). Potential effects from activities on FPHCP covered lands were therefore determined to have no affect on spawning and rearing habitat in these areas. However, the FPHCP does include lands adjacent to many non-fish-bearing streams, adjacent to fish-bearing tributaries, and adjacent to the streams and mainstem rivers, which have the potential to adversely affect downstream critical habitat.

There were no FPHCP covered lands adjacent or interspersed with critical habitat designated as spawning and rearing in the White River (including West Fork White River), the Carbon River (including Ipsut and Ranger Creeks), and Mowich River. Most critical habitat in these local populations is located in Mount Rainier National Park so effects would be minimal. All spawning and rearing habitat segments in the Upper Puyallup, Upper Deer Creek, Canyon Creek, and South Fork Stillaguamish River were excluded.

Critical habitat in local populations at moderate to high risk:

The overall potential risk for spawning and rearing critical habitat segments in Lower South Fork Nooksack River local population is high and North Fork Stillaguamish River local population is moderate-high to adverse effects. The Geographic Risk Analysis indicates that sediment, temperature, and large wood in are functioning at moderate to high risk. Generally, the critical habitat in these local populations has low resiliency to effects. The Lower North Fork Nooksack River including Maple Creek, Upper Middle Fork Nooksack River, Lower Middle Fork Nooksack, South Fork Stillaguamish River, and South Fork Skykomish River local populations are at an overall moderate risk.

In the Lower North Fork Nooksack (including Maple Creek), Upper Middle Fork Nooksack, South Fork Stillaguamish, and South Fork Skykomish Rivers local populations where there is an overall moderate risk to critical habitat, adverse effects are expected to occur. However, we expect that the habitat conditions or PCEs have some resiliency to recover.

Critical habitat in FMO habitat at moderate-high to high risk:

FMO habitat in the Puyallup River is at an overall high risk; FMO in the Carbon, Nooksack, Middle Fork Nooksack, South Fork Nooksack, Stillaguamish, and North Fork Stillaguamish Rivers are at a moderate-high overall risk; while FMO in the core areas in the Lower North Fork Nooksack (including Kendall Creek, Deer and Canyon Creek), the South Fork Stillaguamish, Snohomish/Skykomish, and White Rivers are at overall moderate risk. Additionally, FMO critical habitat segments in the Lower Nisqually, Lower Green, Samish FMO areas, and the Lower Skagit River core area are at an overall moderate risk to adverse effects. Potential adverse effects to FMO critical habitat segments in this Critical Habitat Unit include reduced quality and quantity of cold water refugia, diminished large wood recruitment, and elevated sediment. Indirect effects from forest management activities on FPHCP covered lands may also result in a decrease in forage or prey base, because adverse effects to habitat also reduce prey availability.

Additional analysis for critical habitat in local populations and FMO habitat:

Because there is a moderate-high or high overall potential risk to critical habitat in the Lower South Fork Nooksack, Lower Middle Fork Nooksack, and North Fork Stillaguamish local populations, and in FMO habitats in the Puyallup, Carbon, Nooksack, Middle Fork Nooksack, South Fork Nooksack, Stillaguamish, and North Fork Stillaguamish Rivers in this Critical Habitat Unit, additional analysis was conducted to evaluate more site-specific watershed conditions related to rain-on-snow, soils, slope steepness and slope hazards, geology, and roads using additional GIS analysis (see Appendix C, Table H). Based on this analysis, it is anticipated that the severity of potential effects from activities on FPHCP covered lands would likely be high due to these watershed conditions. The baseline habitat conditions in conjunction with these watershed conditions tend to increase the likelihood that potential adverse effects would be severe. These effects may contribute to the alteration of riparian and channel conditions, including changes in stream temperatures, sediment routing, and large wood recruitment.

Summary of effects at the Critical Habitat Unit scale:

In the Puget Sound Critical Habitat Unit, the effects of the action on the habitat conditions or PCEs are anticipated to range from moderate to high, depending on site-specific factors and the frequency, timing, duration, and intensity of forest practices over the course of 50 years. There are critical habitat segments in four of the six core areas in this Critical Habitat Unit that are potentially affected. Three local populations are at moderate risk, and FMO areas are at a moderate, moderate-high, or high risk to potential adverse effects due to exposure and habitat conditions, but as discussed earlier they are anticipated to be resilient to the effects of the activities. However, when combined with the critical habitat segments that are at moderate-high and high risk, the Critical Habitat Unit may experience adverse effects in many of the local populations with designated critical habitat, and in all FMO areas designated in four core areas in this Critical Habitat Unit. The critical habitat in these core areas is designated for maintenance and recovery of the local populations. Spawning and rearing critical habitat segments functioning at moderate-high or high risk and that are at high risk of exposure within the local populations, are necessary in supporting the function of the core areas. This suggests that habitat conditions and process in the Critical Habitat Unit and core area may be more severely affected by potential downstream effects of the proposed action, or that the functional suitability of the PCEs at the Critical Habitat Unit scale may be affected. Although effects are likely to be site-specific, it is likely that within FMO habitat PCEs 1, 2, 5, and 6 would be adversely affected, while PCE 4 could be affected. Indirect effects from forest management activities on FPHCP covered lands may result in a decrease in prey base (PCE 7). As noted above, all FPHCP covered lands were excluded from critical habitat designation and effects to critical habitat from the FPHCP would only occur downstream of the FPHCP covered lands. Although site-specific effects to PCEs could be severe, the magnitude of these downstream effects is anticipated to be less than effects to streams directly adjacent to the FPHCP covered activities. In addition, the FPHCP conservation measures are expected to minimize the likelihood of adverse effects and reduce the risks associated with the unknown site-specific conditions in the moderate-high and high risk local populations. We do not expect that the proosed action would alter the function and conservation role of the Critical Habitat Unit.

8.7.3.11 Summary of Effects of the Action on Bull Trout Critical Habitat

Within designated critical habitat throughout the FPHCP Action Area, there is significant uncertainty about the location and timing of activities and the range of adverse effects. Potential effects to critical habitat segments would vary in type and severity; however, in some areas exposure would be reduced due to the location and proximity of critical habitat segments relative to FPHCP covered lands. In some instances there may be no overlap of FPHCP covered lands with segments of critical habitat. Within approximately half of the local populations, there is a moderate-high and high risk of exposure (see Appendix C, Tables J and K for summary of exposure analysis).

In areas where FPHCP covered lands are upstream of or interspersed with critical habitat, adverse effects include an increase in stream temperatures, a reduction in large wood, and/or elevated sediment levels. These effects would likely vary from watershed to watershed, depending primarily on proximity of the critical habitat to FPHCP covered lands, current habitat conditions, site-specific FPHCP prescriptions, geomorphology, and climate. All PCEs may be affected to some extent on a site-specific basis.

Based on the bull trout Geographic Risk Analysis, Critical Habitat Unit GIS analysis, and other exposure information, no critical habitat would be affected in the Priest Lake or Lake Pend Orielle Core Areas, or the Clark Fork and Coeur D'Alene Critical Habitat Unit, respectively. Core areas with only a low potential risk for adverse effects to critical habitat include: Lewis and White Salmon, and Hoh, Dungeness, and Elwha core areas. These are located in the Lower Columbia River Basin, and Olympic Peninsula Critical Habitat Units, respectively. Core areas with only a moderate potential risk for adverse effects include: Grande Ronde, Asotin and Tucannon, and Snohomish/Skykomish core areas. These are located in the Grande Ronde River, Snake River, and Puget Sound Basins Critical Habitat Units, respectively. In these core areas, due to less degraded habitat conditions and/or the proximity of FPHCP covered lands, effects are not anticipated to reduce the function or conservation role of the PCEs.

In general, FMO habitat that is at low or moderate risk is likely to be resilient to adverse affects due to current habitat conditions, or have a low likelihood of exposure to potential adverse effects. Critical habitat segments in these FMO areas have more resiliency to adverse effects than spawning and rearing habitat due to larger stream channels, greater channel/habitat depth, larger volumes of water, and their location further downstream from FPHCP covered activities in most cases. For these reasons, adverse effects to PCEs within FMO habitats are not anticipated to reduce the function or conservation role of PCEs.

Core areas with moderate-high and high risk for adverse effects have a high likelihood that PCEs in spawning and rearing and FMO critical habitat segments would be degraded. The core areas with the highest risk to spawning and rearing critical habitat segments include the Nooksack, Stillaguamish and Puyallup; Yakima; Walla Walla; and Pend Orielle. They are located in the Puget Sound, Middle Columbia River, Umatilla-Walla Walla River, and Northeast Washington Critical Habitat Units, respectively. The core areas with the highest potential for FPCHP covered activities to degrade PCEs in FMO critical habitat segments include the Puyallup, White, Stillaguamish, Nooksack, and Snohomish/Skykomish; Klickitat; Yakima; Walla Walla; and Pend Orielle. They are located in the Puget Sound, Lower Columbia, Middle Columbia, Umatilla-Walla Walla, and Northeast Washington Critical

Habitat Units, respectively. Potential adverse effects to PCEs would likely affect the function and conservation role of the Critical Habitat Units. Additionally, core areas where both the spawning and rearing and FMO critical habitats are at moderate-high or high risk of adverse effects to critical habitat, adverse affects would be the greatest. These core areas include the Stillaguamish, Yakima, Walla Walla, and Pend Orielle. They are located in the Puget Sound, Middle Columbia, Umatilla-Walla Walla, and Northeast Washington Critical Habitat Units, respectively.

The FPHCP has a number of conservation features that help to reduce, minimize, and mitigate the potential and anticipated adverse effects from FPHCP covered activities. These features include the riparian buffers, equipment limitation zones, RMAPs, best management practices (BMPs) for roads, the Landslide Hazard Zonation and Regional Landform Identification Projects, forest practices application screening, the Family Forest Fish Passage Program, and SEPA Class IV-Special evaluations. Riparian buffer strategies are designed to provide adequate wood recruitment, and to minimize temperature increases and sediment inputs. RMAPS, road BMPs, and the Family Forest Fish Passage Program are designed to minimize sediment inputs directly related to roads and failing culverts. The Landslide Hazard Zonation and Regional Landform Identification Projects, forest practices application screening, and SEPA Class IV-Special evaluations are designed to prevent FPHCP covered activities from triggering slope failures and mass wasting, which would help conserve LWD recruitment and minimize temperature increases and sediment inputs to bull trout habitats. These conservation measures work collectively to minimize potential and anticipated adverse effects from sediment, loss of LWD, and increases in temperature PCEs in each critical habitat unit.

8.7.4 CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the FPHCP Action Area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Numerous non-Federal actions that could affect critical habitat are reasonably certain to occur within the FPHCP Action Area. These future actions could contribute to cumulative effects on critical habitat in the FPHCP Action Area.

Cumulative effects from a variety of activities are likely to adversely affect the PCEs of bull trout critical habitat. These actions include, but are not limited to, industrial and residential development, road construction and maintenance, mining, forest activities, agriculture and grazing, and fire management. Impacts from these activities have the potential to degrade PCEs 1, 2, 3, 4, 5, 6, and 7 within the FPHCP Action Area. Water storage facilities and future dams for irrigation are likely to adversely affect PCE 8.

In western Washington, 83 percent of the land is presently forested, 5 percent is in agriculture, 4 percent is urban and industrial lands, and the remaining 8 percent are comprised of water and wetlands, ice, snow and bare rock, shrubland, and grassland. Most of the development has occurred along Puget Sound and along major river systems.

In contrast, eastern Washington is 36 percent forested, 35 percent shrubland/grassland, 26 percent agriculture, 1 percent industrial and urban, and the remaining 3 percent water, wetlands, ice, snow, and bare rock. Major hydroelectric dams and irrigation developments, and agriculture along the Columbia River system have resulted in the greatest change to the eastern Washington landscape, particularly in the non-forested areas.

For additional discussion on the cumulative effects from various actions see the **Cumulative Effects** section immediately following **Effects of the Action on Populations**.

8.7.5 CONCLUSION

The environmental baseline indicates that PCEs in critical habitat in the FPHCP Action Area ranges from functioning at low risk to high risk and that they are variable across core areas. The conservation role of bull trout critical habitat in the FPHCP Action Area is to provide bull trout foraging, migration, over-wintering, spawning, and rearing habitat of sufficient quality and quantity to support viable core area populations.

Compared to the Coastal-Puget Sound population segment, baseline critical habitat conditions are generally more degraded in spawning and rearing habitats within the Columbia River population segment. At the core area scale, numerous historic and ongoing factors continue to contribute to already degraded critical habitat conditions. An exception to this occurs for those core areas with local populations (spawning and rearing habitat) and/or FMO habitats located largely within relatively protected areas (e.g., Wilderness Areas and National Parks).

The proposed action would have short- to long-term adverse effects on sediment, large wood, and temperature. The FPHCP covered activities, when added to the baseline and considering future cumulative effects in the FPHCP Action Area, are likely to influence the ability of PCEs 1 (water temperature), 2 (complex stream channels), 3 (substrate), 4 (natural hydrograph), 5 (springs, seeps, and groundwater), 6 (migratory corridors), and 7 (food base) to function properly. However, these adverse effects from the FPHCP would be temporally, spatially, and situationally (i.e., site-specific conditions) dispersed over the 50-year Permit term across the FPHCP covered lands.

The FPHCP conservation measures are expected to reduce or minimize the likelihood of adverse effects to critical habitat and reduce the risks and uncertainty associated with the site-specific conditions. We do not anticipate the magnitude of these effects to significantly impair the ability of the PCEs to function, and we conclude that the FPHCP is not likely to affect these Critical Habitat Units to the extent that the PCEs would no longer contribute to the conservation value of designated critical habitat. On this basis, the FPHCP covered activities would not destroy or adversely modify designated critical habitat for bull trout in the Critical Habitat Units located completely or partially in Washington.

Bull trout generally have a broad distribution in the FPHCP Action Area and effects from the FPHCP are not expected to decrease their distribution. Most disturbances from the proposed action are generally expected to be short-term in nature and at a reach or less (habitat unit) scale. Disturbance levels are not expected to cause large-scale declines in bull trout abundance or distribution. Maturation of riparian areas, maintaining and restoring fish passage both for bull trout and their prey species, adaptive management, and improved road management practices are all expected from implementation of the FPHCP. These management prescriptions are expected to contribute to increasing the likelihood that bull trout habitat significantly improves in the FPHCP Action Area over the current conditions. However, because designated critical habitat segments are not located immediately adjacent to FPHCP covered lands, any improvements to critical habitat stream segments would be indirect in nature. Management on FPHCP covered lands typically has a limited ability to directly improve channel and especially riparian and streambank conditions in the designated critical habitat stream segments.

8.8 OVERVIEW AND INTEGRATION OF EFFECTS ON COVERED SPECIES

The provisions of the FPHCP were derived through a multi-stakeholder effort to consider the adverse and beneficial environmental effects of conducting forest practices activities under the Washington Forest Practices Rules. The condition of the comprehensive environmental baseline for the FPHCP Action Area is a reflection of historical forest practices and other non-forestry related activities. The FPHCP provisions reduce, minimize, and/or mitigate the effects of forest practices to improve riparian and aquatic conditions in the FPHCP Action Area. These provisions include: (1) riparian buffers on all fish-bearing streams and at least 50 percent of perennial non-fish-bearing streams; (2) equipment limitation zones; (3) RMAPs; (4) road BMPs; (5) regulations governing the identification and protection of potentially unstable slopes including the Landslide Hazard Zonation and Regional Landform Identification Projects; (6) the Family Forest Fish Passage Program, Riparian Open Space Program, and Forestry Riparian Easement Program for small forest landowners; and (7) Class IV-Special SEPA review. These provisions are designed to provide adequate wood recruitment and to reduce and minimize temperature changes and sediment inputs. RMAPs, road BMPs, and the small forest landowner programs are designed to reduce and minimize sediment inputs directly related to roads and culverts. Unstable slope identification and protection and Class IV-Special SEPA review are expected to reduce and minimize slope failures and mass wasting as a result of forest practices activities. These provisions of the FPHCP work collectively to reduce and/or minimize adverse effects from reduced LWD recruitment and increases in sediment and stream temperatures.

In addition, adverse effects from FPHCP implementation are expected to be spatially and temporally dispersed within riparian areas on over 9.3 million acres of forest land over a 50-year Permit term. However, even if individual forest practices in some areas are not spatially or temporally dispersed, adverse effects would continue to be minimized. Also, adverse effects are expected, in some cases, to be minimized for individual forest practice activities because of site-specific conditions and based on the type of forest practice activity conducted. Many forest practices are expected to provide benefits to FPHCP covered species. For example, the requirement that all fish passage barriers on FPHCP covered lands be removed by July 1, 2016, provides substantial benefits to covered fish species. These long-term benefits are expected to far outweigh the short-term adverse effects from the construction and repair work to upgrade or replace these barriers. Another example is the provision of the Desired Future Conditions for both westside and eastside riparian stands on fish-bearing streams. The long-term benefits from achieving these desired future conditions are expected to outweigh the short-term adverse effects from harvesting in the Inner Zone of riparian stands on fish-bearing streams.

There are some adverse effects from forest practices that do pose risks to covered species. In areas where there is greater exposure to adverse effects from forest practices, such as the upper portions of non-fish-bearing streams that may not receive buffers, there is risk to covered amphibian species that occur in these areas. These same forest practices also pose some risk to the upper portions of some fish-bearing streams due to the expected reduction of LWD recruitment and some increases in stream temperature and sediment input in these areas. However, in our weighing of the benefits of the FPHCP, that are expected to grow over the life of the 50-year Permit term and beyond, the risks are reduced and minimized. All covered species are expected to be sufficiently resilient to these adverse effects, with no appreciable reduction in their likelihood of survival and recovery resulting from this action. Even in areas where there is high risk, such as certain local populations of bull trout, the benefits of full fish passage on all streams on FPHCP covered lands and highly functional riparian buffers on all fish-bearing streams, at least 50 percent of perennial non-fish-bearing streams, and the protection of sensitive sites and unstable slopes outweighs the adverse effects of up to the remaining 50 percent of perennial non-fish-bearing streams not receiving buffers, and the short-term effects of construction and repair to remove fish-passage barriers.

Overall, as a result of the FPHCP, we expect improvements in riparian and aquatic habitat quality and function, that would provide conservation benefits to covered species, when compared to current baseline conditions. Over the next 50 years, we expect increases in the quality and quantity of pools, reductions in embedded stream substrates, improvements to stream shade, and improvements to in-channel habitat conditions, compared to current baseline conditions.