United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
Central Washington Field Office
215 Melody Lane, Suite 119
Wenatchee, WA 98801

September 28, 2009

In Reply Refer To:
USFWS Reference: 13260-2009-F-0128
Hydrologic Unit Code: 17-02-00-08, Middle Methow and lower Chewuch Rivers

Mike Liu, District Ranger
Okanogan-Wenatchee National Forest
Methow Valley Ranger District
24 West Chewuch Road
Winthrop, Washington 98862

Dear Mr. Liu:

This correspondence transmits the U.S. Fish and Wildlife Service's (Service) biological opinion, which is based on our review of the Cub Allotment Management Plan Renewal (Project), located in Okanogan County, Washington. Representing the U.S. Forest Service, you requested initiation of formal consultation regarding anticipated adverse effects from the proposed Project on the Columbia River interim recovery unit of the bull trout (*Salvelinus confluentus*). The attached biological opinion describes the effects of the Project on the bull trout in accordance with Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.).

The Service received your letter requesting initiation of formal consultation and the final Biological Assessment for the Project on July 20, 2009. Informal consultation regarding effects of the Project on listed species of terrestrial wildlife was completed on July 30, 2009 (Service ref. 13260-2009-I-0127). These materials and a complete record for this consultation are on file in our Central Washington Field Office.

Our analysis of Project effects in the attached biological opinion leads us to conclude that implementation of the proposed Project will not jeopardize the continued existence of the bull trout. The incidental take statement accompanying our biological opinion provides the U.S. Forest Service with an exemption from the Section 9 prohibitions described in the Endangered Species Act. Please note that this incidental take statement also includes mandatory "reasonable and prudent measures" and "terms and conditions" that are designed to minimize incidental take. We also offer several "conservation recommendations" that are non-binding and are designed to minimize risks to listed species associated with Project implementation.

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Thank you for helping to conserve listed species. If you have questions about this biological opinion or your responsibilities under the Endangered Species Act, please contact Karl Halupka of the Central Washington Field Office in Wenatchee at (509) 665-3508 x11 or via e-mail at Karl_Halupka@FWS.gov.

Sincerely,

Jessica L. Gonyoles for

Ken S. Berg, Manager
Washington Fish and Wildlife Office

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BIOLOGICAL OPINION

for the

Cub Allotment Management Plan Renewal

U.S. Department of Agriculture
Forest Service
Okanogan and Wenatchee National Forest
Methow Valley Ranger District
24 West Chewuch Road
Winthrop, Washington 98862

USFWS Reference Number: 13260-2009-F-0128
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Hydrologic Unit Code: 17-02-00-08, Middle Methow and Lower Chewuch Rivers

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Ken S. Berg, Manager
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TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... **iii**

INTRODUCTION **1**

CONSULTATION HISTORY **2**

BIOLOGICAL OPINION **3**

1.0 PROJECT DESCRIPTION **3**
1.1 Definition of the Action Area 5

2.0 STATUS OF THE SPECIES FOR BULL TROUT **8**
2.1 Listing Status and Distribution 8
2.2 Current Status and Conservation Needs 9
2.3 Jarbidge River 9
2.4 Klamath River 10
2.5 Columbia River 10
2.6 Coastal-Puget Sound 11
2.7 St. Mary-Belly River 11
2.8 Life History and Population Dynamics 12
2.9 Consulted-on Effects 12

3.0 ENVIRONMENTAL BASELINE **13**
3.1 Environmental Baseline for the Methow Core Area 14
3.2 Environmental Baseline in the Middle Methow Watershed 24
3.3 Environmental Baseline in the Chewuch Watershed 27
3.4 Global Climate Change 35
3.5 Likelihood of Species Presence in the Action Area 37

4.0 EFFECTS OF THE ACTION **37**
4.1 Direct Injury or Mortality 39
4.2 Effects to Habitat Indicators 46
4.3 Responses of Bull Trout to Habitat Effects 51
4.4 Integration of Direct Effects and Indirect Habitat Effects 51
4.5 Concurrent Effects 52

5.0 CUMULATIVE EFFECTS **52**

6.0 CONCLUSION **53**

INCIDENTAL TAKE STATEMENT **55**
1. Introduction 55
2. Anticipated Amount or Extent of Take of Bull Trout 55
3. Effect of the Take 57
4. Reasonable and Prudent Measures 57
5. Terms and Conditions 57
6. Reporting Requirements 58

CONSERVATION RECOMMENDATIONS **59**

REINITIATION NOTICE **60**

LITERATURE CITED **61**

APPENDIX A: Bull Trout Life History and Population Dynamics **69**

APPENDIX B: Projects subject to prior Section 7 consultation in the Middle Methow Watershed **93**

APPENDIX C: Projects subject to prior Section 7 consultation in the Chewuch Watershed **94**

EXECUTIVE SUMMARY

The purpose of the Cub Allotment Management Plan Renewal (Project) is to authorize the continuation of grazing on the Cub Allotment for the next 10 years. This Project will implement a new allotment management plan that is consistent with applicable laws, Forest Plan direction, and current best management practices. The Cub Allotment is located in the Middle Methow and Lower Chewuch River watersheds, includes nine pastures, and covers about 63,500 acres.

The U.S. Forest Service (USFS) proposed an Allotment Management Plan that consists of four elements:

1. Grazing (browsing vegetation, trampling aquatic and riparian habitat, input of feces and urine into aquatic habitat, and hauling cattle in trucks on Forest roads)
2. Water-development construction, use, and maintenance
3. Fence construction and maintenance.
4. Monitoring.

The first of these Project elements is likely to result in adverse effects to the bull trout (*Salvelinus confluentus*).

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation, and alteration. Five segments of the coterminous United States population of the bull trout are essential to the survival and recovery of this species and are identified as interim recovery units. The Project is located in the Columbia River interim recovery unit which currently contains about 100 core areas and 500 local populations. The immense size and complexity of this interim recovery unit make it difficult to determine its current status. In a recent risk assessment, 76 percent of the core areas in the unit (including the Methow core area, in which the proposed Project will occur) are in the two highest-risk categories. This risk profile suggests that unit-wide resilience to further habitat degradation may be limited. The high number of and variability in conditions among core areas, difficulty of assessing aggregate risk, lack of key biological information, and the lack of a completed Recovery Plan to inform 7(a)(2) analysis all contribute to uncertainty about the current status of the unit and the potential unit-wide consequences of localized project effects.

Although bull trout are widely distributed in the Methow core area, abundance is generally low and productivity highly variable. The Methow core area also shows a reduced distribution of the migratory life-history form. Numerous historic and ongoing factors continue to limit the potential for population recovery at the core-area scale. Several spawning locations within the Methow core area have been directly and severely affected by wildfire in recent years. The U.S. Fish and Wildlife Service (Service) expects that recruitment of juvenile bull trout into the spawning population will be depressed until the areas destabilized by wildfires are more fully re-vegetated. Population indicators in the Methow core area are "not properly functioning." This evaluation is based on redd surveys yielding low estimates of total population size, insufficient data to accurately estimate abundance trends, reduced connectivity among local populations in the Methow basin, and concern about introgressive hybridization with brook trout (*Salvelinus fontinalis*).

Despite extensive wildfire effects in recent years, the baseline condition of most habitat pathways in the Chewuch watershed are "properly functioning" in the upper watershed or "functioning at risk" in the lower watershed. Elevated temperature and sedimentation, a

deficiency of large woody debris, high road density, and low pool frequency and quality are the primary factors contributing to reduced habitat suitability for bull trout in the lower watershed.

The part of the grazing allotment where adverse impacts to bull trout will occur is located in the Middle Methow watershed. Wolf Creek, Goat Creek, and Beaver Creek are the primary tributaries supporting bull trout spawning in this watershed. In terms of current baseline condition, most habitat indicators in the Middle Methow watershed are either "functioning appropriately" or "functioning at risk." Road density and location is the only habitat indicator with a baseline condition of "not properly functioning."

Project effects will occur primarily in the Goat Creek watershed. Of the estimated 44 adult, sub-adult, and juvenile bull trout from the Goat Creek local population potentially exposed to grazing-related disturbance annually, the Service anticipates that about 10 percent will experience sub-lethal effects due to disruption of normal spawning, sheltering, or feeding behavior (two adults and three sub-adults or juveniles). The Service expects that the severity of sub-lethal effects from exposure to grazing-related disturbance will be sufficiently mild that the survival of exposed individuals will not be reduced appreciably. The reproductive success of disturbed spawning adult individuals may be reduced. The Service, however, does not expect minor reductions in productivity of one spawning pair per year to be sufficient to alter overall demographic trends of the Goat Creek local population.

Project implementation will have negative effects on two components of bull trout habitat: streambank condition and riparian reserves. These negative effects will result in indirect adverse effects on bull trout exposed to these degraded habitat conditions. We expect adverse effects on up to two bull trout per year, primarily in the form of reduced physiologic condition. These adverse indirect effects are likely to be sub-lethal, and bull trout that experience these adverse effects are expected to fully recover, with no long-term reduction in survival or reproduction. Combining both direct and indirect effects, the Project will have transient sub-lethal effects on about seven individuals annually for 10 years.

Incidental take of bull trout is likely to occur as a result of implementation of the grazing Project element. We estimate sub-lethal incidental take of up to 50 bull trout due to harassment and up to 20 bull trout due to harm associated with habitat degradation during the 10-year term of this Project. No lethal incidental take will occur. The Incidental Take Statement accompanying this biological opinion includes mandatory Reasonable and Prudent Measures and Terms and Conditions intended to minimize this incidental take. Non-mandatory conservation recommendations are also provided to minimize or avoid adverse effects of this proposed action on listed species and to develop information.

Our opinion is that all Project effects are unlikely to diminish the numbers and reproduction of the local population of bull trout affected and will not reduce the distribution of local populations in the core area. We expect the negative effects of the Project at the local scale to be imperceptible at the larger scales of the core area, interim recovery unit, or range-wide. Based on our review and analysis, it is the Service's biological opinion that the Project, as proposed, is not likely to jeopardize the continued existence of the Columbia River interim recovery unit of the bull trout.

INTRODUCTION

The purpose of the Cub Allotment Management Plan Renewal (Project) is to authorize the continuation of grazing on the Cub Allotment for the next 10 years. This Project will implement a new allotment management plan that is consistent with applicable laws, Forest Plan direction, and current best management practices. The Cub Allotment is located in the Middle Methow and Lower Chewuch River watersheds, and covers about 63,500 acres.

The proposed action includes provisions to minimize cattle access to fish spawning habitat. This will be accomplished by shifting pasture timing, reducing permitted livestock numbers, constructing one new water development, constructing new fence, and by adding a currently ungrazed pasture previously used for USFS pack and saddle stock to the Cub allotment. The season of use would continue to be from June 1 to October 15, using a rest/rotation system.

The U.S. Fish and Wildlife Service's (Service) objective for the following biological opinion (BO) is to determine whether the proposed Project is likely to "jeopardize the continued existence" of the bull trout (*Salvelinus confluentus*). No designated critical habitat for the bull trout will be affected by the Project. The standards for determining jeopardy are described in Section 7(a)(2) of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*) and further defined in 50 C.F.R. 402.14.

The jeopardy determination for bull trout relies on four components: (1) the *Status of the Species*, which evaluates the species' range-wide condition, the factors responsible for that condition, and the species' survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the role of the action area in the species' survival and recovery; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the listed species present.

In accordance with the implementing regulations for section 7 of the Act and Service policy, the jeopardy determination is made by integrating these components. The integration begins with combining the effects of the proposed Federal action with the aggregated effects of everything that has led to the listed species' current status. This aggregation includes consideration of non-Federal activities in the action area that are likely to affect listed species in the future. The Service uses this assessment of aggregated effects to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the affected listed species.

To facilitate jeopardy analysis and recovery planning for wide-ranging species, the Service sometimes defines interim recovery units. Interim recovery units were defined in the final listing rule for the bull trout in November 1999 (64 FR 58910). We use these interim recovery units to guide consultation analyses and recovery efforts until a final recovery plan is developed. Pursuant to Service policy, when an action impairs or precludes the capacity of a recovery unit to provide both the survival and recovery functions assigned to it, that action may represent

jeopardy to the species. When using this type of analysis, the biological opinion describes how the action affects not only the recovery unit's capability, but also the relationship of the recovery unit to both the survival and recovery of the listed species as a whole.

The jeopardy analysis for bull trout in this BO uses this approach. This analysis begins with a consideration of the role of the action area and the Methow core area in the function of the Columbia River interim recovery unit. This functional assessment provides context for evaluating the effects of the proposed Federal action, combined with other relevant effects, on the survival and recovery of the bull trout.

This BO is based upon information provided in the final Project Biological Assessment (BA) and numerous documents about bull trout, including previous biological opinions, published literature, and unpublished reports. A complete record of this consultation is on file in the Service's Central Washington Field Office in Wenatchee, Washington.

CONSULTATION HISTORY

The following chronology documents key points of the consultation process that culminated in the following biological opinion for the bull trout.

1. June 10, 1998: The Service issued a Final Rule listing Klamath and Columbia River DPSs of bull trout as threatened species. This listing was superseded on November 1, 1999 when the Service listed the bull trout as threatened throughout the coterminous United States (64 FR 58910).
2. November 9, 2002: The Service published a Federal Register Notice proposing designation of critical habitat for the Klamath River and Columbia River DPSs of bull trout (USDI 2002, 61 FR 71236). The Methow River was included in proposed critical habitat (USDI 2002).
3. October 6, 2004: The Service published a Final Rule designating critical habitat for the Columbia River DPS of the bull trout. This final rule was remanded to the Service, and a revised final rule was published on September 26, 2005. This final rule excludes all areas that were proposed as critical habitat for bull trout in the upper Columbia River basin, including the action area (70 FR 56212). Consequently, no effects to bull trout critical habitat are described in the following biological opinion.
4. June 1, 2009: The Level 1 consultation streamlining process for the Project was completed.
5. July 20, 2009: The Service received a final BA and an official request for formal consultation on the Project from the USFS. Consultation was initiated on that date.
6. July 30, 2009: The Service completed informal consultation on the Project for listed terrestrial wildlife species (Service reference number 13260-2009-I-0127).
7. August 31, 2009: The Service met with the USFS to clarify details about the process and timing of cattle removal from the allotment, information about the timing of the onset of spawning of bull trout populations in the Methow core area, and new information about calculating the probability of redd trampling.

BIOLOGICAL OPINION

1.0 PROJECT DESCRIPTION

The project description provided here is an abbreviated summary. For more detailed descriptions of the proposed action, please refer to the Project BA. The Cub Allotment consists of 9 pastures occupying about 63,500 acres. The U.S. Forest Service (USFS) proposes an Allotment Management Plan that will continue for the next 10 years. The Service characterizes this plan as consisting of 4 elements:

1. Grazing (browsing vegetation, trampling aquatic and riparian habitat, input of feces and urine into aquatic habitat, and hauling cattle in trucks on Forest roads[1]);
2. Water-development construction, use, and maintenance;
3. Fence construction and maintenance; and
4. Monitoring.

These Project elements are used throughout the remainder of this biological opinion to describe and evaluate the likely consequences of the Project for the bull trout.

In their BA, the USFS described the Project in terms of functional expectations associated with different Project activities. Although this functional approach does not strictly match the elements listed above, it provides insights into the likely effects of different activities on bull trout and their habitat. For example, "water-development construction, use, and maintenance" will have small negative effects on habitat indicators, but is likely to be effective at reducing impacts from the "grazing" element. The same is true of the "fence construction and maintenance" and "monitoring" elements. In many ways, elements 2, 3, and 4 are functionally conservation measures in that they are likely to minimize overall Project effects. The functional scheme for describing the Project also subdivides the Project into four primary categories, each with multiple sub-activities:

1. Permitting about 564 cow/calf pairs to graze on the allotment.
    a. Browsing vegetation.
    b. Trampling in aquatic and riparian habitat.
    c. Input of feces and urine into aquatic habitat.
    d. Fence construction and maintenance.
    e. Water development construction, use, and maintenance.
    f. Hauling cattle in trucks on Forest roads.
2. Minimizing grazing impacts to habitat quality.
    a. Reducing the permitted number of livestock on one of the two permits for the allotment from 195 to 175 cow/calf pairs. This results in a reduction in total numbers permitted for the allotment from 584 to 564 cow/calf pairs.
    b. Changing the use of the First Creek Administrative Pack and Saddle Stock Allotment to be a pasture of the Cub Allotment. This includes building a fence around the beaver dam complex in First Creek and making a hardened site at the

[1] The Project BA did not evaluate the effects of hauling. The Service included this sub-element to be consistent with our evaluation of other projects, such as timber sales, that include hauling. This sub-element is an interrelated/interdependent component of the proposed action.

stream for cattle to access water. In odd-numbered years, cattle will use this pasture from October 1 to October 15.

c. Minimizing cattle access to Falls Creek wet meadows by installing a drift fence with a spring-loaded trail gate downstream of the wet meadow system. Maintenance of the stock driveway that accesses upper Falls Creek would be removed from the grazing permit.
d. Minimizing cattle access to Falls Creek fen by developing a spring uphill and to the north of the fen and blocking the existing cattle trails to the fen with logs, stumps, and other native materials.
e. Minimizing cattle use at Ortell Bog by reconstructing a former spring development near the road east of the bog to draw cattle away from the bog.
f. Protecting upper Cub Creek by constructing an exclosure fence around upper Cub Creek, above the FS Rd 400, to allow streambanks and vegetation to recover.
g. Requiring the permittee to complete annual maintenance of all assigned improvements to USFS standards. Riding will be done at least once a week and more often, if necessary, so as not to exceed allowable use standards. As the grazing season progresses and allowable use is reached, livestock will be moved to areas of lighter use. It is the permittees' responsibility to maintain a current knowledge of the status of the allotment with regard to allowable use levels, and to move cattle early to the next pasture or off of the allotment if needed. Salt or attractants will be used as tools to better distribute livestock and to reduce conflicts with other resources. The permittee will continue to use road crossings to move cattle across riparian areas, especially Goat Creek. Additional fencing and new water developments will be constructed as needed to draw cattle away from streams and decrease the amount of time that livestock spend within riparian areas. Temporary fencing can be constructed to protect sensitive riparian areas that are not meeting management objectives.
h. Establishing limits on crossing use where the demand is more than can be accommodated. No crossing permits will be issued for livestock permitted by either term or temporary grazing permits accessing allotments. This will be specified in the season of use for the allotment. One crossing exists from Lower Falls pasture to permittees' off-season corral downstream of Eightmile Creek off National Forest lands.

3. Reducing potential direct effects of cattle on salmonid redds.
   a. Changing the scheduled use of the Long Creek Pasture to be from July 15 to August 31 each year.
   b. Minimizing cattle access to salmonid spawning areas:
      i. Extending the existing Falls Creek drift fence to the south by approximately 0.2 miles.
      ii. Installing a cattleguard with drift fence on the Doe Mountain road.
      iii. Constructing ¼ mile of new fence with a gate along the West Chewuch road between the USFS Eightmile Ranch and the private land field to the north.
      iv. Reducing cattle use in the Lamb Butte unit by adding the First Creek unit as the starting point on even numbered years.

v. Requiring the permittee to respond to drifting cattle in the Chewuch River within 24 hours.
vi. Requiring the permittee to actively manage livestock at the end of the season when cattle are being removed from the pasture to prevent access to the Chewuch River.
vii. Requiring the permittee to actively remove cattle from the Long Creek Pasture to Cub Burn on August 31.
viii. Creating an in-season Move Trigger on Goat Creek. Because of bull trout spawning, Designated Monitoring Area (DMA) 10 will be moved upstream adjacent to bull trout spawning habitat and designated as a Critical DMA. A move trigger based on streambank alteration will be established for this DMA.

4. Implementing an Allotment Monitoring Plan with four established Designated Monitoring Areas. The monitoring plan includes:
   a. Range-readiness surveys.
   b. Upland utilization surveys.
   c. Checks for compliance with annual operating instructions.
   d. Inspection of structural improvements to ensure compliance with maintenance requirements.
   e. Annual monitoring of streambank alteration and woody browse utilization.
   f. Surveys of cattle presence along Goat Creek, including surveys focused on detecting cows that linger after the take-off date.
   g. Inspection of known redds for evidence of livestock trampling.
   h. Surveys for cattle drifting along the Chewuch River, and response to detection of straying cattle within 24 hours; after Chinook spawning begins these surveys will include checking for evidence of cattle in the river.
   i. Implementation of a move-trigger in the Goat Creek DMA; i.e., when bank alteration exceeds 20 percent, livestock must be moved from the pasture (before the specified take-off date of August 31).
   j. Effectiveness monitoring that will follow Burton et al. (2008) and include measurement of greenline vegetation, streambank stability, woody species age and height, greenline-to-greenline width, summer water temperature, the species composition and distribution of noxious weeds, and the impacts of cattle on sensitive plants.

1.1 Definition of the Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action, including interrelated and interdependent actions, and not merely the immediate area involved in the action (50 C.F.R. 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment. Subsequent analyses of the environmental baseline, effects of the action, cumulative effects, and levels of incidental take are based upon the action area as determined by the Service.

The Cub Allotment lies on the northwest side of the Lower Chewuch River Watershed and the north end of the Middle Methow River watersheds. Within the Lower Chewuch River 5th field watershed, the action area includes the Cub Creek, Eightmile Creek, Falls Creek, Lower

Chewuch River, and Chewuch – Pearrygin Creek 6th field sub-watersheds. Within the Middle Methow River 5th field watershed, the action area includes a portion of the Goat Creek sub-watershed (Figure 1; note that the critical habitat depicted in this figure is designated for anadromous fish species other than bull trout). The action area for this project includes the grazing allotment in the above sub-watersheds and fish habitat up to 600 feet downstream. This includes the Chewuch River from the confluence with Cub Creek at RM 6.1, which is a mile below Cub Creek, up to Doe Creek at RM 18.5. On the Middle Methow River side, the action area includes Goat Creek above RM 3.

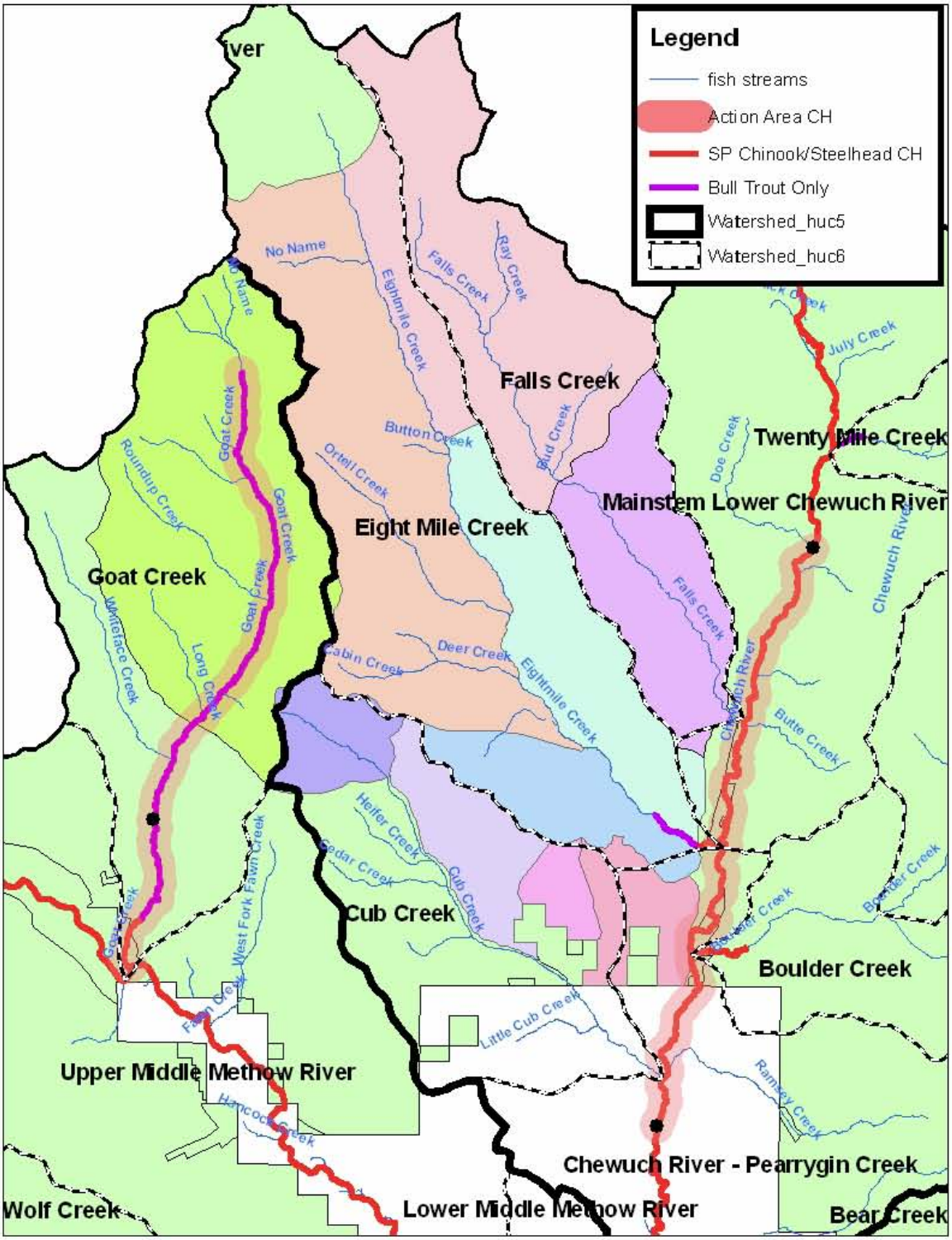

Figure 1. Sixth-field sub-watersheds and the Cub Allotment action area with the distribution of bull trout, steelhead, and Chinook salmon. Critical habitat depicted is for steelhead and Chinook salmon. "Bull Trout only" indicates that the bull trout is the only listed species currently present in most of Goat Creek.

2.0 STATUS OF THE SPECIES FOR BULL TROUT

This section, along with Appendix A, provides information about the bull trout's life history, habitat preferences, geographic distribution, population trends, threats, and conservation needs. This includes description of the effects of past human activities and natural events that have led to the current status of the bull trout. This information provides the background for analyses in later sections of the biological opinion.

2.1 Listing Status and Distribution

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). The current range of the threatened bull trout extends from the Klamath River Basin of south-central Oregon and the Jarbidge River in Nevada, north to various coastal rivers of Washington, to Puget Sound and east throughout major rivers within the Columbia River Basin to 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; incidental angler harvest; entrainment (a process by which aquatic organisms are pulled through a diversion or other device); and introduced non-native species (64 FR 58910).

The bull trout was initially listed as three separate Distinct Population Segments (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 distinct population segments, into one listed taxon, and the application of the jeopardy standard under section 7 of the Endangered Species Act 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 Act, 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.

Thus, the Service's jeopardy analysis for the proposed Project is done at the scale of the Columbia River interim recovery unit.

On January 9, 2001, the Service proposed to list the Dolly Varden (*Salvelinus malma*) as a threatened species in Washington due to similarity of appearance (66 FR 1628). This proposed listing has not been finalized due to the need to complete higher priority listing actions.

2.2 Current Status and Conservation Needs

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 Service's draft recovery plan for the bull trout (USFWS 2002a; 2004a, b), the Service's Science Team Document (Whitesel et al. 2004), Critical Habitat Listing Rule (Service 2005a), the Rock Creek Mine Biological Opinion (USFWS 2006), and the 5-year review (USFWS 2008).

The habitat conservation needs of the bull trout are 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 coterminous United States to local populations. The recovery planning process for the bull trout has also identified the following conservation needs for the bull trout: (1) maintain and restore multiple, interconnected populations in diverse habitats across the range of each interim recovery unit; (2) preserve the diversity of life-history strategies; (3) maintain genetic and phenotypic diversity across the range of each interim recovery unit; and (4) establish a positive population trend (USFWS 2002a; 2004a, b).

Central to the survival and recovery of the bull trout is the maintenance of viable core areas (USFWS 2002a, 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, and in some cases in their use of spawning habitat. Each of the interim recovery units consists of one or more core areas. About 114 core areas are recognized across the coterminous United States range of the bull trout (USFWS 2002a; 2004a, b).

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. 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 preserve the species' resilience to changing environmental conditions.

2.3 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 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).

2.4 Klamath River

This interim recovery unit currently contains three 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 2002a). Bull trout populations in this unit face a high risk of extirpation (USFWS 2002a). The draft bull trout recovery plan (USFWS 2002a) 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; 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 three core areas (USFWS 2002a).

2.5 Columbia River

This interim recovery unit currently contains about 100 core areas and 500 local populations. 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, and alteration 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; incidental angler harvest; entrainment into diversion channels; introduced non-native species; and the decline or elimination of salmon populations which provided an important prey base and other essential aquatic ecosystem functions. The draft bull trout recovery plan 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 (USFWS 2002a).

The size and diversity of the Columbia River interim recovery unit make it difficult to determine its current status and the potential unit-wide ramifications of implementing individual projects. The Columbia River Unit occupies all or parts of Washington, Oregon, Idaho and Montana, and contains about 100 discrete or semi-discrete core areas (USFWS 2008). The degree to which demographic performance of core areas is correlated across this vast geography is unknown. Given the large number of factors and threats that influence bull trout populations, it is reasonable to expect different core areas across the Unit to experience different arrays of factors that yield a shifting mosaic of stable, increasing, and declining demographic performance. This mosaic of demographic performance obscures the Unit's actual level of resilience, and at the

scale of individual projects, may increase its apparent resilience to persistent localized degradations in habitat quality.

The Service compiled information about core area resilience for its 5-year review of bull trout status, but did not aggregate this information into assessments at the unit-wide scale (USFWS 2005). The core area risk assessment indicates that 76 percent of the core areas in the Columbia River interim recovery unit, (including the Methow core area, in which the proposed Project will occur) are in the two highest-risk categories. This risk profile suggests that unit-wide resilience to further habitat degradation may be limited. Population trends for most core areas in the unit are unknown. Distribution of bull trout at the core area scale has not changed since the coterminous listing in 1999, but distribution changes at the scale of local populations have not been comprehensively evaluated. Furthermore, genetic information necessary for identifying core areas that are distinctive elements of intra-unit diversity is being developed, but is not currently available. Overall, the high number of and variability among core areas, difficulty of assessing aggregate risk, lack of key biological information, and the lack of a completed Recovery Plan to inform 7(a)(2) analysis all contribute to uncertainty about the current status of the Unit and the potential Unit-wide consequences of localized project effects.

2.6 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 limited 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, angler harvest, 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.

2.7 St. Mary-Belly River

This interim recovery unit currently contains 6 core areas and 9 local populations (USFWS 2002a). 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 2002a). 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 2002a). The draft bull trout recovery plan (USFWS 2002a) 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.

2.8 Life History and Population Dynamics

Like other salmonids from western North America, the bull trout is a well studied fish species. Detailed summaries of available information about the diverse life-history strategies exhibited by bull trout and the resulting variability in population dynamics are available in the Service's draft bull trout recovery plan and in the background information for the 5-year status review of the bull trout. A brief overview of this information is presented in Appendix B.

2.9 Consulted-on Effects

Projects subject to Section 7 consultation under the Act have occurred throughout the range of bull trout. Singly or in aggregate, these projects could affect the species' status. In order to assess the effects of previous actions/projects on bull trout, we incorporate by reference the Service's Biological Opinion for the Rock Creek Mine in Montana prepared by our Region 6 office (USFWS 2006). In the Status of the Species section of that BO, the Service reviewed 137 BOs produced by the Service from the time of listing in June 1998 until August 2003. The Service analyzed 24 different activity types (e.g., grazing, road maintenance, habitat restoration, timber sales, hydropower, etc.). Twenty BOs involved multiple projects, including restorative actions for bull trout.

The geographic scale of projects analyzed in these BOs varied from individual actions (e.g., construction of a bridge or pipeline) within one basin, to multiple-project actions, occurring across several basins. Some large-scale projects affected more than one interim recovery unit. In summary, 124 BOs (91 percent) applied to activities affecting bull trout in the Columbia River population, 12 BOs (9 percent) applied to activities affecting bull trout in the Coastal-Puget Sound population, 7 BOs (5 percent) applied to activities affecting bull trout in the Klamath River population, and 1 BO (less than 1 percent) applied to activities affecting the Jarbidge and St. Mary Belly populations.

Our aggregate analysis of BOs was also stepped-down from the interim recovery unit scale to the core area scale (USFWS 2006). For example, the Rock Creek Mine Biological Opinion included an evaluation of the Clark Fork River basin from the time of listing until August 2003. Of 37 actions that occurred in this river basin during this period, the majority (35) involved habitat disturbance with unquantifiable effects, 16 actions were ongoing, and 21 actions had been completed and effects were no longer occurring. Similarly, the number of actions, type of actions, and a brief description of the action was provided for each river basin where bull trout may have been adversely affected (USFWS 2006).

For each action, the causes of adverse effects were identified, as were the anticipated consequences for spawning streams and/or migratory corridors, if possible (in most cases, these consequences were known). Actions whose effects were "unquantifiable" numbered 55 in

migratory corridors and 55 in spawning streams. The Service also attempted to define the duration of anticipated effects (e.g., "short-term effects" varied from hours to several months). Projects likely to result in long-term benefits also were identified.

At the time of preparation of the Rock Creek Mine Biological Opinion, all other BOs within the range of bull trout reached a "no-jeopardy" determination. After reviewing previous BOs, the Service concluded that the continued long-term survival and existence of the bull trout had not been appreciably reduced range-wide (USFWS 2006). The Service's assessment of BOs from the time of listing until August 2003 (137 BOs), confirmed that no actions that had undergone Section 7 consultation during this period, considered either singly or cumulatively, would appreciably reduce the likelihood of survival and recovery of the bull trout or result in the loss of any (sub) populations (USFWS 2006).

Between August 2003 and July 2006, the Service issued 198 additional BOs that included analyses of effects on bull trout (USFWS 2006). These BOs also reached "no-jeopardy" determinations, and the Service concluded that the continued long-term survival and existence of the species had not been appreciably reduced range-wide due to these actions (USFWS 2006). All BOs issued after July 2006 also reached "no-jeopardy" determinations.

Currently, the Service is developing a database for tracking consulted-on effects and the exemption of incidental take associated with all biological opinions for bull trout. This database will be used across all Service field offices within the coterminous range of bull trout.

3.0 ENVIRONMENTAL BASELINE

Regulations implementing the Act (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 action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress. This section analyzes the current condition of the bull trout in the action area, the factors responsible for that condition, and the intended role of the action area in the conservation of the Columbia River interim recovery unit.

Characterizing the environmental baseline for highly mobile species requires a multi-scale analysis that evaluates the condition of all areas used by the affected population. The population of bull trout found in the action area of a project often inhabits a much larger area through the course of its life cycle. For example, bull trout often migrate over 100 km between spawning and overwintering habitat. For bull trout, the Service primarily considers two different spatial scales: (1) the watershed or specific reaches in a watershed affected by the proposed project, and (2) the "core area" scale, which typically incorporates multiple watersheds occupied by separate, but potentially interacting, local populations of bull trout. The watershed or reach scale is used to characterize habitat conditions in the vicinity of the proposed action.

The condition of habitat at both scales is evaluated in terms of seven broad classes of habitat features (pathways), each of which has a related set of specific metrics (indicators) that are rated

based on their functional condition. Baseline conditions for each indicator are described on a relative scale of functionality ("functioning properly," "functioning at risk" or "functioning at unacceptable risk"). This analytical framework is referred to as the Matrix of Pathways and Indicators (MPI) (USFWS 1999). In a similar fashion, the condition of bull trout metapopulations at the core area scale is evaluated in terms of "subpopulation" indicators in the Matrix of Pathways and Indicators (USFWS 1999). The Service uses these hierarchical scales to structure its evaluation of baseline condition as well as its subsequent analysis of project effects and jeopardy.

The action area is wholly within the Methow River core area for the bull trout. For context, we first discuss the baseline condition of the bull trout within the Methow core area, followed by a discussion of baseline conditions in the Middle Methow and Lower Chewuch sub-watersheds, with particular attention to the action area. In the following analysis of baseline conditions, most information for the core area scale is drawn from the *Draft Bull Trout Recovery Plan* (USFWS 2002b) with updates from a variety of other sources. Information for the watershed or reach scale is drawn primarily from the Project BA, the Middle Methow Watershed Analysis (USFS 1997), the Biological Assessment for New and Ongoing Activities completed in 2004, and the Biological Assessment for Tripod Fire Salvage project.

3.1 Environmental Baseline for the Methow Core Area

The Methow Core area is located on the upper Columbia River, in north central Washington State. The size of the core area is about 1,890 square miles (NPPC 2001). The Methow River runs about 86 miles from its headwaters to its confluence with the Columbia River near Pateros. The major tributaries in the core area include Early Winters Creek, Twisp River, Lost River, and the Chewuch River. The majority of precipitation in the core area falls as snow from October to March. Near the Cascade crest, up to 80 inches of precipitation falls annually. The rainshadow effect reduces precipitation to only 10 inches in the eastern portion of the core area. This pattern of precipitation results in a snowmelt-driven hydrograph in the Methow River that ranges from average June high flows of nearly 6,000 cfs to average low flows in January and February of about 425 cfs. Some sections of the mainstem Methow River and its tributaries go dry in late fall and winter. The extent and duration of this condition is dependent on previous year precipitation and winter snowpack. Thus, in very dry years these stream reaches may go dry earlier in the year, stay dry longer, and the dry reaches may be more extensive than during wetter years (WSCC 2000).

Most of the land in the lower watershed has been modified by a combination of irrigated agriculture, residential development, and recreation facilities. Human activities have resulted in a shift in many plant communities' composition from native to aggressive introduced species. Undisturbed riparian areas in the lower watershed are rare. In disturbed riparian areas, where livestock graze the major shrubs and herbs, native understory tends to be replaced by exotic grasses and noxious weeds (Okanogan County 1996). Undisturbed riparian areas in the Methow core area have a more reliable source of water than is available in most parts of the basin, and are therefore heavily vegetated with deciduous trees and shrubs.

Upslope of the private lands, the USFS manages the majority of the core area for multiple uses. Logging and associated road building, fires and fire suppression, grazing, and recreation have impacted aquatic habitats on USFS lands.

Not all of the information necessary to definitively determine the appropriate conservation role of the Methow core area is available, but a reasonable working hypothesis can be deduced from what is known. The conservation role of core areas is best characterized in terms of distribution, numbers, and reproduction of bull trout, given that the Services analysis of project effects and the potential for these effects to jeopardize the continued existence of the bull trout are evaluated in these terms.

In terms of distribution, the Methow core area is located in the northwest corner of the Columbia River interim recovery unit in Washington State. This peripheral location suggests this core area is important for maintaining the historic geographic distribution of bull trout within the unit. A growing body of work indicates that counter to conventional wisdom about geographic patterns of extirpation, peripheral populations often persist longer than populations near the centers of species' distributions (e.g., Channel and Lomolino 2000; Nielsen et al. 2001). It remains to be seen if global climate change might accentuate this trend.

A peripheral location may also expose populations to unusual selection pressures that can favor different alleles, contributing to overall genetic diversity within species. Although samples have been collected, analyses of genetic characteristics of bull trout populations in the Methow core area have not been completed. Presence in the Methow core area of both resident bull trout populations isolated above impassible natural barriers (e.g., Early Winters Creek) and multiple small local populations increase the likelihood of genetic divergence.

From a demographic perspective, the demographic contribution of the Methow core area to adjoining core areas is likely to be small. The Methow core area currently consists of multiple small populations (effective population size less than 100 individuals) and one moderate sized population (N_e = 100 to 500 individuals) in the Twisp River. The Service's draft bull trout recovery plan established an abundance criterion for all local populations in the Methow core area of between 3,610 and 5,886 individuals (USFWS 2002b). Historic population levels are unknown. It is reasonable to assume that when populations of anadromous salmon were more abundant, bull trout also were more abundant. Currently, coho salmon are extirpated from the Methow core area, spring Chinook salmon are endangered, and upper-Columbia River steelhead are threatened. But even at historic levels of bull trout abundance, the relatively long distance between spawning locations in the Methow core area and spawning areas in the neighboring Entiat and Wenatchee core areas suggest that demographic exchange between these core areas was likely limited. Telemetry studies, however, have indicated that bull trout do move between the Methow, Entiat, and Wenatchee core areas. These telemetry studies were not designed to document gene flow, so the level of effective exchange among these core areas remains unknown. Low levels of exchange may be more important for preserving genetic diversity than for supporting positive demographic trends.

If these hypothesized roles of the Methow core area are correct, extirpation or functional extirpation of bull trout from this core area could have negative consequences primarily for the

distribution and reproduction of the Columbia River interim recovery unit. Removing populations from the periphery of the range could reduce the potential for long-term persistence of the recovery unit by diminishing the resilience provided by peripheral populations. To the degree genetic diversity promotes productivity in fluctuating environments, loss of the genetic diversity associated with this unique location could reduce the productivity of the unit and reduce its ability to adapt to changing conditions. These outcomes are contrary to the recovery goals and objectives in the Service's draft recovery plan for the bull trout.

3.1.1 *Methow Core Area – Bull Trout Abundance and Distribution*
Bull trout are found in all seven watersheds in the Methow core area, and migratory and resident life-history forms are present. The Washington Department of Fish and Wildlife (WDFW) classifies the status of bull trout in the Lost River as "Healthy," but the remaining bull trout in the Methow River are classified as "Unknown" (WDFW 1998). Information about population size comes primarily from redd surveys that have been conducted in selected areas of the Methow River basin since 1992 (Table 1). The largest populations of migratory bull trout occur in the Twisp River, Wolf Creek, West Fork Methow River, and the Lost River (NPPC 2001; see Table 1). Resident populations are known to occur in the Lost River, Early Winters Creek, Goat Creek and Beaver Creek.

3.1.1.1 Chewuch River. The bull trout local population in the Chewuch drainage spawns in Lake Creek and the Chewuch River. Bull trout in Lake Creek are thought to be an adfluvial population inhabiting Black Lake (DeLaVergne, J., USFWS, pers. comm., 2001). Lake Creek redd surveys conducted since 1995 are low and highly variable (Table 1), resulting in stock status being characterized as unknown, but potentially healthy (WDFW 1998). Above Black Lake, bull trout have been observed in Lake Creek up to Three Prong Creek (USFS 1995a). In 2001, large bull trout were observed spawning in Lake Creek, indicating successful migration. The number of redds in Lake Creek does not appear to be related to flow conditions (USFS 2003). Moderate fishing intensity occurs on Black Lake, in part due to its location in the Pasayten Wilderness, requiring a 5-mile hike to the lake (WDFW 1998).

From the mouth of the Chewuch River to the confluence with Thirtymile Creek, the mainstem is not known to provide spawning habitat for bull trout. In 2001, bull trout redds were found in the mainstem Chewuch River near Thirty Mile Creek (USFS 2003). In subsequent survey years, up to 35 redds have been found in this area (see Table 1) Migratory bull trout may also spawn below passage barriers in sections of three tributaries (Andrews, Boulder, and Twentymile Creeks) (USFS 2003). Historically, Eightmile and Boulder Creeks may have supported bull trout (USFS 1994), but none were observed in Eightmile Creek during surveys conducted in 1999 (USFS 2003). Abundant brook trout in these tributaries may exclude bull trout.

3.1.1.2 Twisp River. Migratory and resident bull trout in the Twisp River local population are found in the mainstem Twisp River, Buttermilk Creek, Bridge Creek, Reynolds Creek, and North Creek (USFS 1995b). From 1998 to 2007 the average number of redds in the Twisp watershed was 93, with a standard deviation of 10.2. The majority of these redds are located in the mainstem Twisp River (from South Creek to the Roads End Campground) and in North Creek. The Twisp River is the largest and most consistently productive population of bull trout in the Methow core area. Both fluvial and resident bull trout use Buttermilk and Reynolds creeks, with

the distribution of fluvial fish limited below barriers. The Twisp River is also an important tributary for spring Chinook and steelhead production.

3.1.1.3 Wolf Creek. In the Middle Methow Watershed, Wolf Creek is the most important tributary for bull trout spawning. Redd counts have been as high as 27 and 29 in 1998 and 1999, respectively. The average redd count across all survey years from 1998 to 2007 was 21 redds, with a standard deviation of 5 (differences in survey procedures and surveyors among years may have contributed to apparent variation in counts). Distribution within the subwatershed extends up to approximately river kilometer 18 (river mile 11) where a natural rock and log barrier blocks upstream passage. Resident bull trout have also been located in Wolf Creek below the barrier (WDFW 1998). In 2005 the diversion dam at RM 4 was replaced with a rock cascade structure that is expected to improve fish passage at all flows.

3.1.1.4 Upper Methow River. The Upper Methow River local population includes the West Fork of the Methow River, Trout Creek, Robinson Creek, and Rattlesnake Creek. Most spawning occurs in the West Fork Methow River. A few bull trout have been observed spawning in the lower portions of Trout Creek (WDFW 1998). Bull trout have not been documented in Robinson or Rattlesnake Creeks, but the lower portions of these systems are accessible to bull trout and may provide additional spawning habitat (De La Vergne, J., USFWS, pers. comm., 2001). Resident and fluvial life-history forms are present in this local population. Redd surveys in the upper Methow River have been conducted since 1995. The redd counts are highly variable ranging from 1 redd in 1999 to 64 redds in 2002, with some of this variation resulting from inconsistent surveys (Table 1).

3.1.1.5 Early Winters Creek. The Early Winters Creek local population is found in the mainstem, Cedar Creek, and Huckleberry Creek. Incomplete redd surveys in the mainstem have been conducted since 1995, with a high redd count of 12 occurring in recent years (Table 1). Redd surveys are conducted from Klipchuck Campground up to the falls at river kilometer 13 (river mile 8.0) near the crossing of Highway 20. The falls are thought to be a barrier to Chinook salmon and steelhead. Migratory-sized bull trout were found above the falls during recent electrofishing surveys by the Service (De La Vergne, J., USFWS, pers. comm., 2001). Resident bull trout are known to be above these falls and are thought to spawn in the upper reaches (WDFW 1998).

3.1.1.6 Lost River. The Lost River local population may be represented by resident, fluvial, and adfluvial forms (USFS 1999). In 1993, the WDFW estimated the bull trout population size in the Lost River to be 1,092 fish (WDFW 1998). This estimate did not distinguish between resident and migratory life-history forms and was based on a catch-per-unit-effort density estimate of 210 fish per mile. Timing and distribution of bull trout migration in the Lost River is unknown. Many holding areas in the upper Lost River and near the outlet of Cougar Lake were identified during snorkel surveys conducted by the Service and USFS (De La Vergne, J., USFWS, pers. comm., 2001). Connectivity among headwater lakes and downstream areas occurs only during high runoff periods in spring and early summer. The Lost River periodically goes subsurface near the downstream end of the gorge above Monument Creek. Spawning in the Lost River, currently seems to be occurring upstream of the gorge and in Monument Creek (WDFW 1998; De La Vergne, J., USFWS, pers. comm., 2001).

3.1.1.7 Goat Creek. Redd surveys in the Goat Creek local population began in 2000, when 11 migratory bull trout redds were found. Since that time, the high count of 18 redds occurred in 2007. The 3-mile reach above Vanderpool Crossing is now regularly surveyed. In years when the entire spawning reach was surveyed, an average of 9 bull trout redds was detected. The sub-watershed contains both resident and fluvial fish, but the status of each life-history form is unknown (USFS 1995c). Breeding by resident bull trout was determined by the presence of resident-sized female bull trout that were sexually mature (WDFW 1998).

3.1.2 *Reasons for Decline*

Within the Methow core area, historic and current land use activities have impacted bull trout local populations. Some of the historic activities, especially water diversions, forestry, and agriculture, have significantly reduced migratory populations. Lasting effects from some of these early land and water developments still act to limit bull trout production in this core area. Threats from current activities are also present.

3.1.2.1 Dams. No dams that are complete barriers to fish migration are present currently in the Methow Core Area, although some dams may be partial barriers. Mainstem Columbia River dams (Rock Island, Rocky Reach, and Wells) have significantly altered historic habitat conditions within the mainstem Columbia River. Bull trout tagged at these mainstem dams have been tracked to Methow core area streams. Dams on the Columbia River affect salmonids by delaying or impeding adult migration, by injuring or killing juveniles that pass downstream, and by altering the ecology of the river. Information on effects of these mainstem Columbia River dams on bull trout is being collected in the context of hydro-power relicensing (e.g., BioAnalysts, Inc. 2004), but many questions remain unanswered.

3.1.2.2 Forest Management Practices. Both direct and indirect impacts from timber harvest and associated road building have altered habitat conditions in portions of the Methow core area. Impacts from forest management included the removal of large woody debris, reduction in riparian areas, increased water temperatures, increased erosion, and simplification of stream channels (Quigley and Arbelbide 1997). Bull trout are less likely to use streams for spawning and rearing in areas with high road densities and were typically absent at mean road densities above 1.1 kilometer per square kilometer (1.7 miles per square mile) (Quigley and Arbelbide 1997).

In the Methow Core area, roads that access timbered lands are located in the narrow floodplains, with extensive networks in the Twisp watershed including sensitive bull trout tributaries (e.g., Little Bridge and Buttermilk Creeks). A similar situation exists in Lake Creek in the Chewuch watershed (WSCC 2000). High road densities within portions of USFS lands in the Methow River Core Area may contribute to habitat degradation (USFS 2003; 2001a; 2001b). Culverts under these roads are common impediments to passage that fragment both habitat and populations, and degrade habitat by preventing transport of large woody debris.

Table 1. Methow core area redd survey summary for 1995 to 2007. Total numbers of redds detected by survey year.

Watershed/Stream Surveyed	Miles	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Mean
Twisp River Watershed															
1. Twisp River															
-Reynolds Cr. to Poplar Flats	1.5	-	-	-	-	-	-	19	13	16	24	35	23	24	22
-South Creek to Roads End	3.0	18*	-	2*	66*	37	72	53	67	30*	56	39	53	46	53
-Roads End CG to barrier falls	0.5	-	-	0*	1*	1	-	0*	-	-	-	-	-	22	12
2. North Cr – Mouth to Falls	0.6	3*	-	-	19*	63	33	0	2	29	18	6	9	15	19
3. E. Fork Buttermilk to Falls	2.0	4*	0	-	0*	0*	0	3	3	2	0	3	3	0	2
4. W. Fork Buttermilk Cr.	2.0	-	-	-	-	-	-	-	7	9	2	4	1	1	4
. Other Surveys in Twisp River		0*	-	-	-	0*	0*	1*	1*	-	1*	-	-	-	
Subtotal Twisp River		***25****	***0****	***2****	***86****	***101***	***105***	***76***	***93***	***86****	***101***	***87***	***89***	***108***	95
Upper Methow River															
1. West Fork Methow River															
-Trout Cr to Falls at Brush Cr	5.3	27	15	13*	11*	1	2	19	54	-[1]	21	44	25	21	21
2. Early Winters-Below Falls	4.0	-	9*	1*	2*	0*	3	5	6	0	1	3	12	12	5
3. Goat Creek above Vanderpool	3.0	-	-	-	-	-	11[2]*	-*	4[2]	3[2]	12[2]	9[2]	8[3]	18[4]	9
4. Other Upper Methow Surveys		1*	2*	1*	-	-	-	3*	-	-	-	-	-	-	
Subtotal Upper Methow River		***28***	***26***	***15***	***13***	***1***	***16***	***27***	***64***	***3***	***34***	***56***	***45***	***51***	29
Chewuch River Watershed															
1. Chewuch – RM 32.9 to 34.2	1.3	-	-	-	-	-	-	9*	11	6	4	19	35	19	16
2. Lake Creek															
-River Mile 4 to River Mile 5	1.0	-	-	-	-	-	10*	1	-	4	0	0	4	2	2
-Black Lake to Three Prong	1.5	22	13*	9*	8*	0	8	21	11	10	6	24	15	25	14
Subtotal Chewuch River		***22***	***13***	***9***	***8***	***0***	***18***	***31***	***22***	***20***	***10***	***43***	***54***	***46***	23
Wolf Creek															
Wolf Cr. – RM 2.6 to N. Fork	4.0	-	**3***	**3***	**27***	**29**	**26**	**20**	**15**	**18**	**24**	**15**	**18**	**22**	21
Gold Creek															
Crater Cr. – RM 0 to 2	2.0	-	2*	2*	1*	0	-	0	1	0	3	4	3	?[5]	2
Foggy Dew Creek[2]		-	-	-	-	-	-	-	-	-	--	10[2]	1[2]	4[2]	
Subtotal Gold Creek		**-**	**2**	**2**	**1**	**0**	**-**	**0**	**1**	**0**	**3**	**14**	**4**	**4**	3
Total Methow Basin Redds		***75****	***44****	***31****	***135***	***131***	***165***	***154***	***195***	***127****	***172***	***215***	***210***	***231***	179

Miles = total stream miles surveyed in index reach.

[1]Not surveyed due to Needle Creek Fire.

[2]Likely all resident redds.

[3]Two of these redds are likely migratory bull trout redds.

[4]One to three redds are possible migratory bull trout redds.

* = Incomplete Survey; Mean includes only complete surveys; - = Not Surveyed.

[5]Data have not been received at the time of this report (03-25-07). The report will be updated and redistributed when data are received.

Forestry activities on State and private lands in Washington State are covered under a recently completed Habitat Conservation Plan that is based on statewide Forestry Practices Rules. The term of the Habitat Conservation Plan is 50 years, and over this period effects to bull trout are expected to include short-term adverse effects to stream temperatures, large woody debris, and sediment, and long-term beneficial effects on habitat access. Analysis of the effects of this Plan led to the identification of bull trout core areas that were at increased risk of exposure to adverse effects, primarily due to the high proportion of private timberlands in these core areas. The Methow core area contains two local populations (Gold and Goat creeks) that are at increased risk. However, it is difficult to predict actual impacts that are likely to occur because level of timber harvest on private land is driven by unpredictable market factors. About 18 percent of the Methow core area is privately or State-owned, and the proportion of this area that is forested is unknown. In the Chewuch watershed, only about 5 percent is privately owned, all in the lower 8 miles of the watershed. For the purpose of describing the environmental baseline in this core area, we assume that rates of timber harvest on private land will not change appreciably in response to completion of the Plan, and the rate of timber harvest will be low.

3.1.2.3 Livestock Grazing. Historically, grazing of cattle, horses, and sheep has occurred throughout the Methow core area (WSCC 2000). Concerns associated with grazing include water withdrawals, loss of riparian vegetation, sedimentation, and redd trampling. Over 60 percent of the private bottom lands in the Methow River area have erosion problems related to grazing (USFWS 1992). Cattle have access to the main channels, resulting in eroded stream banks and associated sediment inputs. Riparian areas adjacent to the Twisp River, lower Wolf Creek, Upper Methow River, Chewuch River, Buttermilk Creek, Gold Creek, and Goat Creek have experienced grazing-related degradation (USFWS 1998).

3.1.2.4 Agricultural Practices and Irrigation Diversions. Irrigation diversions can result in passage barriers by creating structural blockages, reducing instream flow or even dewatering streams, and increasing water temperatures. Decreased stream flow can result in increased stream temperatures that can degrade habitat quality for bull trout or create barriers to upstream migration. Historically, there were many irrigation diversions in the Methow core area that may have totally or partially blocked migrating fish (USFWS 1992). Other irrigation diversions, although not located in bull trout spawning streams, remove instream flow and may impact important foraging and high water refuge habitat.

At the time bull trout were listed, operation of irrigation diversion dams was thought to disrupt annual migrations of fluvial bull trout in five of seven spawning streams in the Methow River basin (USDI 1998). An estimated 60 percent of the available spawning habitat in the Methow has been lost due primarily to high temperatures and dewatering caused by irrigation diversions (Mullan, J., USFWS, as referenced by USDI 1998). Many of these problems have been addressed in recent years. For example, several passage barriers associated with irrigation diversions have been removed from Beaver Creek since 2002, and a partial barrier on Little Bridge Creek (tributary to the Twisp River) was replaced with a roughened channel structure in 2005. Additional improvements to diversion dams are described below.

Some diversion dams that impede fish passage remain. In the Twisp watershed, East Fork Buttermilk Creek has a partial barrier to migration resulting from an irrigation diversion. A diversion dam across the Twisp River on non-Federal land at approximately river kilometer 8 (river mile 5) is used by the Twisp Power Irrigation Ditch and the WDFW for Chinook brood-stock collection (WSCC 2000). The Service assumes that this dam does not impede passage, but further investigation of the diversion's operation is needed to verify suitable passage conditions.

Irrigation withdrawals by three diversions operated in the Wolf Creek subwatershed (including use of Patterson Lake for irrigation storage) may be adversely impacting bull trout (WSCC 2000). The Wolf Creek diversion is one of the largest irrigation ditches in the Methow Valley and has been in operation since 1921. A project implemented in the summer of 2005 is expected to improve passage at this diversion (FWS reference 01-09-2004-F-W0518) and operational changes are expected to improve instream flow conditions.

In the Chewuch watershed, diversions in the lower watershed are an important factor affecting habitat quality. There are two private irrigation ditches in the lower river that divert large volumes of water. The Fulton Ditch has its diversion at river mile 0.7 and has a functional diversion capacity of 22 cfs. The Chewuch Ditch (RM 8) has a current diversion capacity of 30 cfs. The concrete and rock weir at the Chewuch Ditch diversion was replaced with a new concrete dam and rock-ramp fish passage in 2006 (FWS reference 01-09-2005-F-0385). The rock ramp is expected to provide passage for all life stages of fish at all flow rates. Replacement of the rock weir for the Fulton Ditch was the subject of another biological opinion completed in November 2006 (FWS Reference Number 13260-2006-P-0025). The Skyline Ditch (RM 8.7) has a diversion located on land managed by the USFS. Historically, the Skyline Ditch carried a flow in excess of 25 cfs. The current maximum diversion rate into the ditch is 17.8 cfs, and operation of this ditch is governed by a Special Use Permit issued by the USFS. This permit is in turn conditioned by biological opinions from the Service (FWS reference 01-09-2003-F-W0225) and from National Marine Fisheries Service (reference 2003/00123). These permit conditions are expected to improve instream flow conditions in the mainstem Chewuch. A small surface diversion from Eightmile Creek that was used by the USFS to irrigate Eightmile Ranch has been replaced by wells, which also contribute to improved instream flow in the lower Chewuch River.

3.1.2.5 Mining. Mining can degrade aquatic habitats used by bull trout by altering water chemistry (e.g., pH); altering stream morphology and flow; and causing sediment, fuel, and heavy metals to enter streams (Nelson et al. 1991; Spence et al. 1996; Harvey and Lisle 1998). The potential for establishing a gold mine in the Twisp River (North Creek) is being considered (De La Vergne, J., USFWS, pers. comm., 2001). Small scale recreational gold mining occurs within the Methow core area.

3.1.2.6 Residential Development. Numerous areas within the Upper Columbia basin are experiencing a socio-economic shift from an economy based on natural resources (agriculture, forestry, and mining) to an economy more dependent on industries associated with tourism, recreation, and general goods and services. Population growth in Okanogan County was 18.6 percent in the 1990's (WSOFM 2000). Potential development impacts to bull trout include degradation of water quality, instream habitat, and riparian habitat in migratory corridors within the Methow core area (WSCC 2000). Bank armoring in response to high flow events is an

ongoing practice that continues to degrade riparian and streambank conditions. Aggregate effects from development within the basin are difficult to estimate, but could be substantial.

Areas of residential development that are degrading aquatic habitat conditions in the Methow Core Area include:

1. Early Winters Creek (riprap and diking of the lower 0.5 miles).
2. Mainstem Methow River (bank erosion and loss of vegetation, beginning at the Early Winters Creek confluence downstream to Pateros).
3. Lower Chewuch River (mouth to river mile 8; loss of vegetation and bank protection).

3.1.2.7 Recreational Development. Campgrounds (including user-built dispersed camps), trails, and other recreational developments in the Methow core area frequently overlap areas of bull trout spawning, juvenile rearing, and adult migration (USFS 1999, 2001a, 2001b). Impacts of these recreational developments can include reduction in large woody debris and its recruitment, loss of riparian vegetation, and diking or bank hardening to protect campgrounds. These developments can also increase stream access, which can lead to poaching of bull trout. In many cases, the USFS is taking action to move campgrounds away from streams and use temporary closures to minimize effects.

In the Twisp River watershed, the Roads End and South Creek Campgrounds and associated trails impact adjacent spawning and holding areas for bull trout (USFWS 2002b, Nelson 2004). The USFS is minimizing these impacts through relocation of campsites away from the streambanks and temporary closures during sensitive time periods.

3.1.2.8 Fisheries Management. Fisheries management can affect bull trout through stocking of non-native species, harvest management, and effects on prey base. All of these effects are occurring in the Methow Core area.

Problems with non-native species in the Methow core area focus primarily on brook trout (WSCC 2000). Brook trout are widespread within the Methow River (NPPC 2001). Brook trout are well-established in Beaver and Eightmile Creeks and are thought to have resulted in the loss of bull trout from these systems (WDFW 1998). Brook trout are also known to inhabit portions of the Twisp River (NPPC 2001).

Although the draft bull trout recovery plan states that stocking of brook trout no longer occurs in the Methow Recovery Unit, apparently stocking of triploid brook trout continues (Molesworth, J., USFS, pers. comm. 2003). Use of triploids reduces the risk of hybridization with bull trout, but a small percentage of triploid fish are fertile (Molesworth, J., USFS, pers. comm. 2003), and the more robust growth rates of triploids may increase their competitive effects on bull trout. Cessation of all brook trout stocking is an important conservation need throughout the upper Columbia basin (USFWS 2002b).

Harvest of bull trout is currently prohibited on all stocks in the Methow core area with the exception of the Lost River above Drake Creek in the Methow drainage (WDFW 1998). The estimated abundance of bull trout in this area (210 catchable-sized fish per mile) was thought to be sufficient to allow retention of bull trout as part of a two-fish catch limit. Fishery rules

include a bait prohibition and a 36 centimeter (14 inch) minimum size intended to permit most females to spawn at least once. Angling is minimized by the lack of direct access to the lower end of this reach. The canyon reach is accessible only in late summer when stream flows recede enough for fording. Almost no fishing occurs in this reach. Some fishing occurs below Cougar Lake, in the vicinity of the horse camp around Diamond Creek, and in the area just above the mouth of Drake Creek.

Fisheries management can also impact bull trout by promulgating fishing regulations that lead to the incidental harvest of bull trout and trampling of bull trout redds by wading anglers. Incidental catch during open seasons for mountain whitefish (*Prosopium williamsoni*) and steelhead have been implicated as a possible source of bull trout mortality in the Wenatchee, Entiat, and Methow Rivers. Injury and mortality from incidental catch of bull trout and harvest as a result of misidentification still continues under existing fishing regulations (only 44 percent of surveyed Montana anglers correctly identified bull trout; Schmetterling and Long 1999). In experimental tests, a single wading event just before hatching can result in up to 43 percent mortality of eggs (Roberts and White 1992).

Throughout the Methow core area there have been severe declines in the numbers of native salmonids. Both spring Chinook salmon and steelhead are listed under the Act in this area, and with few exceptions, continue to exhibit low abundances. The decline of salmon and steelhead has reduced both the prey base for bull trout and a historic nutrient source coming into the basin.

WDFW has operated a captive broodstock collection program for Upper Columbia River spring Chinook salmon eggs and juveniles in the Chewuch River (WDFW 1999). Adult Chinook were collected at the fish ladder at the Fulton Dam until this structure was renovated in 2006-2007. New facilities for broodstock collection have not been completed. Proposals to build a separate weir for spring Chinook broodstock collection could result in delay and handling of migratory bull trout due to overlap in migration timing between spring Chinook and bull trout.

3.1.2.9 Isolation and Habitat Fragmentation. Road culverts in watersheds with bull trout can block or impede upstream passage (WSCC 2000; NPPC 2001). Culverts may preclude bull trout from entering a drainage during spawning migrations, emigration of juveniles, and foraging activities, and may also limit access to refuge habitat needed to escape high flows, sediment, or higher temperatures. Culverts have been identified as a limiting factor for salmonids in the Methow River basin (NPPC 2001; WSCC 2000). Specific culverts have been identified as possible passage barriers in the Methow (Twisp River, Beaver Creek, Gold Creek, Little Bridge Creek, and East Fork Buttermilk Creek) core areas. In recent years barrier culverts have been replaced in Libby Creek, the Twisp River (four culverts or bridges, improving passage in 4 tributaries), and Beaver Creek.

In the Methow Core Area, aquatic habitats have also been fragmented by dikes, resulting in loss of floodplain and off-channel habitats that could provide important rearing areas for bull trout (WSCC 2000). Dikes that contribute to habitat fragmentation are the McKinney Mountain Dike, People Mover Dike, and the dike on the Lost River. Alteration of habitat from channel modification (e.g., bank revetment and riparian alterations) have disconnected floodplains and

impacted normal stream function. Specific areas that have been impacted include Goat Creek, lower Early Winters Creek, and the Twisp River.

3.1.2.10 Fires and Fire Suppression. In August and September 2003, the Needles Fire burned about 21,300 acres in the Upper Methow, with about 1,680 acres (8 percent of the burned area) burning at high intensity (USFS 2004). Suppression activities included drift from retardant drops reaching the Methow River, excavating a dip site in the Methow River and helicopter dips from this site, construction of contingency fire lines both perpendicular (5 lines) and parallel (1 line for about 1 mile) to the Methow River, some of which were later used as skid trails to remove timber felled during fire line construction, and refilling of the Early Winters Irrigation Ditch for 10 days after it had been closed due to low flows. Rehabilitation efforts reduced the adverse effects of the fire lines and dip site construction, but the overall quality of habitat in this important spawning area for bull trout was degraded by wildfire effects and fire suppression activities.

In 2006, the Cedar Creek Fire burned in the West Fork Cedar Creek drainage and along the mainstem of Cedar Creek in the Early Winters watershed. The fire perimeter included about 1,630 acres. Preliminary mapping indicates the fire did burn through more than a mile of riparian areas. Detailed information about the distribution of fire severity levels, and the effects of suppression and rehabilitation activities is not available at this time. Several large and severe wildfires have also occurred in the Middle Methow and Chewuch sub-watersheds where the proposed Project will occur. The effects of these wildfires and associated suppression and rehabilitation activities are described in the following descriptions of baseline conditions in these sub-watersheds.

3.2 Environmental Baseline in the Middle Methow Watershed

Within the Methow Core Area, the Middle Methow watershed covers about 250,000 acres. The watershed includes the mainstem Methow River starting near Mazama (Weeman Bridge) and extends south to Carlton. The watershed includes the Goat, Wolf, Fawn, Bear, Beaver, Frazer, Benson, and Alder sub-watersheds. The Twisp and Chewuch Rivers enter the mainstem Methow within the Middle Methow reach, but these Rivers are considered separate watersheds. About 165,000 acres (77 percent) of the Middle Methow watershed are managed by the USFS. Logging and grazing have been the primary land uses on USFS lands since 1909, but in more recent times recreational use has increased as logging decreased. Most of the valley floor is privately owned and consists of grazing land, orchards, field crops, and residences.

In the Middle Methow watershed, Goat, Wolf, and Beaver creeks are the primary tributaries to the Methow River, and several low-order, non-fish bearing streams are also present. Goat Creek drains a sub-watershed of about 15,000 acres. Nearly the entire sub-watershed is managed by the USFS, with private land concentrated near the confluence of Goat Creek with the Methow River. The conservation roles of the Goat Creek local population are to maintain the distribution of the bull trout within the Methow core area and to contribute to recovery goals for numbers and reproduction of this core area. The action area is important to fulfilling these conservation roles because it includes spawning and rearing habitat for the Goat Creek local population.

Beaver Creek drains about 71,400 acres. Private ownership extends up to river mile 8.3, and this reach has been impacted by channelization, water withdrawals for irrigation, road construction, timber harvest, grazing, and removal of beaver. Removal of many barriers to fish passage has occurred which could return migratory fish to nearly 11 miles of habitat in upper Beaver Creek. The USFS manages the upper watershed above river mile 8.3, and impacts to aquatic habitats on these lands have occurred from road construction, fire and fire suppression, timber harvest, and grazing. Wolf Creek drains about 23,800 acres, and about 95 percent of the sub-watershed is located within the Okanogan and Wenatchee National Forest. Private development of the lower one mile of Wolf Creek has constrained the channel from moving across its historic alluvial fan. The headwaters of Wolf Creek are on Gardner Mountain and Storey Peak. These high elevation origins, steep-walled geomorphology of the sub-watershed, and dense forests all contribute to low water temperatures in Wolf Creek. The creek flows from west to east in a steep valley before opening onto an alluvial fan about 1.5 miles above its confluence with the Methow River.

The main activities in the Middle Methow watershed in the recent past have been timber harvest and grazing (see FWS ref. 01-09-2004-I-W0323). Several projects in the watershed with the potential to affect both bull trout and aquatic habitats have been the subjects of prior consultations (see Appendix B).

3.2.1 *Geomorphology, Hydrology, and Aquatic Biology*

Bull trout distribution in the Methow sub-basin is closely linked to the valley's geology. In some drainages, large areas of exposed bedrock in the upslopes quickly route precipitation to moderate to deep glacial till on valley floors. Precipitation in the watershed averages about 31 inches per year, most of which falls as snow from October to March. Precipitation is stored in the tills and released gradually over the summer. This reduces the severity of summer low flows and maintains low stream temperatures during low flow periods. This combination of features is found in drainages throughout the Methow sub-basin, including Wolf Creek, and the current distribution of bull trout is largely coincident with this geologic context.

Soils tend to be fine-textured loams and clay loams derived from shales, siltstones, and sandstones (USFS 1997). Much of the valley bottom landscape also has deposits of boulders and glacial till mixed with volcanic ash and pumice.

Mass wasting in the Middle Methow watershed is most evident in the upper reaches of the Wolf Creek sub-watershed (USFS 1997). Mass wasting in this area mostly takes the form of debris flows associated with avalanche chutes. These flows may occur on a cyclic basis following heavy snow years and subsequent rain-on-snow events (USFS 1997). These flows deliver pulses of rock, gravel, fine sediment, and organic debris and contribute to the development of channel complexity (USFS 1997).

Extirpation of some native species, severely diminished abundance of other species, and introduction of exotic species have affected the fish community in the Middle Methow watershed. Coho salmon (*O. kisutch*) were extirpated from the Methow watershed, but efforts to determine the feasibility of reintroducing this species are underway. Upper Columbia River spring chinook and steelhead populations are listed as endangered under the Act, indicating their depressed abundance. Redband trout (*O. mykiss*) and westslope cutthroat trout (*O. clarki lewisi*)

are present throughout the watershed. Westslope cutthroat trout occur in high abundance upstream of the barrier falls of Wolf Creek. The eastern brook trout is an introduced species in the sub-watershed that has been found in many locations (USFS 1997). Mountain whitefish (*Prosopium williamsoni*) are present in the mainstem Methow River. Non-salmonid species present in the sub- watershed include sculpins (*Cottus* spp.), suckers (*Catostomus* spp.), red-sided shiners (*Richardsonius balteatus*), and dace (*Rhinichthys* spp.).

3.2.2 *Factors Affecting the Species' Environment in the Action Area*

Current condition of the Middle Methow watershed ranges from extensive pristine areas in the headwaters to degraded areas on private lands in the lower watershed. Wolf Creek is a Tier 1 Key Watershed in the context of the Northwest Forest Plan's Aquatic Conservation Strategy (USDA and USDI 1994) and is considered a critical refuge for bull trout and anadromous salmonids in the middle Methow watershed.

Most soil erosion in the Middle Methow watershed is related to road construction, timber harvest, or fire (USFS 1997), but little site-specific information is available about the volume of sediment delivered due to these human activities or natural disturbances. Grazing has likely resulted in some soil compaction, but no estimates of the extent of grazing-related compaction and resulting increases in erosion are available. Grazing allotments extend throughout the Middle Methow watershed.

Before the Tripod Fire in 2006, only about 18,000 acres burned in the Middle Methow watershed from 1909 to 1997 (USFS 1997). Compared to other watersheds in the Methow core area (e.g., the Chewuch watershed), the Middle Methow watershed has not experienced extensive wildfire effects in the recent past. The Hubbard Creek Fire, which occurred in 1985, was one of the largest fire events in the watershed, burning more than 4,000 acres in the upper Wolf Creek sub-watershed, from Gardner Meadows down to the North Fork of Wolf Creek (USFS 1997, 2004). The entire burned area was above the area accessible to migratory bull trout. Despite high intensity burning in riparian areas, follow-up surveys found little impact on channel conditions, and very high levels of large woody debris (USFS 1997).

In 2006, the Tripod Fire burned about 20,600 acres (51 percent) in the Upper Beaver Creek sub-watershed, and about 2,400 acres (22 percent) in the Bear Creek sub-watershed. This burned area represents about 11 percent of the Middle Methow watershed. Burn severity was variable across sub-watersheds, but averaged 16 percent very low, 34 percent low, 28 percent moderate, and 22 percent high. Erosion processes are naturally high within the fire-affected areas. Vegetation recovery sufficient to stabilize slopes is expected to take 5 to 10 years.

Fire suppression activities in this watershed during the Tripod fire included:

- Construction of 26.5 miles of hand line (3 feet wide) and 13.25 miles of dozer line (10 feet wide), both with hazard tree removal. Some line construction occurred in riparian areas, but the affected acreage is unknown.
- Black line and burnout on an unknown number of acres, including some riparian zones.
- Construction of safety zones, staging areas, and drop points (mostly on previously disturbed sites).
- Water withdrawals from a variety of water sources.

- Retardant batch plant operation at Campbell Lake.
- Re-opening of closed roads (road miles unknown).

Rehabilitation of areas disturbed by suppression actions included installing waterbars, distributing slash, and blocking access to hand and dozer line, decompacting safety zones and other compacted areas, improving road drainage features, seed and fertilizer application to disturbed areas, and removal of temporary water impoundment and diversion structures. Completed rehabilitation work includes about 5,600 acres of heli-mulching, aerial seeding of 2,300 acres, danger tree felling, aerial fertilization in upper Beaver Creek, integrated noxious weed control, and road and trail rehabilitation. Three culvert replacements on Lightening Creek (2) and Bear Creek (1) will occur, but these are above natural barriers to fish migration.

After evaluating the available information about the effects of the Tripod Fire and rehabilitation activities in the Middle Methow watershed, the USFS determined that none of these effects were extensive, prolonged, or severe enough to warrant changing the baseline condition of any indicators. The Service agrees with this assessment. Based on the USFS's assessment, we also find that the effects of the Tripod Fire to habitat conditions may result in a short-term (5 to 10 year) reduction in the reproductive success of the bull trout local population in the upper Beaver sub-watershed. However, because this local population has been isolated from the remainder of the Methow metapopulation, effects to this population are unlikely to influence population dynamics of the middle Methow watershed or entire Methow core area.

Defoliating insects and disease have also affected the baseline condition of this sub-watershed. Quantitative estimates of tree damage and mortality are not available. However, we have observed relatively extensive defoliation in the upper Goat Creek sub-watershed. Defoliation could reduce stream shading, increasing water temperature, and by hastening tree mortality could influence rates of woody debris recruitment, peak and base flows, and streambank condition. Another potential effect of defoliating insects, which may be the most consequential, is that extensive tree mortality could increase the severity of subsequent wildfires. Higher fire severity can intensify the immediate negative effects of fire on watersheds and prolong the duration of the post-fire period of instability.

Most habitat indicators for the middle Methow watershed are "functioning at risk." Only the physical barriers and streambank condition indicators are considered to be "functioning properly." Road density and location is only indicator rated as "not functioning properly." This condition reflects that many roads in the middle Methow watershed run parallel to streams along valley floors, resulting in a high density of riparian roads, averaging about 3 miles per square mile across the nine sub-watersheds.

3.3 **Environmental Baseline in the Chewuch Watershed**

The Chewuch River is a fifth-order tributary which flows into the Methow River at Winthrop, Washington. The headwaters of the Chewuch River extend almost to the Canada/United States border. Total watershed area is about 340,000 acres, of which about 95 percent is managed by the USFS. About 30 percent of the watershed is located in the Pasayten Wilderness Area. Much of the eastern side of the watershed that is outside designated Wilderness is roadless area. Private land constitutes about 4.5 percent (about 15,000 acres) of the watershed and occurs

primarily below river mile 8. The remainder of the watershed (about 5,000 acres) is managed by the Washington Department of Fish and Wildlife. Current condition of the Chewuch watershed ranges from extensive pristine areas in the headwaters to degraded areas on private lands in the lower watershed.

The Chewuch watershed is divided into two 5th field hydrologic units; the Lower and Upper Chewuch watersheds. The Lower Chewuch Watershed (where the proposed Project occurs) consists of the mainstem Chewuch River and all tributaries downstream of Lake Creek, which flows into the Chewuch River at river mile 24.3.

3.3.1 *Geomorphology, Hydrology, and Aquatic Biology*

The geomorphology of the Chewuch River basin has a strong influence on current landscape features, stream morphologic properties, and hydrologic responses. Two distinct geologic provinces bisect the watershed, with Methow province rock underlying the southwest one-fifth of the watershed, and the Okanogan Range province underlying the remainder. Methow province rocks are primarily sedimentary, except for Buck Mountain. The Okanogan Range province is primarily comprised of highly metamorphosed crystalline rocks (gneiss). The primary geomorphic processes that have had the greatest influence on current landscape features are alpine and continental glaciation along with glacial fluvial processes. Approximately 100,000 to 20,000 years ago, a series of alpine glacial processes were prominent in the Chewuch River and its major tributaries. These alpine glaciers carved out pre-existing V-shaped stream valleys, creating broader U-shaped valleys with steep side slopes. Major tributaries such as Falls, Twentymile, Farewell, and Lake Creek drain hanging U-shaped valleys. Volcanic activity has left ash and pumice deposits on the surface of these glaciated landscapes, especially on northerly aspects and lower- to mid-elevation slopes (USFS 1994, p. 87).

Soils in the watershed have varied origins. Much of the valley bottom landscape has deposits of boulders and glacial till. Areas in the Methow province produce soils of finer grain size derived from sedimentary rocks. Areas in the Okanogan Range province produce sandier soils derived from gneissic and granitic rocks. Landslides are most common in these Okanogan Range province soils throughout the upper reaches of the Chewuch in the Pasayten Wilderness. As of 1994, 26 slope failures ranging in size from10 to 300 acres were identified in the watershed, including debris torrents, large deep-seated landslides, and shallow seated landslides. All were attributed to natural events (USFS 1994, p. 92).

Most soil erosion in the Chewuch watershed is related to road construction and runoff, timber harvest, or fire (USFS 1994, p. 86). Erosion following these activities has deposited sediments in the Chewuch River, Boulder Creek, Doe Creek, and Falls Creek. Soil compaction from forest practices can also accelerate surface erosion. Between 3,300 and 11,200 acres in the watershed is estimated to be compacted due to historic tractor logging (USFS 1994, p. 91).

Hydrology in the Chewuch watershed is dominated by a pattern of fall and winter snow accumulation, with snowmelt and runoff during spring and summer driving the annual hydrograph. No glaciers are present in the watershed. During the late summer, the proportion of flow resulting from snowmelt decreases and groundwater becomes an increasing contributor to instream flow (Golder Associates 2002). During base flow in fall and winter, stream flow is

predominantly groundwater discharge (Golder Associates 2002). Glacial tills provide high continuity between ground water and surface waters (USFS 1994). Water storage in wetlands occurs in the upper reaches of several tributaries (USFS 1994). Abundance of beaver (*Castor canadensis*) has been severely reduced in the watershed, reducing the water storage capacity and habitat complexity of the watershed (USFS 1994).

The fish community in the Chewuch River has been affected by both extirpation of native species, severe reductions in abundance of some species, and introduction of exotic species. Coho salmon (*O. kisutch*) were extirpated from the Methow watershed, but efforts to determine the feasibility of reintroducing this species are underway. Upper Columbia River spring chinook and steelhead populations are listed as endangered under the Act, indicating their depressed abundance. The eastern brook trout is an introduced species in the watershed that has been found up to river mile 22.7 (USFS 2003). Brook trout are scarce in the mainstem Chewuch River, but they are abundant in all tributaries below Twentymile Creek (USFS 2003). Mountain whitefish were abundant at all sites surveyed in the lower river (Smith et al. 2000b). Non-salmonid species in the lower river include sculpins (*Cottus* spp.), red-sided shiners (*Richardsonius balteatus*), and dace (*Rhinichthys* spp.). Redband trout and westslope cutthroat trout (*O. clarki lewisi*) are present in upper tributaries, with stocking of westslope cutthroat trout occurring in many mountain lakes (USFS 2003).

3.3.2 *Factors Affecting the Species' Environment in the Action Area*

The main activities in the watershed in the recent past have been fire suppression and post-fire management, timber harvest, grazing, water diversions, road realignment or closure, habitat restoration, summer home maintenance, and recreation (developed and dispersed camping, hiking, packing with horses, mules and llamas, hunting, outfitter-guiding, rock and ice climbing, and snowmobiling). Housing and agricultural development continues on private lands along the Chewuch River downstream of river mile 8. Several projects in the watershed with the potential to affect both bull trout and aquatic habitats have been the subjects of prior consultations (see Appendix C).

Wildfire is a major natural disturbance factor in the Chewuch watershed. Wildfires can strongly influence water temperature, chemistry, and quantity, as well as channel structure through changes in transpiration, infiltration, ground water recharge, erosion and mass wasting, riparian shading, and recruitment and delivery of coarse woody debris (summarized in Rieman et al. 2003). These effects on habitat quality can have detrimental effects on populations of bull trout including increasing the potential for brook trout invasion (Dunham et al. 2003). However, effects from specific wildfire events are difficult to predict and vary with the particular characteristics of specific fires and the watersheds where they occur (Rieman et al. 2003). Growing evidence suggests that in some cases fire can increase habitat complexity, providing a benefit to bull trout and other native fish (e.g., Benda et al. 2003).

Fire suppression activities and post-fire management have affected aquatic habitats in the Chewuch watershed. The Thirtymile Fire burned about 9,300 acres of the Chewuch watershed during the summer of 2001. This area is about 3 percent of the watershed and occurred in a swath about 3 miles wide from east to west and 6 miles long from north to south. High fire intensity occurred on 16 percent of the fire area, moderate intensity on 62 percent, and low

intensity with scattered unburned areas on 23 percent of the fire area. About 4 miles of riparian areas burned along the Chewuch River between river miles 29 and 37, including known bull trout spawning areas in the mainstem Chewuch River. Subsequent to this fire, the USFS relocated a portion of the Chewuch Road and felled a large number of hazard trees in the area of the road relocation (Service reference 01-09-2005-I-W0194).

During the summer of 2003, the Farewell Creek Fire burned about 81,000 acres in the Chewuch watershed. About 66,000 acres of this total were in the Pasayten Wilderness. High fire intensity occurred on 20 percent of the fire area, moderate intensity on 24 percent, and low intensity on 56 percent of the fire area. Although most of this fire occurred in the subalpine-fir zone at higher elevations, it also burned over known bull trout spawning areas in Lake Creek. This fire also affected some of the area within the perimeter of the Thirtymile Fire. Maps of fire intensity provided by the USFS suggest that in the Lake Creek and Andrews Creek drainages, about 5 miles of riparian areas burned at high intensity and about 5 miles at moderate intensity.

In 2006, the Tripod Fire burned about 107,000 acres or roughly half of the Lower Chewuch watershed. The Ramsey, Boulder, and Twenty-mile drainages experienced the greatest effects. Burn severity was highly variable across sub-watersheds, but averaged 16 percent very low, 22 percent low, 44 percent moderate, and 22 percent high. Erosion potential on most of the burned area is considered moderate. The greatest potential for fire-related erosion is likely within the next 5 to 10 years, before vegetation recovers and stabilizes the soil.

Fire suppression activities included use of an incident command post at Eightmile Ranch, construction of 33 miles of handline (3 feet wide) and 10 miles of dozer line (10 feet wide), some of which occurred in riparian areas, blackline and burnout on an unknown number of acres, construction of safety zones, use of water pumps and seven helicopter dip sites, re-opening of closed roads (road miles unknown), and application of retardant.

Rehabilitation actions included installing waterbars, distributing slash, and blocking access to hand and dozer line, decompacting safety zones and other compacted areas, improving road drainage features, seed and fertilizer application to disturbed areas, and removal of temporary water impoundment and diversion structures. Completed rehabilitation work includes about 13,100 acres of heli-mulching, aerial seeding of 4,400 acres, 13,000 acres of fertilization, danger tree felling, integrated noxious weed control, and road and trail rehabilitation.

The USFS's assessment of effects in the Chewuch watershed stemming from the Tripod Fire and related activities included the factors summarized in Table 2, which the Service considers to be the most substantive changes to the baseline condition of the watershed.

Table 2. Baseline condition of habitat indicators in the Chewuch watershed and major effects of Tripod Fire and related activities.

Indicator	Pre-Tripod Baseline Condition*	Effects of Tripod Fire and Related Activities
Temperature	FAR above RM 27.2 (upper) NPF below (lower)	The Tripod Fire significantly reduced vegetative cover over extended reaches of Twentymile and Boulder creeks, which is likely to lead to increased temperatures below RM 18, especially during base flow. Short-term degradation until stream shade is restored by vegetative growth.
Sediment and embeddedness	FAR	Sediment loads in Boulder and 20-Mile creeks are likely to increase from both surface erosion and debris slides. BAER treatments, though ambitious in scale, only affected a small proportion of the total burned area, making it unlikely that these efforts would substantially limit increases in sediment delivery resulting from the fire. Short-term degradation will persist until vegetation stabilizes soil.
Large woody debris	PF upper FAR lower	Fire-caused tree mortality, expected debris flows, suppression related felling have all increased recruitment. Levels are currently high and are likely to be dynamic over next 5 to 10 years with continued landslides.
Pool frequency and quality	PF	Surveys in 3 reaches after 30-Mile and Farewell fires indicate an average 38 percent reduction in pool area. Duration of decline in this habitat type is uncertain.
Peak and base flow	FAR	Fire effects likely to increase peak flows, but magnitude of change uncertain. Base flows likely to show a minor increase due to reduced evapotranspiration.
Drainage network increase	FAR	Dozer line, increase in open roads, potential for rill erosion in burned areas all degrade indicator.
Riparian Reserves	PF upper FAR lower	Tripod Fire resulted in a moderate loss of riparian function in Boulder and 20-mile creeks. Some effects due to suppression activities in riparian areas and cattle sheltering in riparian during fire. Degraded function will persist until riparian vegetation recovers (decades).
Disturbance Regime	PF upper FAR lower	Large scale disturbance likely moved watershed toward restoration.

* PF = Properly Functioning; FAR = Functioning At Risk; and NPF = Not Properly Functioning

After evaluating the available information about the effects of the Tripod Fire and rehabilitation activities in the Chewuch watershed, the USFS determined that none of these effects were extensive, prolonged, or severe enough to warrant changing the baseline condition of any indicator. The Service agreed with that assessment. Based on the USFS's assessment, we also found that the combined beneficial and detrimental effects of the Tripod Fire to habitat

conditions may result in a short-term reduction in the reproductive success of the bull trout local population in the Chewuch watershed. However, based on bull trout response to the Thirtymile and Farewell fires, we expect that the magnitude of this effect will be minor, and too small to influence population dynamics of the entire Methow core area.

The 2002 Chewuch River stream survey found that surface fine sediments were at or exceeded established guidelines at the low gradient (<1%) segments of the river and that surface fine sediments were far less abundant in the stream segments with a gradient greater than 1%. Several debris flows have originated in areas burned in recent years in the Chewuch watershed. Andrews Creek, Lake Creek, and some unnamed tributaries contributed large amounts of fines, sand, gravel, and rocks to the Chewuch River after thunderstorm activity over the Thirtymile and Farewell Fire areas in the summer 2004. Sediment sampling in 2004 did not show any effect to spawning gravels in the Chewuch, but the 2005 sample suggests increased sedimentation is occurring. Fine sediment filled pools and covered gravels affecting spawning and rearing habitat for spring Chinook salmon, steelhead and bull trout. After two years however, the fine and coarse sediment and woody debris that was delivered to the Chewuch River began to stabilize and create high quality, complex instream habitat. Although these disturbance events were extensive, we believe the effects will be short lived and the Thirtymile and Farewell Fires may have helped restore the fire disturbance regime in large portions of the upper Chewuch watershed. Future monitoring may help identify the effects of the slides and subsequent sediment transport on bull trout.

Large wood recruitment is increasing in the upper Chewuch River as a result of the Thirtymile and Farewell fires. The landslides of 2004 also delivered log complexes to the Chewuch River. These inputs of large wood have contributed to improvement in the amount and quality of pool habitat in the upper Chewuch, and may improve floodplain connectivity by raising the elevation of the riverbed. Despite the acceleration of natural recruitment of large wood and restoration efforts that placed large wood into the channel, transport and retention of large wood in the lower 20 miles of the Chewuch River is still below natural levels. This deficit is thought to be due to historic channel cleaning and riparian harvest that removed key large trees (> 40 inches dbh) from the banks of the lower river.

Water diversions in the lower watershed are an important factor affecting habitat quality. There are two private irrigation ditches in the lower river that divert large volumes of water. The Fulton Ditch has its diversion at river mile 0.7 and filed claim in 1910 for 30 cfs. The fish screen at this diversion has a functional capacity of 22 cfs. The Chewuch Ditch filed claim in 1910 for 200 cfs and may have used up to 50 cfs prior to 1950. In 1974 they filed a revised claim for 56 cfs, and the current fish screen has a capacity of 30 cfs. Both ditches have concrete and rock weirs that divert flow into the ditches, with fish ladders to allow fish migration at low flow (Smith et al. 2000a). The weirs are passable to bull trout at higher flows. These ditches joined with the Skyline Ditch Company in 2001 to form the Chewuch Basin Council to address stream flow and endangered species issues (USFS 2003).

In addition to the Skyline diversion, two other ditches and several water transmission lines begin on land managed by the USFS. The Eightmile diversion was owned and operated by the USFS and recently diverted up to 4 cfs. This ditch was abandoned in 2003 and replaced by wells. The

Lucille Mason diversion has an interruptible claim for 0.5 cfs (April 1 to October 31) and turns off when the Chewuch River reaches base flow (USFS 2003).

Minimum instream flows for the Chewuch River were established by the Washington Department of Ecology (WDOE) in December 1976 (Caldwell and Catterson 1992). The minimum instream flow set by WDOE for the Chewuch from August 15 through September 15 is 47 cfs (USFS 1998), as measured at RM 8.7, upstream of all major water users. The Skyline, Chewuch, and Fulton diversions presently withdraw up to 68.8 cfs. Periodically, during diversion operations, WDOE administratively established minimum instream flows are not met.

This WDOE study also included an analysis of the relationship between fish habitat availability and instream flow using the Instream Flow Incremental Methodology. The highest quantity of rearing habitat for juvenile bull trout in the lower Chewuch River was estimated to occur at flows near 400 cfs (Caldwell and Catterson 1992).

Below the Skyline diversion, most of the riparian areas of the Chewuch River are in private ownership, with small areas owned by the Washington Department of Fish and Wildlife (Smith et al. 2000a). Development of residential and vacation homes on private lands are affecting riparian vegetation and all of its associated functions, as well as increasing demand for water for domestic use and irrigation.

Rising demand for recreational opportunities has led to many dispersed camping sites along the mainstem and tributaries in the lower watershed that have extensive road systems. The Respect the River program, initiated in 1994 by the USFS, is designed to increase awareness of riparian and aquatic habitat and inhabitants, restoration efforts, and individual responsibility to restore or maintain habitat quality. No new dispersed sites are being allowed and existing sites have been modified to allow riparian area recovery and reduce recreational impacts through improved visitor awareness. Other restoration efforts in the watershed have focused on reducing the impacts of roads in riparian areas, particularly in Cub and Doe creeks. Well-coordinated restoration planning and implementation efforts in the watershed are expected to continue.

Roads have important impacts on aquatic ecosystems in the Chewuch watershed. Road densities exceed 3.5 miles per square mile among most of the river corridor from Lake Creek to the mouth, and many areas have greater than 5 miles of road per square mile (USFS 1994). There are over 1,000 stream crossings, 579 miles of open roads, and 74 miles of closed roads in the Chewuch watershed, most of which are on highly erosive soils (USFS 1994). Areas with the greatest potential for sediment delivery from roads are concentrated in the lower river (USFS 1994).

Noxious weed control projects were covered in a batched consultation (FWS reference number 01-03-2001-I-1262) to be implemented within the Chewuch and Twisp watersheds. This batch included proposed work by the USFS that would occur from May 2001 to May 2006. Treatment would be by chemical, manual, and cultural methods. Generally treatment is restricted to road corridors. Effects of this activity to listed fish would be minimized through implementation of conservation measures that minimize the potential for chemical contamination of surface waters. As this batched consultation expired, the Service completed a regional programmatic

consultation on the USFS Region 6 Invasive Plant Program (FWS reference 01-07-2005-7-0653). The BA and associated BOs for this program provide management direction and conservation recommendations that will guide all future weed control actions in the Chewuch watershed.

Prescribed fire projects used as a silvicultural or management tool could occur within the Chewuch watershed under a programmatic consultation (FWS reference number 1-3-00-I-0906). These projects would be designed to reduce fuel (dead wood, brush, grass, etc.) levels, reduce the catastrophic risk of fire particularly to private lands and forest resources, reduce vegetative competition, and to restore the natural fire disturbance regime. Fire preparation (fireline, pruning) ignition of fuels, and containment of fire are the main activities employed with this management. Fire is used in the spring and fall as underburns consisting of low to moderate intensity fires with an average flame length of less than three feet and less than 10 percent pine needle scorch. The USFS proposed to implement this between April 2000 and April 2005 with five to ten burns annually across the Okanogan National Forest ranging from 50 to 5,000 acres each. No more than 25 percent of any 6th field watershed would be burned in a single year. Conservation measures to reduce impacts to listed fish would include: using pump chances that will not cause streambed alterations, screening pumps, refueling equipment outside of Riparian Reserves, preventing changes in road use or access, and monitoring of burns within Riparian Reserves.

Two cattle grazing allotments are entirely within the Chewuch watershed as are portions of six others. Ongoing effects of these allotments on aquatic habitats were determined to be insignificant and discountable generally because allotments have little overlap with primary tributaries and mainstem areas used by bull trout, ongoing inspection of pasture fencing, monitoring before turnout, and grazing schedules designed to minimize sediment impacts to listed fish. Sheep grazing no longer occurs in the watershed; and, cattle grazing is declining. Consultation on revised allotment management plans for the Chewuch allotments was completed in December 2005 (Appendix C).

Timber harvest and mining have not had important effects on aquatic habitats in the Chewuch Watershed since implementation of the Northwest Forest Plan. Other activities in the watershed include backcountry recreation and summer home use. These activities have also had relatively minor impacts on aquatic habitats.

Most habitat pathways in the watershed are “properly functioning” in the upper watershed or “functioning at risk” in the lower watershed. The lower watershed is “not properly functioning” for the “road density and location” indicator. Elevated sedimentation, a deficiency of large woody debris, high road density, and low pool frequency and quality are the primary factors contributing to reduced habitat suitability for bull trout in the lower watershed. Integration of all pathways indicate that the environmental baseline for this sub-watershed is generally “properly functioning” above river mile 19 and “functioning at risk” below that point. Recent surveys of habitat condition and fish use in the lower river suggest that, although the lower river has been degraded by various impacts, it still supports relatively high numbers of rearing anadromous salmonids (Smith et al. 2000a).

3.4 Global Climate Change

Global climate change has the potential to affect the baseline condition of bull trout habitat at all scales from the coterminous U.S. to the sub-watershed and action area. Available evidence also indicates climate change effects are reasonably certain to continue into the foreseeable future. Consequently, climate change could be addressed under multiple headings in this BO (e.g., rangewide status of the species, environmental baseline, and cumulative effects). Rather than scatter our discussion of this important topic throughout the BO, we consolidate in this section our consideration of how climate change may alter baseline conditions across scales.

Climate change is one of the most significant ongoing effects to baseline conditions for bull trout and their associated aquatic habitat throughout the state of Washington. Climate change, and the related warming of global climate, has been well-documented in the scientific literature (Bates et al. 2008; ISAB 2007). Evidence includes increases in average air and ocean temperatures, widespread melting of snow and glaciers, and rising sea level. Given the increasing certainty that climate change is occurring and is accelerating (Bates et al. 2008; Battin et al. 2007), we can no longer assume that climate conditions in the future will resemble those in the past.

Climate change has the potential to profoundly alter the aquatic habitat through both direct and indirect effects (Bisson et al. 2003). Direct effects are evident in alterations of water yield, peak flows, and stream temperature. Some climate models predict 10 to 25 percent reductions in late spring, summer, and early fall runoff amounts in coming decades. Indirect effects, such as increased vulnerability to catastrophic wildfires, occur as climate change alters the structure and distribution of forest and aquatic systems. Observations of the direct and indirect effects of global climate change include changes in species ranges and a wide array of environmental trends (ISAB 2007; Hari et al. 2006; Rieman et al. 2007). In the northern hemisphere, ice-cover durations over lakes and rivers have decreased by almost 20 days since the mid-1800s (WWF 2003). For cold-water associated salmonids in mountainous regions, where upper distribution is often limited by impassable barriers, an upward thermal shift in suitable habitat can result in a reduction in size of suitable habitat patches and loss of connectivity among patches, which in turn can lead to a population decline (Hari et al. 2006; Rieman et al. 2007).

Climate change is already affecting the frequency and magnitude of fires, especially in the warmer, drier regions of the west. To further complicate our understanding of these effects, the forest that naturally occurred in a particular region may or may not be the forest that will be responding to the fire regimes of an altered climate (Bisson et al. 2003). In several studies related to the effect of large fires on bull trout populations, bull trout appear to have adapted to past fire disturbances through mechanisms such as dispersal and plasticity. However, as stated earlier, the future may well be different than the past and extreme fire events may have a dramatic effect on bull trout and other aquatic species, especially in the context of continued habitat loss, simplification and fragmentation of aquatic systems, and the introduction and expansion of exotic species (Bisson et al. 2003).

In the Pacific Northwest, most models project warmer air temperatures and increases in winter precipitation and decreases in summer precipitation. Warmer temperatures will lead to more precipitation falling as rain rather than snow. As the snow pack diminishes, stream flow timing will change, and peak flows will likely increase in volume. Higher ambient air temperatures will

likely cause water temperatures to rise (ISAB 2007). Data from long-term stream monitoring stations in western Washington indicate a marked increasing trend in temperatures in most major rivers over the past 25 years (WDOE 2007).

There is still a great deal of uncertainty associated with predictions of timing, location, and magnitude of climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007). Research indicates that temperatures in many areas will continue to increase due to the effects of global climate change. According to model predictions, average temperatures in Washington State are likely to increase between 1.7 °C and 2.9 °C (3.1 °F and 5.3 °F) by 2040 (Casola et al. 2005).

Bull trout rely on cold water throughout their various life stages and increasing air temperatures likely will cause a reduction in the availability of suitable cold water habitat. For example, ground water temperature is generally correlated with mean annual air temperature and has been shown to strongly influence the distribution of char species. Groundwater temperature can also be linked to bull trout selection of spawning sites and has been shown to influence the survival of embryos and early juvenile rearing of bull trout (Rieman et al. 2007). Increases in air temperature are likely to be reflected in increases in both surface and groundwater temperatures.

Migratory bull trout can be found in lakes, large rivers and marine waters. Effects of climate change on lakes are likely to impact migratory adfluvial bull trout that seasonally rely upon lakes for their greater availability of prey and access to tributaries. Climate-related warming of lakes will likely lead to longer periods of thermal stratification, forcing coldwater fish such as bull trout to be restricted to the bottom layers for greater periods of time. Deeper thermoclines resulting from climate change may further reduce the area of suitable temperatures in the deeper depths of lakes and intensify competition for food (WWF 2003).

Bull trout require very cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. However, impacts on hydrology associated with climate change will cause shifts in timing, magnitude, and distribution of peak flows that are also likely to be most pronounced in these high elevation stream basins (Battin et al. 2007). The increased magnitude of winter peak flows in high elevation areas is likely to affect spawning and incubation habitat for bull trout and Pacific salmon. Although lower elevation rivers are not expected to experience as severe an impact from alterations in stream hydrology, they are generally not cold enough for bull trout spawning, incubation, and juvenile rearing.

As climate change progresses and stream temperatures warm, thermal refugia will be critical to ensure the persistence of bull trout and other species dependent on cold water. Thermal refugia are important for providing bull trout with patches of suitable habitat while allowing them to migrate through, or to make foraging forays into, areas with above optimal temperatures. Juvenile rearing may also occur in waters that are at or above optimal temperature, but these rearing areas are usually in close proximity to colder tributaries or other areas of cold water refugia (USEPA 2003).

Climate change is and will be an important factor affecting bull trout distribution and population dynamics. As distribution contracts, patch size decreases and connectivity is truncated; populations that are currently connected may become thermally isolated, which could accelerate the rate of local extinction beyond that resulting from changes in stream temperature alone (Rieman et al. 2007). In areas with already degraded water temperatures or where bull trout are at the southern edge of their range, they may already be at risk of impacts from current as well as future climate change. As these trends continue, the conservation role of bull trout populations in headwaters habitats may become more significant. Long-term persistence of bull trout may only be possible in these headwater areas that provide the only suitable habitat refugia.

3.5 Likelihood of Species Presence in the Action Area

Bull trout are likely to be in the action area during Project implementation. Both resident and migratory forms of bull trout are present in Goat Creek. In the Chewuch watershed the migratory form dominates, but resident bull trout may also be present in some tributaries (e.g., Lake Creek). In Goat Creek, the action area overlaps both spawning and FMO (i.e., foraging, migratory, and overwintering) habitat. In the Chewuch River, the action area overlaps only FMO habitat. Although the Goat Creek and Chewuch River local populations of bull trout are relatively small, overlap of the action area with occupied habitat makes it highly likely that bull trout will be exposed to Project activities. In Goat Creek, all life-cycle stages may be exposed. In the Chewuch watershed, migrating adults have the highest likelihood of being exposed to grazing cattle, and there is a slight chance that small numbers of emigrating sub-adults could also be exposed.

4.0 EFFECTS OF THE ACTION

The section 7 regulations define “effects of the action” as “the direct and indirect effects of an action on the species together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline” (50 C.F.R. 402.02). “Indirect effects” are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

To assess potential Project effects, the Service uses a format titled “A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Scale” (USFWS 1999). This format, adapted from the 1996 National Marine Fisheries Service format of a similar name, includes a decision matrix with pathways and indicators (MPI) designed to describe a baseline of subpopulation and habitat conditions and effects of the proposed action on these conditions. Baseline conditions are described on a relative scale of functionality (“functioning properly,” “functioning at risk” or “not properly functioning”) for each indicator. We then evaluate project effects on each indicator in the context of the environmental baseline in the action area. We consider proximity, distribution, timing (duration, frequency), type, intensity, and severity of effects in order to evaluate the degree of effect resulting from project implementation (USDI and USDC 1998, pp. 4-22 to 4-24). The Service typically expresses degree of effect in terms of impacts to individual fish and fish populations and deviations of habitat indicators in the MPI from their baseline condition.

To begin our analysis of effects, we typically deconstruct projects into separate elements that trigger different impact mechanisms. We have characterized this Project as having four elements, with the first element having the greatest potential to affect bull trout and their habitat and the remaining three elements functioning largely as conservation measures that reduce impacts of the first element (see Project Description above for details). The proposed allotment management plan would be in place for 10 years. The Service used the following Project elements to structure our analyses of direct effects to bull trout and indirect effects to habitat conditions, which are presented in the following sections.

1. Grazing (browsing vegetation, trampling aquatic and riparian habitat, input of feces and urine into aquatic habitat, and hauling cattle in trucks on Forest roads).
2. Water development construction, use, and maintenance.
3. Fence construction and maintenance.
4. Monitoring.

To describe and analyze Project effects in a logical way, we identified the following underlying premises:

1. Project elements trigger various impact mechanisms that directly kill (lethal effect), injure, or modify the behavior of bull trout, or result in changes in habitat condition that cause indirect injury (sub-lethal effects). Sub-lethal effects can vary from transient but significant disruptions of feeding behavior that temporarily reduce physiologic condition to physical injuries that reduce longevity and reproductive success.
2. All adverse effects are integrated and expressed in the common currency of changes in the numbers, distribution and reproduction of bull trout.
3. The Project will not result in beneficial effects.
4. Individual bull trout from two local populations in the Methow core area may be affected by the Project. Based on the distribution of bull trout spawning and rearing habitat in the Project area, the Service expects only the Goat Creek local population will experience adverse effects.

Based on these premises, our effect analysis consists of two major components:

1. Evaluate the potential for direct injury or mortality of individual bull trout, and
2. Evaluate the potential for effects on habitat indicators to result in indirect adverse effects.

Both components will be integrated to determine their influence on numbers, distribution and reproduction of bull trout populations exposed to effects of the action. Evaluating effects at the individual level relative to components 1 and 2 requires several sub-steps:

a. Determine which project elements and impact mechanisms are likely to result in adverse effects,
b. Determine the life stages most likely exposed to those effects.
c. Estimate the number of individuals in these life stages that will be exposed to project effects based on the intersection between the timing of element effects and the seasonal timing of habitat use by different life stages. This typically involves estimating the total number of individuals present in the vicinity at the time project activities begin and the number of individuals likely to pass through the affected area during the anticipated period of effects and,
d. Estimate the relative severity of effects resulting from exposure.

Determining the Project elements likely to result in adverse effects can be accomplished by qualitatively evaluating the potential effects of each element on bull trout individuals and habitat indicators (Table 3). Although Table 3 resembles the "checklist" in the Matrix of Pathways and Indicators, we are not referring here to watershed-scale effects on indicators. Rather, we simply borrow the familiar MPI format to structure our ratings of qualitative effects to individuals at the action area scale. Identifying life stages likely to be exposed can usually be based on relatively good information about habitat use patterns. Estimating numbers of individuals exposed and the relative severity of effects requires many assumptions. The most basic assumption is that average conditions in the past can be used as an index of conditions during Project implementation. Numerous additional assumptions about population size, age structure, migration timing, reproductive rate and other features contribute to high levels of uncertainty surrounding these estimates. The Service attempts to be as transparent as possible about these sources of uncertainty.

4.1 Direct Effects

The Project element with the greatest likelihood of contributing to direct injury or mortality of bull trout is grazing. Minimization measures and conservation measures included in the Project should reduce the extent or likelihood of injury and mortality of bull trout. However, despite these measures, disturbance and sub-lethal injury will likely occur and what follows is the Service's attempt to estimate the magnitude of these effects by Project element.

4.1.1 *Grazing*

Grazing can result in adverse effects to redds and free-swimming life stages through trampling, increased sedimentation, and disturbance. We address these stressors below. Along Goat Creek, livestock have access to about 4 miles of spawning and rearing habitat and 1.5 miles of FMO habitat. Two hundred cow/calf pairs are permitted from July 15 to August 31 in the Long Creek Pasture surrounding Goat Creek. Due to steep terrain and dense forest cover, up to 20 cow/calf pairs typically avoid detection as the herd is moved to a new pasture at the end of the specified period. These lingering cow/calf pairs often remain in the area for up to 2 weeks, which overlaps with the early portion of the bull trout spawning period. Although the Service believes the USFS has made many advances in grazing management and range improvements, these reasonable efforts still cannot guarantee that all cattle will be out of the Long Creek pasture by September 1.

Table 3. **Relative effects of Project elements on bull trout and habitat indicators.**

Direct and Indirect (habitat indicators) impact mechanisms	**Project Elements**			
	Grazing	Water Development	Fencing	Monitoring
Direct disturbance	- - -			
Direct injury (redd trampling)	- -			-
Temperature	- -	-	+	
Sediment/turbidity	-			-
Chemical contaminants and nutrients	-			
Physical barriers				
Embeddedness	-			
Large Wood				
Pool frequency and quality	-			
Large pools	-			
Off-channel habitat				
Refugia				
Width:depth ratio	-			
Streambank condition	- - -			
Floodplain connectivity				
Peak and base flow	-	-	+	
Drainage network				
Road density and location				
Riparian reserves	- - -			
Disturbance History	-			
Disturbance regime				

Minus signs indicate level of negative impact. One minus sign indicates a negative impact that is insignificant or discountable. Two minus signs indicates a negative impact that has the potential to cause an adverse effect to a listed species that can be reliably avoided by proper implementation of conservation measures. Three minus signs indicate a high likelihood of causing an adverse effect in all or a proportion of individuals exposed to this impact. No minus signs mean bull trout are unlikely to be directly or indirectly affected by this project element because there are no impact mechanisms that link project elements to an indicator. Plus signs denote beneficial effects.

4.1.1.1. Trampling. Grazing can have direct effects on bull trout either by disrupting normal spawning and rearing behavior or trampling of redds. Direct trampling of redds can result in direct injury and mortality of bull trout. Salmonid eggs in gravel nests (redds) can be damaged or killed by mechanical crushing or agitation and shock generated from nearby disturbance. Livestock wading or wallowing in streams can cause these effects. Using simulated redds in Idaho streams located within grazing allotments, Gregory and Gamett (2009, p. 364) found that cattle impacted from 12 to 78 percent of simulated redds. They observed that higher stocking densities of livestock on pastures correlated with higher percentages of redds impacted. They also suggested that variation in the percentage of redds impacted may be influenced by wild ungulate presence, stream accessibility, stream bank vegetation, water depth, and large woody debris (Gregory and Gamett 2009, p. 365). In another study, six natural Chinook salmon (*Onchorhynchus tshawytscha*) redds located within a livestock grazing area were observed for an average of 36 hours per redd during 28-day grazing periods (Ballard and Krueger 2005, p. 276). During this period, two redds (33.3 percent) were stepped on by cattle (each redd was trampled by a single hoof) (Ballard and Krueger 2005, p. 277). Egg mortality from this level of trampling was not estimated. Wading by human anglers on trout redds just before hatching can result in up to 43 percent mortality of eggs (Roberts and White 1992). Mortality rates from livestock trampling are likely to be similar (Roberts and White 1992).

Estimating potential effects of grazing on bull trout redds is complex and the scientific literature on this topic is limited. A recent study by Gregory and Gamett (2009) that investigated trampling risk of simulated bull trout redds in Idaho streams provides the first quasi-experimental information about the relationships between trampling risk, stocking intensity, and site conditions. Although the data presented by Gregory and Gammett (2009) is an important step in gaining a more general understanding of grazing effects on bull trout redds, we agree with the authors that much more work is needed to gain a basic understanding about how grazing may interact with other factors to affect salmonid population dynamics.

Based on extrapolation of the relationship between livestock stocking intensity and percentage of redds trampled described by Gregory and Gamett (2009), the Project BA concluded that the likelihood of cattle trampling bull trout redds is discountable. Evaluating the risk of trampling is complicated by several factors. First, we believe that while the Gregory and Gamett (2009) study provides a very useful reference point, their results are insufficient for recognizing general patterns because their work included a total of three sites monitored for a single season each, and does not consider the influence of potentially important variables such as availability of upslope water developments. Second, Gregory and Gamett's measure of grazing intensity should incorporate time as a multiplier rather than as a divisor (i.e., using time as a divisor suggests that increasing the amount of time livestock is present reduces the intensity of grazing). Re-calculating Gregory and Gamett's index of stocking intensity with time as a multiplier leads to the pasture with an intermediate level of stocking intensity having the highest level of redd trampling. This result reinforces Gregory and Gamett's (2009) finding that site conditions adjacent to simulated redds, such as presence of overhead cover, large woody debris, and lack of palatable vegetation all influence (reduce) the likelihood of trampling of simulated redds. Finally, Gregory and Gamett report stocking density in units of cattle per hectare, not per acre (as reported in the BA). Converting units to cattle per acre, the livestock density in Gregory and Gamett's "dense conifer" site is 0.28 cattle per acre, which is about 10 times greater than the

density estimated for the Longs Creek Pasture when only about 20 cattle that have eluded roundup remain (estimated density of 0.02 cattle per acre). Given that Gregory and Gamett's "dense conifer" site experienced 12 percent of simulated redds trampled during a single grazing season, this suggests that 1 to 2 percent of redds could be trampled by lingering cattle in the Longs Creek Pasture per year.

Several factors in addition to stocking density, however, may influence likelihood of redd trampling, and the results of Gregory and Gamett (2009) suggest these factors may have greater influence on risk than stocking density. Based on available literature and conversations with USFS biologists and Service fisheries biologists who conduct annual surveys for bull trout redds in Goat Creek, we believe the following factors may influence the likelihood of cattle trampling bull trout redds in Goat Creek (Table 4).

Table 4. Factors affecting the likelihood of cattle trampling bull trout redds

Factor	Effect on likelihood of redd trampling
Number of Cattle lingering in the pasture will start at 20 and decline progressively to 0 by September 15.	Reduction in stocking intensity compared to BA estimate of 20 cattle present continuously for 2 weeks.
Redd survey reports from recent years indicate that the number of redds likely increase progressively from 0 on September 1 to 6 redds by September 15.	Reduction in likelihood compared to BA, which estimated 9 redds present continuously for 2 weeks.
Streamside site conditions, including ease of stream access, overhead cover, large woody debris, availability of palatable forage, and access to alternative water sources.	No change. To provide a benchmark of potential trampling risk, we assume that streamside site conditions in Gregory and Gamett's "dense conifer" pasture are similar to those along Goat Creek. Detailed information necessary to test the accuracy of this assumption is not available, but the narrative description of conditions provided by Gregory and Gamett suggests the assumption is reasonable. Accepting this assumption controls for the effects of streamside conditions that may influence trampling rates, isolating the effect of stocking intensity. Because site conditions may strongly influence trampling risk, uncertainty about the accuracy of the assumption of similarity in site conditions introduces considerable uncertainty into our assessment of risk at Goat Creek.
Cattle typically access Goat Creek at locations with low stream and bank gradients that contain gravels appropriate for spawning (USFWS 2005). Some cattle trails traverse pool tail-outs (USFWS 2005, 2006, 2008).	Increase relative to implicit BA expectation that cattle crossing locations and redd sites are not spatially correlated.
Gregory and Gamett placed simulated redds randomly in suitable habitat, not selecting sites for proximity to cover.	Reduction; given bull trout often select redd sites near overhead cover and this cover may decrease likelihood of trampling (see Gregory and Gamett 2009, p. 363).

Integrating across factors listed in Table 4, the Service's opinion is that the actual rate of redd trampling in Goat Creek is likely to be less than the 1 to 2 percent per year estimated above based on stocking intensity alone. However, several sources of uncertainty, especially lack of information about the relative weight of each of the factors listed above, make it difficult to estimate how much lower actual rates of trampling may be.

In the absence of a quantitative criterion for "discountable," our opinion is that the likelihood of redd trampling from this Project is discountable over the 10-year course of implementing this

Project. The factors we weighted most heavily in reaching this conclusion were those that contribute to temporal separation between spawning activity and presence of cattle. Diligent efforts on the part of the grazing permittee to remove cattle from areas surrounding spawning habitat by September 1 are expected to ensure that redd trampling effects remains extremely unlikely to occur (discountable). Conscientious implementation by the USFS of the comprehensive monitoring and reporting program described in the BA should indicate if this expectation is realized. Annual reports from this monitoring effort will enable us to better understand redd trampling risks associated with the proposed allotment management plan and to reinitiate consultation if risks prove to be greater than currently anticipated. If the likelihood of trampling is greater than we currently believe, reinitiation of consultation may be required and revisions to the allotment management plan to reduce trampling risk may be necessary.

We do not expect grazing to result in direct effects to bull trout in the Lower Chewuch River. We agree with the assessment in the BA that warm water temperatures and temporal separation of cattle use and bull trout use of the lower Chewuch River reduce the likelihood of direct effects to discountable levels.

4.1.1.2. Increased Sedimentation. Grazing can also result in adverse effects to redds and free-swimming life stages by increasing sedimentation. However, this effect mechanism is unlikely to result in adverse effects in Goat Creek due to the pattern of cattle movement through the Creek. Cattle enter the stream at scattered locations along narrow paths, often in areas of cobble substrate. Bank trampling is limited. This pattern makes it unlikely that cattle use of the stream could sufficiently increase the amount of sediment deposited on redds to result in injury or mortality of eggs, or for sediment suspended in the water column to reach concentrations sufficient to result in direct injury or physiological stress. The Service believes that application of the conservation measures and monitoring presented in the BA should be effective at reducing to discountable levels the risks of direct injury from sedimentation.

4.1.1.3. Disturbance. The BA for the Project concluded that adverse effects to bull trout are most likely to occur due to displacement of juvenile, sub-adult, and adult bull trout. We agree that disturbance and displacement of bull trout, particularly small juvenile individuals, will contribute to adverse effects by exposing displaced individuals to increased predation risk and by reducing foraging success and physiologic condition.

Based on the timing of grazing activities in the vicinity of Goat Creek, we believe that adult, sub-adult, and rearing juvenile life stages are likely to be exposed and potentially affected. Estimating the number of individual bull trout in each life stage likely to be exposed annually requires an estimate of the density of each life stage in the action area. Estimating fish density is complicated by high variability and the use of different metrics in published literature. Some of the biological factors influencing bull trout densities are subpopulation demographics, life histories, and spatial and temporal variables related to seasonal availability of forage and high quality habitat. Typically, lower densities of bull trout occur in foraging, migration, and overwintering habitat, while higher densities occur in spawning and rearing areas. Bull trout densities have been reported in terms of area, from as low as 0.03 fish to as high as 37.5 fish per 100 meters squared (McPhail and Baxter 1996), and in terms of linear measurements, from 0.02 fish to 42.5 fish per 100 m (Peterson et al. 2001, p. 35; Bonar et al. 1997).

To estimate the numbers of adult bull trout likely to be affected, we relied on redd surveys. About nine redds were detected on average in Goat Creek during the eight years in which surveys of the entire spawning area were completed. Assuming 2 adults per redd, about 18 adults are expected to be present in the action area and potentially exposed to disturbance from cattle. Given the timing restrictions and other conservation measures included in the Project, we expect a small number of cattle is likely to be present when bull trout spawning behavior is occurring. Therefore, we estimate that no more than two spawning adults would be exposed to disturbance while spawning per year.

Site-specific information is insufficient to allow us to estimate the number of sub-adult and juvenile bull trout likely to be directly disturbed by cattle. For this Project, the action area includes both FMO and spawning/rearing habitat. In this context, we believe the best available information regarding the density of these bull trout life stages is based on surveys conducted across Washington during the development of a protocol to detect bull trout presence. These surveys revealed a statewide average density of bull trout juveniles and sub-adults in spawning areas of 0.058 bull trout per 100 square meters of stream surface area (range of 0.001 to 0.43 fish per $100m^2$; Thurow et al. 2004, pp. 15 and 53). Applying an estimated stream width of 5 meters along the entire 8,850-meter length of Goat Creek affected by this Project yields an estimate of total stream area potentially affected of 44,250 meters squared. The number of bull trout juveniles and sub-adults potentially exposed to disturbance from grazing can then be estimated as: $44{,}250\ m^2 * 0.058$ bull trout/$100\ m^2 \approx 26$ bull trout.

Estimating the relative severity of effects resulting from exposure to direct disturbance is largely a matter of professional judgment due to a lack of information about how bull trout respond behaviorally to the presence of cattle in spawning areas. Bull trout in the adult, sub-adult, and juvenile life stages are highly mobile and therefore not particularly susceptible to injury resulting from disturbance. Of the 44 adult, sub-adult, and juvenile bull trout estimated to be exposed to grazing-related disturbance annually, the Service anticipates that 10 percent will experience sub-lethal effects due to disruption of normal spawning, sheltering, or feeding behavior (see Table 5). These estimates reflect that (1) bull trout in these life stages will typically have the ability to avoid periodic (vs. continuous) grazing disturbances and this avoidance will have insignificant physiologic costs and result in discountable increases in predation risk, (2) that cattle cross and loaf in only a small proportion (likely less than 10 percent) of the total reach of Goat Creek affected, (3) the duration of exposure to disturbance will typically be relatively short, and (4) relatively mild effects of exposure will allow for complete recovery, and no additive effects of multiple exposures are expected. The Service expects that the severity of sub-lethal effects from exposure to grazing-related disturbance will be sufficiently mild that the survival of exposed individuals will not be reduced appreciably. The reproductive success of disturbed spawning adult individuals may be reduced. The mechanism we believe could potentially reduce reproductive success is that spawners prospecting for redd sites that are disturbed by cattle may relocate to lower quality habitat than they originally selected. Although the likelihood and intensity of this effect are difficult to detect or estimate, redd survey reports documenting spatial correlation between gravel appropriate for spawning at pool tail-outs and cattle trails suggests this effect is reasonably likely to occur. The Service, however, does not expect minor reductions

in productivity of one spawning pair per year to be sufficient to alter overall demographic trends of the Goat Creek local population.

Table 5. Summary of direct adverse effect estimates stratified by impact mechanism, life stage, and severity of effect. See text for derivation of these estimates.

			Severity of Estimated Effect		
Impact Mechanisms	Exposure context and life stage	Estimated number exposed/yr	Exposed but not adversely affected/yr	Sub-lethal effects/yr	Lethal effects/yr
Disturbance of normal behavior	Adults	18	16	2	0
	Sub-adults and juveniles	26	23	3	0
Ten-year Totals					
		Estimated number exposed/10 yr	Exposed but not adversely affected/ 10 yr	Sub-lethal effects/ 10 yr	Lethal effects/ 10 yr
Disturbance of normal behavior	Adults	180	160	20	0
	Sub-adults and juveniles	260	230	30	0

4.1.2 *Water Developments, Fencing, and Monitoring Elements*

We also do not expect direct effects to bull trout from other Project elements. Construction, use and maintenance of water developments, and construction and maintenance of fencing will occur out of wetted stream channels occupied by bull trout, eliminating the potential for direct injury. Construction activities will involve equipment and techniques that are unlikely to result in disturbance of bull trout, and will typically occur in locations sufficiently removed from streams (at least ¼ mile) to reduce the likelihood of direct disturbance to discountable levels and to ensure the amount of sediment delivered to the channel of Goat Creek from these activities will be insignificant. Monitoring has some potential to result in direct injury and disturbance, but we expect careful implementation of standard monitoring protocols to effectively minimize this risk to discountable levels.

4.2 Effects to Habitat Indicators

The following sub-sections address indirect effects to bull trout from Project implementation. Both negative and beneficial Project effects to habitat indicators in the MPI are discussed. In general, grazing will have temporary negative effects on habitat quality (Table 3). Water developments and fences will reduce grazing impacts, and in some cases may contribute to beneficial effects on some indicators (Table 3). The BA for the Project provided a thorough analysis of the likely effects of the Project on habitat indicators. With few modifications, mostly regarding the likely magnitude of effects, the Service agrees with the findings in the BA.

4.2.1 *Temperature*

Baseline stream temperatures are rated as “functioning at risk” in the Project area. Browsing or trampling of riparian vegetation can reduce shade, resulting in increased solar radiation reaching and warming the water. Transferring water from springs to above-ground troughs, water loss

from livestock consumption, and evaporation will alter the hydrology at each water development site. Impacts to riparian vegetation are concentrated near road crossings and old clear cuts, which are dispersed across the allotment. A majority of the riparian reserves contain dense stands of trees, limiting livestock use. Livestock access riparian reserves and habitat of bull trout in Goat Creek from river mile (RM) 6 up to RM 10.5. Generally, access by cattle to streambanks is limited and difficult above Vanderpool Crossing (RM 7.5), but easier and more common downstream to RM 6.

Cattle will likely browse and trample understory vegetation in a few areas across the allotment. However, nearly all small order streams within the allotment are characterized by good tree cover with generally thick riparian vegetation and thus are resistant to losing stream shade. Grazing cattle are not expected to have measurable impacts on mature streamside trees. Thick brush within riparian areas is expected to physically limit cattle access to much of the stream channel.

The magnitude of temperature effects along Goat Creek is expected to be insignificant. Cattle access is expected to be concentrated around the few road crossings but is not expected to be widespread or contiguous across the length of Goat Creek. Heavy riparian timber and dense brush coupled with limited road crossings will restrict infiltration by livestock. Vegetation reduction is not expected to reach a level sufficient to increase stream temperatures measurably at the site or 6th field watershed levels.

Water temperatures in Eightmile Creek are very cold (7-day avg <12°C) and livestock appear not to be affecting temperature. Riparian browse along the Chewuch River is minimal. The dominant shade trees are mature conifers that are unaffected by livestock grazing. The only livestock use is from a few drifting cows and they are removed in less than two days by the permittee. Any vegetation browse would have an insignificant effect on river shade and temperature.

Overall, the level of browsing and trampling of vegetation is not expected to lead to measurable changes in water temperature either in small order streams within the allotment or downstream. Similarly, small reductions in flow rates associated with water developments are unlikely to influence stream temperatures. Reduction in riparian browsing associated with water developments may compensate for negligible reductions in flow.

4.2.2 *Sediment and Substrate Embeddedness*

The sediment and substrate embeddedness indicators are “functioning at risk” in the Project area. Trampling and bank shear are likely to continue on less than 10 percent of Goat Creek banks, accelerating bank erosion and increasing sediment and turbidity levels. Streambanks in Goat Creek and across the allotment are well armored with dense vegetation and coarse substrate material, reducing sedimentation effects. Cattle access to Goat Creek is concentrated around a few discrete access points dispersed across the accessible reach. Cattle access to lower Eightmile Creek and the lower Chewuch River is similarly dispersed, and recent surveys indicate bank erosion ranges from 4.6 to 7.3 percent of total linear bank length.

Hauling of cattle in transport trucks along unpaved Forest Roads can generate high levels of dust. Where roads used for hauling are adjacent to streams, some of the dust produced may enter the water column and contribute to increased turbidity. This potential Project effect was not evaluated in the BA. Given that both permittees using the allotment will begin and end their grazing rotation in the First Creek Pasture, which is adjacent to the paved Chewuch River Road, the Service does not expect that cattle hauling to and from the allotment will contribute to increased turbidity in the lower Chewuch River. The Service also does not expect other Project elements to contribute to increased sedimentation, though they may reduce grazing-related sediment effects.

As discussed above in regard to direct effects of sedimentation and turbidity on bull trout, we expect released sediment volumes to be sufficiently small that when they have settled, they will have insignificant effects on patterns of bull trout habitat use at the site scale.

4.2.3 *Chemical Contaminants and Nutrients*

When livestock enter Goat Creek and the Chewuch River, they will introduce nutrients to the system. The expected low frequency of livestock entering streams and the relatively small numbers of cows entering per stream mile, suggest that insufficient nutrients will be introduced to affect habitat quality and patterns of habitat use by bull trout. Fences and water developments should minimize livestock presence along and in streams, which would assist in minimizing effects to nutrient levels.

4.2.4 *Pool Frequency and Quality*

The baseline condition of the pool frequency and quality indicator is rated as "functioning at risk." Because grazing is unlikely to affect rates of large woody debris recruitment or sedimentation rates, we expect little effect of the Project on pool frequency and quality. Localized, minor negative effects could occur if cattle loaf in pools and alter channel morphology, but these effects are unlikely to be sufficient in scope to result in adverse effects to bull trout.

4.2.5 *Width to Depth Ratio*

The baseline condition for this indicator in the Project area is "functioning at risk". Expected levels of cattle use in the riparian area will likely result in widely dispersed patches of bank sheer, increased sediment input, and vegetation trampling and browsing, which all contribute to increasing the width to depth ratio (i.e., producing a wider and shallower channel). The Service expects these effects to be limited to less than 5 percent of the stream length accessible to cattle in Goat Creek. This expectation is based on the patterns of limited stream access, dense riparian vegetation, and Project elements intended to draw cattle away from riparian areas. We expect that grazing effects on this indicator will be insignificant in scope and will not result in adverse changes to patterns of habitat use by bull trout in the Project area.

In the Chewuch River, low use of floodplain areas and limited grazing time in the area suggest that insignificant changes in channel morphology are likely to occur in response to grazing.

4.2.6 *Streambank Condition*

This indicator is currently considered to be "functioning appropriately." As described above for "width to depth ratio," our expectation is that the combination of relatively low numbers of cattle trampling streambanks and short duration of livestock presence in riparian areas will limit effects on streambanks. In particular, we expect water developments and fencing to reduce grazing impacts to streambanks. Consequently, at the reach scale or larger, the proposed grazing management plan is likely to result in insignificant changes in streambank condition.

However, small-scale, localized patches of streambank destabilization are likely to occur. We believe it is possible that cattle grazing could sufficiently destabilize or collapse undercut banks that the habitat value of these features for juvenile, sub-adult, and adult bull trout could be significantly altered. Individual bull trout exposed to these indirect effects would likely be displaced to new locations and experience potentially injurious reductions in their ability to shelter and feed in these locally degraded habitat patches.

To the best of our knowledge, no site-specific data are available regarding the baseline proportion of undercut banks in the reach of Goat Creek most likely to experience streambank effects. On average, undercut banks represented 1.6 percent of total streambank length in Washington streams sampled during development of bull trout sampling efficiency protocols (Thurow et al. 2004, p. 38). Based on site visits and information in the BA, our qualitative expectation is that this mean value may be representative for Goat Creek. Because other studies reviewed by Thurow et al. (2004, p. 38) generally found higher proportions of undercut banks, for this analysis we round upwards and assume roughly 2 percent of Goat Creek banks are undercut.

The monitoring program for the Project specifies that when streambank alteration reaches 20 percent, cattle will be moved out of the Long Creek Pasture along Goat Creek. We assume that cattle do not concentrate their trampling or avoid streambanks in areas with undercut banks, thus 20 percent streambank alteration likely results in an equal proportion of undercut bank trampling. We also expect that bull trout selectively seek out and use undercut banks disproportionately to their overall availability. The degree to which bull trout preferentially select undercut banks is unknown. In order to estimate effects of undercut bank trampling on bull trout, we assume that bull trout use undercut banks at a level twice that expected based only on proportional availability (i.e., they prefer undercut banks twice as much as other bank types; see Muhfeld and Marotz 2005). Another underlying assumption here is that when streambank alteration reaches 20 percent (triggering removal of cattle from the Long Creek Pasture), the 20 percent of undercut bank area trampled will have been altered to the degree that it no longer provides habitat values for bull trout.

Combining these habitat effects with our previous estimate of the average annual population of mobile bull trout of about 44 individuals (18 adults and 26 juveniles/sub-adults), we estimate that the number of bull trout adversely affected annually due to exposure to trampled undercut banks as:

(0.02 undercut bank length) * (0.2 trampled) ≈ 0.004 trampled undercut bank length
0.004 * (2) (habitat selection factor) ≈ 0.01 effective trampled undercut bank length
0.01 * 44 bull trout present annually ≈ up to 1 bull trout exposed and adversely affected.

Although there are multiple, stacked assumptions associated with this estimate, we believe it is reasonable to expect that streambank destabilization could adversely affect 1 bull trout per year or 10 total bull trout over the course of 10 years. We expect these adverse effects to be in the form of sub-lethal reductions in physiologic condition due to significant impairment of feeding and sheltering behavior.

4.2.7 *Peak and Base Flows*

Livestock grazing can compact soils, reducing infiltration and increasing runoff, and potentially limiting vegetation growth by increasing the resistance of soils to penetration by roots. Many site-specific variables influence the degree of compaction, including stocking rate, vegetation type and age, soil type and texture, soil water content, and climate (Broersma et al. 2000, p. 89). Information about most of these factors was not included in the BA. Based primarily on stocking rates and existing vegetation on the allotment, we believe that the proposed grazing scheme implemented for a decade will increase soil bulk density, runoff, and root penetration resistance. However, we expect the scope and intensity of these effects to result in insignificant changes in peak or base flow at the reach scale in Goat Creek. The peak flow indicator is currently "functioning appropriately" in the Project area, while the base flow indicator is "functioning at risk" due to water withdrawals for irrigation lower in the watershed. These slight hydrologic changes are unlikely to result in changes in patterns of bull trout habitat use. This expectation derives from our limited review of pertinent literature indicating that significant changes in hydrology do not occur consistently even under intensive grazing schemes (Pierson et al. 2002, p. 569), and that light to moderate grazing results in compaction effects that are well below critical ranges that trigger ecologic and hydrologic changes (Broersma et al. 2000, p. 92).

We expect water developments to have negligible effects on base flow. Converting shallow groundwater to surface flow, and consumptive loss of water to cattle will likely affect the routing of only a very small proportion of total baseflow supply in Goat Creek.

4.2.8 *Riparian Reserves*

Riparian reserves are generally "functioning properly" with localized areas "functioning at risk." The Project will have a negative effect on this indicator because trampling and browsing of riparian areas associated with cattle grazing will reduce the integrity of riparian vegetation, reducing its capacity to fulfill the multiple functions it normally provides for aquatic habitats (e.g., shading, sediment filtration, nutrient input, large wood inputs, hiding cover, etc.). These effects will be limited to localized areas across the allotment where cattle concentrate their activity in riparian zones. Although these effects are unlikely to change riparian area function at the reach or larger scales, localized degradation of riparian function could lead to adverse effects to bull trout exposed to degraded habitat conditions. Following a rationale similar to what we used for estimating indirect adverse effects emanating from streambank destabilization, we expect that over the 10 years of Project implementation, up to 10 bull trout could be adversely affected by reductions in riparian reserve function. We expect these adverse effects to be in the form of sub-lethal reductions in physiologic condition due to significant impairment of feeding and sheltering behavior.

4.3 Responses of Bull Trout to Habitat Effects

Project implementation will have primarily negative effects on habitat conditions (compared to no grazing). This section integrates these effects and predicts how these effects are likely to influence the numbers, distribution, and reproduction of the local bull trout populations affected.

The most substantive negative effects on bull trout habitat likely will be:

- Degradation of streambank condition – localized degradation of undercut banks may reduce the capacity of habitat in Goat Creek to support bull trout. This habitat feature is likely used for all life-cycle activities by adult, sub-adult, and juvenile bull trout. Degraded streambank conditions are likely to persist throughout the duration of Project implementation and to result in adverse effects to a small proportion of the total bull trout population exposed to these conditions.
- Reduction in function of riparian reserves – grazing will also contribute to localized reductions in the functionality of riparian reserves. We believe degradation in riparian function could be sufficient to displace and adversely affect bull trout exposed to these conditions. These degraded habitat conditions also will likely persist throughout the duration of Project implementation.

The Service believes that negative effects on two aspects of bull trout habitat will be sufficiently strong to result in adverse effects on up to 20 bull trout during the 10-year Project implementation period. We expect these adverse indirect effects to be in the form of significant impairment of feeding and sheltering behaviors that cause sub-lethal reductions in physiologic condition. We expect bull trout that experience these adverse effects to recover fully, with no long-term reduction in survival or reproduction.

We do not expect the Project to have any entirely beneficial effects. Fencing and water developments will reduce the negative impacts of grazing, but will not completely eliminate them.

4.4 Integration of Direct Effects and Indirect Habitat Effects

Direct effects of grazing will likely result in sub-lethal adverse effects on up to 20 adults and 30 sub-adult/juvenile bull trout (Table 6). Some individuals may experience multiple sub-lethal impacts, but for the purpose of quantifying effects the Service assumes all adverse effects are to different individuals. The Service believes that the severity of sub-lethal impacts is low enough that if multiple impacts to single individuals occurred they would still not reduce the survival of exposed individuals. Though two different local populations are present in the Project area, we expect all adverse effects to occur to the Goat Creek local population. Although the Goat Creek local population is small, the Service believes that the Project's sub-lethal impacts are too mild and limited in scope to change rates of survival and reproductive success of the entire Goat Creek local population during the 10-year period of Project implementation.

Table 6: Summary of adverse effects to bull trout by Project element, severity of effect, and life stage for the 10-year implementation period.

	Effect Type				
	Direct		Indirect (habitat degradation)		
Life Stage	Lethal	Sub-lethal	Lethal	Sub-lethal	**Total**
Adult	-	20	-	10	30
Sub-adult/juvenile	-	30	-	10	40
Redd	-	-	-	-	-
Total	-	50	-	20	70

4.5 Concurrent Effects

While this Project is being implemented, effects from other Projects in the middle Methow watershed and lower Chewuch watersheds will also be occurring. In particular, increased sedimentation from the Tripod Fire area and subsequent rehabilitation efforts will occur, ongoing operations of water diversions may contribute to decreased instream flows, and implementation of the Eightmile vegetation management project may have insignificant effects on aquatic habitats. The Service cannot identify any mechanisms by which these concurrent effects could interact synergistically to increase impacts on bull trout in the Methow core area beyond those anticipated in the independent consultations on these activities.

5.0 CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological 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 Act.

The Service is not aware of any other future actions that are reasonably certain to occur in the middle Methow or lower Chewuch watersheds that are likely to contribute to cumulative effects on bull trout. For this description of cumulative effects, the Service assumes that future non-Federal activities in the area of the proposed action will continue into the immediate future at present or increased intensities. Accordingly, these actions will contribute to some habitat indicators continuing to "function at risk" or to be "not properly functioning."

As the human population in Washington State continues to grow, residential growth and demand for dispersed and developed recreation is likely to occur. This trend is likely to result in increasing habitat degradation from housing and road construction, levee building, bank armoring, and campsite development on private lands. These activities tend to remove riparian vegetation (which reduces stream shade, increases stream temperature and reduces the opportunity for large woody debris recruitment), disconnect rivers from their floodplains, interrupt groundwater-surface water interactions, and reduce off-channel rearing habitat. Each subsequent action by itself may have only a small incremental effect, but taken together they may have a substantive effect that will further degrade the watershed's environmental baseline and undermine the improvements in habitat conditions necessary for listed species to survive and recover. Watershed assessments and education programs may reduce these adverse effects by

continuing to raise public awareness about the potentially detrimental effects of residential development and recreation on salmonid habitats and by presenting ways in which a growing human population and healthy fish populations can co-exist.

Easements and land acquisitions for habitat preservation are ongoing throughout the Methow sub-basin and these efforts are likely to contribute to maintaining or improving habitat quality. Many of these efforts are targeted at improving riparian habitat conditions in the Middle Methow watershed. These acquisitions not only prevent development and associated habitat degradation, but they also provide opportunities for restoration of fluvial processes that produce and maintain high-quality aquatic habitats.

6.0 CONCLUSION

The Service has reviewed the current status of the bull trout at the range-wide, interim recovery unit, core area, and action area scales. We have also analyzed the effects of the action and cumulative effects on the bull trout. This review and analysis forms the foundation for determining if the proposed action is reasonably expected to appreciably reduce the bull trout's likelihood of survival and recovery in the wild due to a reduction in its reproduction, numbers, or distribution (i.e., jeopardy). This section describes the key findings of our analyses and discusses them at each relevant scale.

At the scale of local populations, the Project will cause direct negative effects on one of ten local populations in the Methow core area. The baseline condition of the local population likely to be adversely affected is "not properly functioning." Baseline habitat conditions are variable, with strong recent influences of defoliating insects, past grazing allotment management, and several restoration projects that improved habitat access. Cumulative effects include potential residential and recreational development on private lands low in the watershed with associated impacts to habitat quality. Easements and land acquisitions for habitat preservation are ongoing and likely to contribute to improving habitat quality in the watershed. Concurrent effects potentially include insignificant impacts from timber management.

The Service believes that adverse disturbance effects during implementation will cause primarily sub-lethal injury of bull trout from all age classes. Within the context of all the factors that influence the dynamics of bull trout populations, we think the scope and severity of these effects will be too limited to result in changes in the reproduction, numbers, or distribution of the local population affected.

The local population potentially affected by the Project is relatively well connected to other local populations, with no major barriers to migration between them. Connection among local populations has been identified as a factor that contributes to the persistence of bull trout populations. The Project will not affect levels of connectivity among local populations. The Project will have transient sub-lethal effects on a small number of individuals, but these effects are unlikely to diminish the numbers and reproduction of the local populations of bull trout affected and will not reduce the distribution of local populations in the core area.

Although bull trout are widely distributed in the Methow core area, abundance is generally low and productivity highly variable. The Methow core area also shows a reduced distribution of the

migratory life-history form. Numerous historic and ongoing factors continue to limit the potential for population recovery at the core-area scale. Several spawning locations within the Methow core area have been directly and severely affected by wildfire in recent years. The combined effects of the 30-Mile, Farewell, Needles, and Tripod fires, in particular, have degraded spawning habitat conditions for bull trout in key spawning locations in Lake Creek, the upper Chewuch River, the upper Methow River, and upper tributaries of Beaver Creek. The Service expects that recruitment of juvenile bull trout into the spawning population will be depressed until the areas destabilized by wildfires are more fully revegetated. Population indicators in the Methow core area were "not properly functioning" before these wildfire events. The wildfires may contribute to temporary declines in productivity. Recent redd surveys suggest declines in some burned areas, but core area totals are at or above pre-fire numbers. The statistical power of redd surveys to detect changes in population dynamics in this area has not been determined. Nonetheless, available information from redd surveys suggests that high-severity wildfires that burned about 15 miles of riparian areas did not result in a detectable change in reproduction, numbers, or distribution of bull trout at the core-area scale. Because we expect the effects of the proposed Project to be much less severe and extensive than those of recent wildfires, we believe the effects of this Project are highly unlikely to shift bull trout population dynamics at the core-area scale.

The Methow core area encompasses a large geographic area, but the total bull trout population in the core area is intermediate in size between the more abundant population in the Wenatchee core area and the less abundant Entiat core area. Ongoing habitat restoration and preservation efforts, along with natural recovery processes post wildfire are likely to contribute to a positive trend in the abundance of bull trout in the Methow core area. Telemetry studies suggest that demographic exchange and perhaps gene flow may occur among these three core areas. We do not expect the proposed Project to affect bull trout abundance in the Methow core area, nor should it influence the level of exchange among core areas.

The Columbia River Interim Recovery Unit is vast, and contains a mix of core areas with increasing, stable, and declining demographic trends. The Methow core area is among those with a relatively stable population trend at an abundance level that is roughly an order of magnitude less than the goal for this unit in the Service's draft recovery plan, and as such is not currently contributing to the recovery of the Unit. The proposed Project would likely maintain this pattern. Slight degradation in habitat conditions at the local scale will not be sufficient to change population trends or distribution at the core area or interim recovery unit scales.

Over the long term, we expect the negative effects of the Project at the local scale to be imperceptible at the larger scales of the core area, interim recovery unit, or coterminous range. Based on our review and analysis, it is the Service's biological opinion that the Project, as proposed, is not likely to jeopardize the continued existence of the Columbia River interim recovery unit of the bull trout.

Incidental take of bull trout is likely to occur as a result of implementation of the "grazing" Project element described above. The Incidental Take Statement accompanying this biological opinion includes mandatory Reasonable and Prudent Measures and Terms and Conditions intended to minimize this incidental take.

INCIDENTAL TAKE STATEMENT

1. Introduction

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions or omissions that create the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the U.S. Forest Service so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The U.S. Forest Service has a continuing duty to regulate the activity covered by this incidental take statement. If the U.S. Forest Service fails to assume and implement the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) will lapse. In order to monitor the impact of incidental take, the U.S. Forest Service must report the progress of the action and its impact on the species to the Service as specified in this Incidental Take Statement [(50 CFR §402.14(i)(3)].

2. Anticipated Amount or Extent of Take of Bull Trout

In the "Effects of the Action" section of the accompanying biological opinion, the Service estimated the number of bull trout that would be exposed to adverse effects from this Project after making several simplifying assumptions. The rationale for these assumptions is presented in the "Effects of the Action" section. These assumptions necessarily introduce uncertainty into our estimate of incidental take.

The primary mechanisms of incidental take will be (1) harassment resulting from disturbance caused by cattle entering the stream, and (2) harm resulting from indirect exposure of all mobile life stages to reduced habitat quality (degraded streambanks and riparian areas). The amount of incidental take expected to occur, based on the number of bull trout from different life stages exposed to adverse effects from different project elements, is summarized in the following table:

Table ITS-1: Summary of incidental take of bull trout by Project element, severity of effect, and life stage for the 10-year Project implementation period.

	Effect Type				
	Direct (harassment)		Indirect (harm)		
Life Stage	Lethal	Sub-lethal	Lethal	Sub-lethal	**Total**
Adult	-	20	-	10	30
Sub-adult/juvenile	-	30	-	10	40
Redd	-	-	-	-	-
Total	-	50	-	20	70

All incidental take discussed here will occur to the Goat Creek local population of the Methow Core Area, within the Columbia River interim recovery unit. Because this Project will occur in spawning and rearing habitat of a local population and has a 10-year duration, estimated numbers of individuals to be incidentally taken are relatively high (Table ITS-1). We expect annual rates of incidental take to be roughly one-tenth of the values presented here.

The Service acknowledges that the amount of incidental take of bull trout resulting from the Project will be difficult to detect due to: (1) primarily nocturnal activity patterns, tendency to hide in or near the substrate, small body size and cryptic coloration and behavior of juvenile and sub-adult bull trout (2) the low likelihood of finding an injured or dead individual in the relatively complex habitats in the action area, and (3) high rate of removal of injured individuals by predators or scavengers. Given these difficulties, any detection of incidental take can provide valuable information to enable the Service to develop better methods for avoiding and minimizing incidental take, and to refine estimates of incidental take for future projects of a similar nature in similar contexts.

The Service believes that attempts to precisely track the quantity of incidental take occurring due to disturbance during Project implementation would likely result in more harm to bull trout than the Project alone. To comply with the Act, however, the U.S. Forest Service must ensure that its activities do not result in levels of take exceeding that anticipated in this incidental take statement. The Service's proposed solution to this dilemma is based on the relationship between specific Project elements and resulting incidental take. In the accompanying biological opinion, the Service attempted to estimate the numbers of bull trout to be taken during Project implementation and to associate this take with different Project elements. The Service believes that as long as each Project element is implemented as described in the biological assessment, the U.S. Forest Service will not exceed the level of incidental take exempted here. However, if implementation methods are changed in ways that are likely to result in different net effects, resulting incidental take could exceed the level exempted here and reinitiation of consultation is required.

For incidental take associated with habitat degradation, the Service relied on the proposed monitoring plan, especially its trigger for moving cattle based on streambank alteration. We believe that monitoring streambank alteration will provide an index of both streambank condition

and riparian reserve function. As long as streambank alteration remains less than 20 percent, the Service expects that levels of incidental take estimated here will not be exceeded.

3. Effect of the Take

In the accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

4. Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of bull trout.

RPM 1. Minimize incidental take resulting from harassment of bull trout by cattle.
RPM 2. Minimize incidental take due to habitat degradation.

5. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the U.S. Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measures described above, and are designed to minimize impacts to bull trout. These terms and conditions are mandatory.

To implement RPM 1:

T&C 1. The Biological Assessment currently specifies in section 2.4.9.X – *Annual Maintenance and Improvements* that "riding will be done at least once a week and more often, if necessary, so as not to exceed allowable use standards." When permittees have cattle in the Long Creek Pasture, require them to ride that pasture at least twice weekly with the intent of moving cattle upslope and away from Goat Creek. Riding in the wetted channel of Goat Creek should be avoided. Frequent riding will both reduce the time cattle spend in Goat Creek, and familiarize riders with the typical distribution of cattle in the allotment. We expect this familiarity to increase the efficiency of cattle removal from the pasture on August 31.

T&C 2. Conduct a performance review with permittees after each grazing season to discuss the results of monitoring. This performance review can be combined with other coordination meetings that typically occur with permittees. These meetings should be timed to allow permittees adequate opportunity to adjust to potential changes in allotment management (e.g., 3 months before the new grazing season begins). These meetings will be the official mechanism for completing the adaptive management feedback loop for allotment management. If changes in allotment management are needed, options will be considered and a final approach selected during these meetings. The Service shall be invited to these meetings, but if we cannot attend, the U.S. Forest Service shall provide notes summarizing the proceedings and documenting decisions about substantive changes in allotment management within 7 days of the meeting date. If changes in allotment management require reinitiation of consultation, reinitiation must occur by April 1.

To implement RPM 2:

T&C 3. Off-stream water developments are effective at reducing livestock impacts to riparian areas during mid-season grazing (DelCurto et al. 2005, pgs 120 to 121). In conjunction with monitoring activities, schedule at least two full days per grazing season for the investigation and development of additional off-stream watering opportunities in the Long Creek Pasture. Develop at least two additional off-stream watering opportunities at least ¼ mile from Goat Creek during the next decade.

T&C 4. By February 1, 2010, submit to the Service for review a detailed protocol for the allotment monitoring plan. This protocol shall specify the following:

- Measurable criteria and *a priori* thresholds that will be used to minimize ambiguity when implementing the Goat Creek move trigger (i.e., how exactly will 20% bank alteration be measured).
- The process for notification of permittees that the trigger level has been exceeded and their timetable for effective response. The process for notifying the Service should also be specified.
- The delivery date to the Service for annual monitoring reports.

The Service's perspective is that these measures will increase the efficiency of implementing the move trigger and thereby minimize habitat degradation and associated harm.

T&C 5. Compile a consolidated list (cheat-sheet) of all permittee maintenance and monitoring requirements. Provide this list to permittees in an easy-to-understand, "field-ready" format to remain with them for reference at all times.

6. Reporting Requirements

In order to monitor the impacts of implementation of the reasonable and prudent measures, the U.S. Forest Service shall prepare a report describing the progress of the proposed Project, including implementation of the associated terms and conditions, and impacts to the bull trout (50 CFR § 402.14(I)(3)). The report, which shall be submitted to the Central Washington Field Office on or before March 1 of the year following monitoring, shall list and describe:

1. Adverse effects to bull trout resulting from Project activities including number and life stages of affected individuals detected, if any.
2. Date grazing began and date removal of cattle from the Long Creek Pasture was completed.
3. Deviations from proposed allotment management plan, including monitoring activities.
4. Results of all monitoring activities, and outcomes of adaptive management meetings with permittees specified in T&C 2 above. The date of report submission can be adjusted based on the schedule of meetings with permittees.
5. In 2010, reporting components specified in T&C 4 above also need to be included.
6. Implementation of any conservation recommendations.

Upon locating a dead, injured, or sick specimen of an endangered or threatened species, initial notification must be made to the nearest Service Law Enforcement Office (Richland, Washington; Special Agent Corky Roberts, telephone 509.546.8344). Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

The Service believes that no more than 70 bull trout will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiating of consultation and review of the reasonable and prudent measures provided. The U.S. Forest Service must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures. Because incidental take for this Project is difficult to estimate and detect, the Service must be contacted if implementation plans change substantially from those described and the project effects no longer fall within the effects analyzed in the accompanying biological opinion.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service provides the following recommendations:

CR 1. Coordinate with fisheries personnel from the Mid Columbia River Fishery Resource Office who conduct bull trout redd surveys on Goat Creek to assist with inspections of redds for evidence of trampling.

CR 2. Construct water developments in locations and using methods that minimize the potential delivery of sediment from these developments to the drainage network during spring runoff or heavy precipitation events.

CR 3. Investigate the feasibility of using fencing or new technologies such as radio frequency and GPS collars that deliver audio warnings and electrical shocks (DelCurto et al. 2005, pp. 125 and 126) to restrict cattle access to Goat Creek above Vanderpool Crossing.

In order to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR §402.16, reinitiating of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In particular, if monitoring indicates that changes in allotment management are needed that could change effects to bull trout, reinitiation of consultation should occur before April 1 to allow adequate time for analysis of the proposed changes. Likewise, if during the 10 year term of this permit, restoration actions occur in Eightmile Creek that improve opportunities for bull trout access, reinitiation will be necessary. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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APPENDIX A: Bull Trout Life History and Population Dynamics

1. Historic and Current Range

Bull trout are native to northwestern North America, historically occupying a large geographic range extending from California north into the Yukon and Northwest Territories of Canada and east into western Montana and Alberta (Cavender 1978). They are generally found in interior drainages, but also occur on the Pacific Coast in Puget Sound and in the large drainages of British Columbia.

The historic range of the bull trout is likely to have contracted and expanded over time in relation to natural environmental and climate changes; the distribution of the species was likely patchy even in pristine environments. Despite uncertainty about the exact historical range, the number and size of historical populations, and the role of natural factors in the status of the species, there is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and continue to pose significant risks of further extirpations of local populations.

Bull trout currently occur in rivers and tributaries in Montana, Idaho, Washington, Oregon (including the Klamath River basin), Nevada, two Canadian Provinces (British Columbia and Alberta), and several cross-boundary drainages in southeast Alaska. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta, and the MacKenzie River system in Alberta and British Columbia (Cavender 1978; McPhail and Baxter 1996; Brewin and Brewin 1997). The current distribution of bull trout is highly fragmented.

The distribution of bull trout has shrunk in the Pacific Northwest and northern California. The distribution of bull trout has been reduced by an estimated 55 percent in the Klamath River DPS and 79 percent in the Columbia River DPS since pre-settlement times, due primarily to local extirpations, habitat degradation, and isolating factors (Quigley and Arbelbide 1997). Within the Puget Sound basin, bull trout distribution is similar to historic conditions, but population abundance has significantly decreased. In California, bull trout were historically found only in the McCloud River, which represented the southernmost extension of the species' range. The last confirmed report of bull trout in the McCloud River was in 1975, and this population is now considered to be extirpated (Rode 1990).

2. Life History

Bull trout populations exhibit three different life-history types: resident, migratory, and anadromous. Resident and migratory forms exist throughout the range of the bull trout (Rieman and McIntyre 1993) and spend their entire lives in freshwater. The anadromous life- history form is currently only known to occur in the Coastal-Puget Sound region within the coterminous United States (Volk 2000; Kraemer 1994; Mongillo 1993). Multiple life-history types may be expressed in the same population, and diversity of life-history types is considered important to the stability and viability of bull trout populations (Rieman and McIntyre 1993).

Life history type determines where the majority of the growth and maturation occurs. Anadromous bull trout growth and maturation mostly occurs in estuarine and marine waters.

Juvenile bull trout displaying the anadromous life history spend 1 to 3 years near freshwater natal areas before moving to estuary and/or nearshore marine areas to mature (Rieman and McIntyre 1993). Migratory bull trout mostly grow and mature in lakes, reservoirs, and large river systems. Like anadromous bull trout, juvenile migratory bull trout typically rear in or near natal streams for 1 to 3 years before migrating downstream into larger rivers or lakes. In some systems, age 0+ fish may migrate directly to lakes (Riehle et al. 1997). Resident bull trout populations are generally found in small headwater streams where the fish remain for their entire lives.

2.1 Freshwater Habitat

Bull trout have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Growth, survival, and long-term persistence are dependent upon several habitat characteristics, including: cold water, complex instream habitat, a stable substrate with a low percentage of fine sediments, high channel stability, and connectivity among streams supporting bull trout populations. Stream temperature and substrate type, in particular, are critical factors for the long-term persistence of bull trout. Spawning is often associated with the coldest, cleanest, and most complex stream reaches within basins. Consequently, bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1995), and should not be expected to occupy all available habitats at the same time (Rieman et al. 1997a).

Although bull trout clearly prefer cold waters and nearly pristine habitat, they can occur in degraded habitats. It is likely that small remnant populations of bull trout persisting in degraded rivers are using less than optimal habitat because that may be all that is available. In basins with high productivity, such as the Skagit River basin, bull trout may be using marginal areas when optimal habitat becomes fully occupied (C. Kraemer, WDFW, pers. comm. 2002). Bull trout have been documented using habitats that may be atypical or characterized as likely to be unsuitable (USFWS 2000).

2.1.1 Temperature. Bull trout are typically associated with the coldest stream reaches within basins. For long-term persistence, bull trout populations need a stream temperature regime that ensures sufficient amounts of cold water are present at the locations and during the times needed to complete their life cycle. Temperature is most frequently recognized as the factor limiting bull trout distribution (Dunham et al. 2003a; Dunham and Chandler 2001; Rieman and McIntyre 1993), which partially explains their generally patchy distribution within watersheds (Fraley and Shepard 1989; Rieman and McIntyre 1995). When maximum daily temperatures did not exceed approximately 11 to 12° C, the probability of occurrence for juvenile bull trout in Washington was high (75 percent) (Dunham et al. 2001). The most productive bull trout habitat in several Oregon streams had temperatures which seldom exceeded 15 ^{o}C (Buckman et al. 1992; Ratcliff 1992; Ziller 1992).

Stream temperatures must drop below 9 or 10 ^{o}C before spawning occurs (McPhail and Murray 1979; Riehle 1993). Water temperature also seems to be an important factor in determining early survival, with cold water temperatures resulting in higher egg survival and faster growth rates for fry and juveniles (Pratt 1992). Optimum incubation temperatures range from 2 to 6 ^{o}C, while at 8 to 10 ^{o}C, survival ranged from 0 to 20 percent (McPhail and Murray 1979). Stream

temperatures for tributary rearing juvenile bull trout are also quite low, ranging from 6 to 10 ^{o}C (Buchanan and Gregory 1997; Goetz 1989; Pratt 1992; McPhail and Murray 1979).

Although bull trout require a narrow range of cold water temperatures to rear, migrate, and reproduce, they are known to occur in larger, warmer river systems that may cool seasonally, and which provide important migratory corridors and forage bases. For migratory corridors, bull trout typically prefer water temperatures ranging between 10 to 12 ^{o}C (McPhail and Murray 1979; Buchanan and Gregory 1997). When bull trout migrate through stream segments with higher water temperatures they tend to seek areas offering thermal refuge such as confluences with cold tributaries (Swanberg 1997), deep pools, or locations with surface and groundwater exchanges in alluvial hyporheic zones (Frissell 1999).

Increases in stream temperatures can cause direct mortality, increased susceptibility to disease or other sublethal effects, displacement by avoidance (McCullough et al. 2001, Bonneau and Scarnechia 1996), or increased competition with species more tolerant of warm stream temperatures (Rieman and McIntyre 1993; Craig and Wissmar 1993 cited in USDI 1997; MBTSG 1998). Brook trout, which can hybridize with bull trout, may be more competitive than bull trout and displace them, especially in degraded drainages containing fine sediment and higher water temperatures (Selong et al. 2001; Leary et al. 1993). Recent laboratory studies suggest bull trout are at a particular disadvantage in competition with brook trout at temperatures >12 ^{o}C (McMahon et al. 2001; Selong et al. 2001).

2.1.2 Substrate. Bull trout show a strong affinity for stream bottoms and a preference for deep pools in cold water streams (Goetz 1989; Pratt 1992). Stream bottom and substrate composition are highly important for spawning site selection and juvenile rearing (Rieman and McIntyre 1993; Graham et al 1981; McPhail and Murray 1979). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985; Pratt 1992; Suttle et al. 2004) but may also limit access to substrate interstices that are important cover during rearing and over-wintering (Goetz 1994; Jakober 1995). Rearing densities of juvenile bull trout have been shown to be lower when there are higher percentages of fine sediment in the substrate (Shepard et al. 1984). Due to this close connection to substrate, bed load movements and channel instability can negatively influence the survival of young bull trout.

2.1.3 Cover and Stream Complexity. Bull trout of all age classes are closely associated with cover, especially during the day (Baxter and McPhail1997; Fraley and Shepard 1989). This association appears to be more important for bull trout than for other salmonids (Pratt 1992; Rieman and McIntyre 1993). Cover may be in the form of overhanging banks, deep pools, turbulence, large wood, or debris jams. Young bull trout also use interstitial spaces in the substrate for cover. Bull trout distribution and abundance are positively correlated with pools and complex forms of cover, such as large or complex woody debris and undercut banks, but may also include coarse substrates (cobble and boulder) (Rieman and McIntyre 1993; Jakober 1995; MBTSG 1998). Juvenile and adult bull trout frequently inhabit side channels, stream margins and pools with suitable cover (Sexauer and James 1993) and areas with cold hyporheic zones or groundwater upwellings (Baxter and Hauer 2000).

Large pools offeringa wide range of water depths, velocities, substrates, and cover, are characteristic of high quality aquatic habitat and are an important component of channel complexity. Large wood in streams creates pools and undercut banks, deflects streamflow, retains sediment, stabilizes the stream channel, increases hydraulic complexity, and improves feeding opportunities (Murphy 1995). All these functions of large wood enhance the quality of habitat for salmonids and contribute to channel stability (Bisson et al. 1987). By forming pools and retaining sediment, large wood also helps maintain water levels in small streams during periods of low stream flow (Lisle 1986).

Reduction of wood in stream channels, either from present or past activities, generally reduces pool frequency, quality, and channel complexity (Bisson et al. 1987; House and Boehne 1987; Spence et al. 1996). Studies conducted with Dolly Varden, a species similar to bull trout, showed that population density declined with the loss of woody debris after clearcutting or the removal of logging debris from streams (Bryant 1983; Dolloff 1986; Elliott 1986; Murphy et al. 1986).

2.1.4 Channel and Hydrologic Stability. Maintaining bull trout habitat requires stream channel and flow stability (Rieman and McIntyre 1993). Bull trout are exceptionally sensitive to activities that directly or indirectly affect stream channel integrity. Juvenile and adult bull trout frequently inhabit areas of reduced water velocity, such as side channels, stream margins, and pools that are easily eliminated or degraded by management activities (Rieman and McIntyre 1993).

Channel dewatering caused by low flows and bed aggradation (accumulation of rock and sediment) can block access for spawning fish, resulting in year class failures (Weaver 1992). Aggradation of the streambed can be accelerated by management activities that increase the frequency of landslides (e.g., road building and timber harvest) or that constrict stream channels (e.g., undersized culverts at stream crossings).

Patterns of stream flow and the frequency of extreme flow events that influence substrates may be important factors in population dynamics (Rieman and McIntyre 1993). With lengthy overwinter incubation and a close tie to the substrate, embryos and juveniles may be particularly vulnerable to flooding and channel scour associated with the rain-on-snow events that are common in some parts of the range (Rieman and McIntyre 1993).

2.1.5 Migration and Habitat Connectivity. Bull trout are highly migratory. The persistence of migratory bull trout populations requires intact migration corridors. Migration corridors link wintering areas with foraging, spawning, and rearing areas used at different times of the year, and by different life-history stages (MBTSG 1998, Rieman and McIntyre 1993). In the Coastal-Puget Sound DPS, migratory corridors may link marine and freshwater habitats as well as linking lake, river, and tributary complexes that are necessary for bull trout to complete their life cycle. Migratory corridors also link local populations, providing opportunities for gene flow and demographic exchange.

Bull trout migratory movements include both spawning migrations and downstream emigration of juveniles from headwater rearing areas to feeding and maturation areas. Migratory bull trout

may begin their spawning migrations as early as April and have been known to migrate upstream as far as 250 kilometers (155 miles) to spawning grounds (Fraley and Shepard 1989). Current radio-telemetry work being done in the upper Columbia River basin is revealing movement patterns of migratory bull trout that extend over 160 kilometers (100 miles), from the headwaters of the Wenatchee and Methow basins to the Columbia River and the pools formed by Rocky Reach, Rock Island, and Wells Dams (J. De La Vergne, pers. comm. 2001; BioAnalysts 2004). During these long migrations, bull trout use a wide variety of habitats. Compared to spawning migration, relatively little published information is available about juvenile emigration. Age of emigration varies from one to three years old (Rieman and McIntyre 1993), and annual timing of emigration is highly variable and can extend from spring until winter.

Stream habitat alterations that restrict or eliminate bull trout migration corridors include degradation of water quality (especially increasing temperatures and increased amounts of fine sediments), alteration of natural stream flow patterns, impassable barriers (such as dams and culverts), and structural modification of stream habitat (such as channelization or removal of cover). Dam and reservoir construction and operations have altered major portions of bull trout habitat throughout the Columbia River basin. Dams without fish passage create barriers to fluvial and adfluvial bull trout which isolates populations. The operations of dams and reservoirs alter the natural hydrograph, thereby affecting forage, water temperature, and water quality (USDI 1997). Many populations of "resident" bull trout that are isolated above artificial barriers to migration are remnants of populations that once supported larger, more fecund, migratory forms.

2.2 Marine Phase

Anadromous bull trout forage and mature in the nearshore marine habitats on the Washington coast and in Puget Sound. The marine and estuarine residency period for bull trout is poorly understood. Thorpe's (1994) review found little evidence in the literature that the estuary was used for physiological adjustment or as a refuge from predation, but he did find clear evidence of a trophic advantage to estuarine residency (abundant prey). While in the estuary, native char can grow very quickly. Subadults grow from 20 to 40 mm per month and reach a length of 250 to 350 mm before their upstream migration in late summer and early fall (Kraemer 1994). During their marine residency, subadults from Dolly Varden populations on Vancouver Island gained 74 mm and adults gained 45 mm in length (Smith and Slaney 1979).

Kraemer (1994) speculated that the distribution of native char in marine waters may be closely tied to the distribution of bait fish and coincident with their spawning beaches. Char from Puget Sound have been found to prey on surf smelt, Pacific herring, Pacific sand lance, pink salmon smolts, chum salmon smolts, and a number of invertebrates (Kraemer 1994). The Quinault Indian Nation documented smelt as a prey item for native char in the Queets River. Kraemer (as cited in Nightingale and Simenstad 2001) observed that native char in estuaries typically foraged in water less than 3 meters deep and were often seen foraging in water less than 0.5 meters deep.

Anadromous migrations of bull trout have been studied in Rivers of the Olympic Peninsula in Washington. Radio-tagged bull trout from the Hoh River have migrated out into the marine environment and then back into a number of other coastal drainages, including the Queets, and Quinault Rivers, and have showed complex movement patterns within and between rivers

(Brenkman and Corbett 2005). In Alaska and British Columbia, downstream migration of Dolly Varden occurs in spring and early summer and upstream migration occurs from late spring through early winter (ADFG 1963; Armstrong 1965; Smith and Slaney 1979). In southeast Alaska, Dolly Varden spent an average of 116 days in marine waters (Armstrong 1965). Armstrong (1965) also reported that Dolly Varden migrated directly to saltwater and did not backtrack or linger in the river.

Anadromous char undertake fairly extensive marine migrations. Anadromous Dolly Varden typically stay close to the shoreline, but sometimes move up to 30 miles off shore (e.g., ADFG 1963). Dolly Varden move extensive distances in salt water, and may enter freshwater streams that are far from their natal streams (DeCicco 1992; Thorpe 1994). Kraemer (1994) has documented fish in Puget Sound as far as 25 miles from their natal stream. Marking studies used to investigate migratory patterns of Dolly Varden in southeast Alaska found marked fish in 25 different stream systems as far as 72 miles from their natal stream (Armstrong 1965). About forty percent of the marked fish appeared to migrate to other streams during the winter, but most fish remained within tens of miles of their natal streams.

Nearshore marine habitats have been significantly altered by human development (PSWQAT 2000). Construction of bulkheads and other structures have modified the nearshore areas and resulted in habitat loss that has directly affected forage fish for bull trout. Other impacts to the marine environment include alterations to water quality resulting from fish pathogens, nutrients and toxic contaminants, urbanization, and stormwater runoff from basins that feed Puget Sound. Global changes in sea level and climate may also have more widespread ramifications on these habitats, and on the Puget Sound ecosystem as a whole (Klarin et al. 1990; Thom 1992).

2.3 Food Habits

Like many fish, different life stages of bull trout feed at different trophic levels. Adult bull trout are apex piscivores, and require a large prey base and home range. Adult and subadult migratory bull trout feed primarily on various trout and salmon species, whitefish (*Prosopium* spp.), yellow perch (*Perca flavescens*), and sculpin (*Cottus* spp.). Subadult and adult migratory bull trout move throughout and between basins in search of prey. Anadromous bull trout in the Coastal-Puget Sound DPS also feed on ocean fish such as surf smelt (*Hypomesus pretiosus*) and sandlance (*Ammodytes hexapterus*). Resident and juvenile bull trout prey on terrestrial and aquatic insects, macrozooplankton, amphipods, mysids, crayfish, and small fish (Wyman 1975; Rieman and Lukens 1979 in Rieman and McIntyre 1993; Boag 1987; Goetz 1989; Donald and Alger 1993). A recent study in the Cedar River Watershed of western Washington found bull trout diets also include aquatic insects, crayfish, and salamanders (Connor et al. 1997).

2.4 Reproductive Biology

Bull trout become sexually mature between 4 and 9 years of age, and may spawn in consecutive or alternate years (Shepard et al. 1984; Pratt 1992). Spawning typically occurs from August through December in cold, low-gradient 1st- to 5th-order tributary streams, over loosely compacted gravel and cobble having groundwater inflow (Shepard et al. 1984; Brown 1992; Rieman and McIntyre 1996; Swanberg 1997; MBTSG 1998; Baxter and Hauer 2000). Surface/groundwater interaction zones, which are typically selected by bull trout for redd

construction, have high dissolved oxygen, constant cold water temperatures, and increased macro-invertebrate production. Spawning sites frequently occur near cover (Brown 1992).

Hatching occurs in winter or early spring, and alevins may stay in the gravel for up to three weeks before emerging. The total time from egg deposition to fry emergence from the gravel may exceed 220 days.

Post-spawning mortality, longevity, and repeat-spawning frequency are not well known (Rieman and McIntyre 1996), but lifespans may exceed 10 to13 years (McPhail and Murray 1979; Pratt 1992; Rieman and McIntyre 1993). Adult adfluvial bull trout may live as long as 20 years, and may require as much as 20 months in the lake or reservoir habitat to facilitate adequate energy storage and gamete development before they return to spawn again (67 FR 71236).

Migratory bull trout are highly visible during spawning due to their large size and location in relatively small streams during periods of low flow. Channel complexity and cover are important components of spawning habitat to reduce both predation risk and potential for poaching.

3. Population Dynamics

Bull trout are considered to display complex metapopulation dynamics (Dunham and Rieman 1999). Size of suitable habitat patches appears to play an important role in the persistence of bull trout populations, along with habitat connectivity and human disturbance, especially road density. Analyses of spatial and temporal variation in bull trout redds indicates weak spatial clustering in patterns of abundance through time (Rieman and McIntyre 1996). Spatial heterogeneity in patterns of abundance was high, however, at a regional scale. This combination of patterns suggests that maintenance of stable regional populations may require maintenance of connected patches of high quality habitat where dispersal and demographic support can occur readily among patches (Rieman and McIntyre 1996).

The importance of maintaining the migratory life-history form of bull trout, as well as migratory runs of other salmonids that may provide a forage base for bull trout, is repeatedly emphasized in the scientific literature (Rieman and McIntyre 1993; MBTSG 1998; Dunham and Rieman 1999; Nelson et al. 2002). Isolation and habitat fragmentation resulting from migratory barriers have negatively affected bull trout by: (1) reducing geographical distribution (Rieman and McIntyre 1993; MBTSG 1998); (2) increasing the probability of losing individual local populations (Rieman and McIntyre 1993; MBTSG 1998; Nelson et al. 2002; Dunham and Rieman 1999); (3) increasing the probability of hybridization with introduced brook trout (Rieman and McIntyre 1993); (4) reducing the potential for movements in response to developmental, foraging, and seasonal habitat requirements (MBTSG 1998; Rieman and McIntyre 1993); and (5) reducing reproductive capability by eliminating the larger, more fecund migratory form from many subpopulations (MBTSG 1998; Rieman and McIntyre 1993). Therefore, restoring connectivity and restoring the frequency of occurrence of the migratory form will reduce the probability of local and subpopulation extinctions. Remnant populations, that lack connectivity due to elimination of migratory forms, have a reduced likelihood of persistence (Rieman and McIntyre 1993; Rieman and Allendorf 2001).

Lakes and reservoirs provide important refugia for bull trout. In general, lake and reservoir environments are relatively more secure from catastrophic natural events than stream systems (67 FR 71236). They provide a sanctuary for bull trout, allowing them to quickly rebound from temporary adverse effects to spawning and rearing habitat. For example, if a major wildfire burns a drainage and eliminates most or all aquatic life (a rare occurrence), bull trout sub-adults and adults that survive in the lake may return the following year to repopulate the burned drainage. This underscores the need to maintain migratory life forms and habitat connectivity in order to increase the likelihood of long-term population persistence.

4. Threats and Conservation Needs

Threats are factors that reduce a species' likelihood of survival and recovery and lead to listing under the Act. Conservation needs are ecological conditions necessary to sustain stable or increasing populations of listed species, and measures that will create these conditions. Conservation needs alleviate or reverse the effects of threats and contribute to increasing the likelihood of survival and recovery of listed species.

4.1 Reasons for Listing

Factors contributing to the decline of bull trout populations were described in the final rules for listing. They include restriction of migratory routes by dams and other unnatural barriers; forest management, grazing, and agricultural practices; road construction; mining; introduction of non-native species; and residential development resulting in adverse habitat modification, over-harvest, and poaching (Bond 1992; Thomas 1992; Rieman and McIntyre 1993; Donald and Alger 1993; WDFW 1997).

Extensive habitat loss and fragmentation of subpopulations have been documented for bull trout in the Columbia River basin and elsewhere within its range (Rieman and McIntyre 1993). Road construction, grazing, and agricultural practices in the Columbia River basin have degraded habitat conditions by contributing to elevated stream temperatures, increased sedimentation and channel embeddedness, and reductions in the extent of riparian vegetation. Mining activities have compromised habitat conditions by discharging waste materials into streams and diverting and altering stream channels. Residential development has threatened water quality by introducing domestic sewage and altering riparian conditions. Dams of all sizes (e.g., mainstem hydropower and tributary irrigation diversions) have severely limited migration of bull trout in the Columbia River basin. Competition from and hybridization with non-native trout are also considered threats to bull trout (USDI 1998; 1999).

Wildfire in the dry forests of the interior Columbia Basin also presents a substantive threat to bull trout populations. Although bull trout evolved with wildfire, and can benefit from it, fire suppression in some areas has altered fire regimes so drastically that they no longer resemble historic fire regimes in which bull trout evolved (Rieman et al. 1997b; Rieman and Clayton 1997; Gresswell 1999). Species that have narrow habitat requirements, such as bull trout, that inhabit degraded and fragmented aquatic systems are considered vulnerable to fire and fire-related disturbance (Dunham et al. 2003b). In this context, wildfire could threaten long-term persistence of bull trout because it exerts selection pressures different than those that produced the phenotypes and genotypes present today.

4.2 New Threats

No new threats since listing have been specifically identified at the range-wide scale, but previously identified threats, or new threats at the local scale, may not have been fully appreciated. Examples include the proposed introduction of northern pike (*Esox lucius*) as a sport fish in Montana and expansion of the range of whirling disease (*Myxobolus cerebralus*).

4.3 Conservation Needs

Conservation needs are measures necessary to redress the threats that led to the listing of a species. As described in the "habitat" sections above, the habitat conservation needs of bull trout are often generally expressed as the need to provide 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 long-term conservation of bull trout.

In addition to habitat conservation needs, other needs are associated with sustaining population dynamics. These conservation needs include: (1) maintain and restore multiple, interconnected populations in diverse habitats across the range; (2) preserve the diversity of life-history strategies; and (3) maintain genetic and phenotypic diversity across the range. Each of these needs is described below in more detail. These conservation needs apply to bull trout at multiple scales ranging from the coterminous listing down to local populations.

4.3.1 *Interconnected Populations*. Maintaining multiple bull trout populations distributed and interconnected throughout their current range will also provide a mechanism for spreading the risk of extinction from stochastic events (Rieman and McIntyre 1993; Rieman and Allendorf 2001; Spruell et al. 1999; Healey and Prince 1995; Hard 1995). Bull trout still occur widely, but in reduced numbers, across most portions of their historical range. Within this broad distribution, significant declines and local extinctions have occurred. Current patterns in distribution and other empirical evidence indicate that further declines and local extinctions are likely (Rieman et al. 1997a; Spruell et al. 2003; Rieman and Allendorf 2001; Dunham and Rieman 1999). Maintenance of widespread and interconnected populations improves the chances that declining populations can be "rescued" from extinction by immigrants from more robust populations, or if local extinctions occur, that recolonization will follow.

Preservation of interconnected populations and multiple life histories enable bull trout to persist through natural disturbance events, such as large fires. 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 homogeneity of terrestrial and aquatic habitats, increasing the likelihood of large, intense forest fires in some areas. Because the most severe effects of fire on native fish populations can be expected where populations have become fragmented by human activities or natural events, an effective strategy to ensure persistence of native fishes in habitats susceptible to large fires may be to restore aquatic habitat structure and life-history complexity of populations in these areas (Gresswell 1999).

The spatial diversity and complexity of aquatic habitats strongly influence the effects of large disturbances on salmonids (Rieman and Clayton 1997). For example, Rieman et al. (1997b) studied bull trout and redband trout (*Oncorhynchus mykiss*) 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, after areas within the watersheds had experienced debris flows, fish became reestablished in many reaches. In some instances, fish densities were higher than those present before the fires even 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).

In terms of conserving bull trout, the appropriate strategy to reduce the risk of fires on bull trout habitat is to emphasize 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. Both passive (e.g., encouraging natural riparian vegetation and floodplain processes to function appropriately) and active (e.g., reducing road density, removing barriers to fish movement, and improving habitat complexity) actions offer the best approaches to protect bull trout from the effects of large fires.

4.3.2 *Life-History Diversity*. Bull trout populations exhibit multiple life-history forms, including migratory forms, throughout the range of the species (Rieman and McIntyre 1993). Migratory forms appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes, where foraging opportunities may be enhanced (Frissell 1997). 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 of the Snake River. Such multiple life-history strategies help to maintain the stability and persistence of bull trout populations in the face of environmental changes. Migratory bull trout may enhance persistence of metapopulations due to their high fecundity, large size, and dispersal across space and time, which promotes recolonization should resident populations suffer a catastrophic loss (Frissell 1997; Rieman and McIntyre 1993; MBTSG 1998).

4.3.3 *Genetic and Phenotypic Diversity*. Genetic diversity promotes both short-term fitness of populations and long-term persistence of a species by increasing the likelihood that the species is able to survive changing environmental conditions. This beneficial effect can be displayed both within and among populations. Within a genetically diverse local population of bull trout, different individuals may have various alleles that confer different abilities to survive and reproduce under different environmental conditions (Leary et al. 1993; Spruell et al. 1999; Hard 1995). If environmental conditions change due to natural processes or human activities, different allele combinations already present in the population may be favored, and the population may persist with only a change in allele frequencies. A genetically homogeneous population that has lost variation due to inbreeding or genetic drift may be unable to respond to environmental change and be extirpated. The prospect of local extirpation highlights the importance of genetic

diversity among local populations. Recolonization of locations where extirpations have occurred may be promoted if immigrants are available that possess alleles that confer an advantage in variable environmental conditions. Extending this reasoning to the entire range of the species, reduction in rangewide genetic diversity of bull trout through the loss of local populations can reduce the species ability to respond to changing conditions, leading to a higher likelihood of extinction (Rieman and McIntyre 1993; Leary et al. 1993; Spruell et al. 1999; Hard 1995; Rieman and Allendorf 2001).

Barriers to migration are an important factor influencing patterns of genetic variability in bull trout (Spruell et al. 2003; Costello et al. 2003). Although barriers increase the vulnerability of isolated populations to stochastic factors, they also insulate these populations from the homogenizing effects of gene flow. If isolated populations were founded by ancestors with rare alleles, genetic drift, unimpeded by gene flow, can lead to fixation of these rare alleles. Subsequent downstream migration from these isolated populations may be important in maintaining the evolutionary potential of metapopulations, because they provide inputs of genetic diversity (Costello et al. 2003).

The amount of genetic variation necessary for a population to adapt to a changing environment can be estimated using the concept of effective population size (N_e). Effective population size is the average number of individuals in a population which are assumed to contribute genes equally to the succeeding generation. Effective population size provides a standardized measure of the amount of genetic variation that is likely to be transmitted between generations within a population.

Specific benchmarks for bull trout have been developed concerning the minimum N_e necessary to maintain genetic variation important for short-term fitness and long-term evolutionary potential. These benchmarks are based on the results of a generalized, age-structured, simulation model, called VORTEX (Miller and Lacy 1999), used to relate effective population size to the number of adult bull trout spawning annually under a range of life histories and environmental conditions (Rieman and Allendorf 2001). Using the estimate that N_e for bull trout is between 0.5 and 1.0 times the mean number of adults spawning annually, Rieman and Allendorf (2001) concluded that (1) an average of 100 adults spawning each year would be required to minimize risks of inbreeding in a population, and (2) an average of 1,000 adults is necessary to maintain genetic variation important for long-term evolutionary potential. This latter value of 1,000 spawners may also be reached with a collection of local populations among which gene flow occurs.

Bull trout populations tend to show relatively little genetic variation within populations, but substantial divergence among populations (e.g., Spruell et al. 2003). For example, Spruell et al. (1999) found that bull trout at five different spawning sites within a tributary drainage of Lake Pend Oreille, Idaho, were differentiated based on genetic analyses (microsatellite DNA), indicating fidelity to spawning sites and relatively low rates of gene flow among sites. This type of genetic structuring indicates limited gene flow among bull trout populations, which may encourage local adaptation within individual populations (Spruell et al. 1999; Healey and Prince 1995; Hard 1995; Rieman and McIntyre 1993).

Current information on the distribution of genetic diversity within and among bull trout populations is based on molecular characteristics of individual genes. While such analyses are extremely useful, they may not reflect variability in traits whose expression is dependent on interactions among many genes and the environment (Hard 1995, Reed and Frankham 2001; but see Pfrender et al. 2000). Therefore, the maintenance of phenotypic variability (e.g., variability in body size and form, foraging efficiency, and timing of migrations, spawning, and maturation) may be best achieved by conserving populations, their habitats, and opportunities for the species to take advantage of habitat diversity (Healey and Prince 1995; Hard 1995).

Local adaptation may be extensive in bull trout because populations experience a wide variety of environmental conditions across the species' distribution, and because populations exhibit considerable genetic differentiation. Thus, conserving many populations across their range is essential to adequately protect the genetic and phenotypic diversity of bull trout (Hard 1995; Healey and Prince 1995; Taylor et al.1999; Rieman and McIntyre 1993; Spruell et al. 1999; Leary et al. 1993; Rieman and Allendorf 2001). If genetic and phenotypic diversity is lost, changes in habitats and prevailing environmental conditions could increase the likelihood of bull trout suffering reductions in numbers, reproductive capacity, and distribution.

Based on this information about the life history and conservation needs of bull trout, the Service concludes that each subpopulation or local population is an important genetic, phenotypic, and geographic component of its respective interim recovery unit. Adverse effects that compromise the persistence of a bull trout subpopulation or local population can reduce the distribution, as well as the phenotypic and genetic diversity of the unit.

4.4 Recovery Planning

Recovery plans developed by the Service typically contain the most detailed articulation of the conservation needs of listed species. The goal of the draft recovery plan for bull trout is to ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of bull trout distributed across the species' native range.

The recovery of bull trout will depend on the reduction of the adverse effects from dams, logging, agricultural practices, road building, urbanization, fisheries management, and by remedying legacy effects from past activities. Other general conservation needs described in the draft recovery plan, but not mentioned in the preceding paragraphs, include:

- Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout
- Establish fisheries management goals and objectives compatible with bull trout recovery, and implement practices to achieve those goals
- Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout (USFWS 2002).

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APPENDIX B: **Projects subject to prior Section 7 consultation in the Middle Methow Watershed*.**

Project Name	**FWS Reference**	**Date**
Coyote Timber Sale	01-03-1994-I-0138	December 30, 1993
Wolf Creek Grazing Renewal	01-03-1997-I-0410	
Wolf Creek Grazing Ongoing	01-03-1998-I-0398	August 24, 1998
Winthrop Administrative Site Land Exchange	01-03-1999-I-0190	February 10, 1999
Beaver, Finley, and Frazer Grazing Allotments	01-09-2000-I-0023	November 23, 1999
Fawn Timber Sale	01-03-2001-I-1238	August 25, 2001
Upper Methow New and Ongoing Activities	01-03-2002-I-0672	February 25, 2002
Irrigation Dam removals (private lands)	01-09-2003-I-W0189	June 26, 2003
Middle Methow New and Ongoing Projects	01-09-2004-I-W0323	June 1, 2004
Wolf Creek Diversion Enhancement Project	01-09-2004-F-W0518	February 25, 2005
Marracci Diversion and Ditch Piping	01-09-2005-I-W0389	October 12, 2005
Tripod Fire Salvage Project	13260-2007-I-0130	June 22, 2007
Blue Buck Hawkweed Project	13260-2008-F-0111	July 28, 2008
Methow Valley Irrigation District East Canal: Dam Removal and Wing Dam Renovation Project	13260-2008-F-0134	October 2, 2008
Methow River Restoration (COE Programmatic)	13260-2009-F-0137	August 14, 2009
Beaver Creek Restoration (COE Programmatic)	13260-2009-F-0138	August 14, 2009
Operskalski Restoration (COE Programmatic	13260-2009-I-0141	August 24, 2009

* This list does not include projects that were determined to have “no effect” on bull trout, or projects that were covered under the Programmatic for Selected Forest Management Activities (USFWS ref. 1-9-2003-I-W0102 and 1-09-2005-I-W0172). This programmatic covers only activities that result in “not likely to adversely affect” determinations, based on conformance with specific design criteria.

APPENDIX C: Projects subject to prior Section 7 consultation in the Chewuch Watershed that may have resulted in effects on bull trout or their habitat.*

Project Name	FWS Reference	Date
Doe Timber Sale	1-3-96-I-0333 1-3-98-CR-0132 -134	June 21, 1996 March 3 1998
Burgett Timber Sale	1-3-98-CR-0132 -134	March 3, 1998
Livestock Grazing (Cub Creek and Fawn allotments)	1-3-98-I-0394 to 0398	August 24, 1998
Winthrop Administrative Site Land Exchange	1-3-99-I-0190	February 9, 1999
Skyline Irrigation Company operations	1-3-99-F-1321 - 1323	September 29, 1999
Cub Creek Road Closures	1-3-01-I-0003	November 1, 2000
Ongoing activities and new actions	1-3-01-I-0072, 0074-0077	December 29, 2000
Thirty Mile Bridge	1-3-01-I-1785	July 1, 2001
Thirty Mile Memorial	1-3-02-I-0767	March 13, 2002
Thirty Mile Bridge Replacement	1-9-03-F-W0243	May 28, 2003
Skyline Ditch Company Special Use Permit Amendment	1-9-03-F-W0225	April 5, 2003
Hazard tree felling along 30-Mile Road	1-9-05-I-W0008 and 1-9-05-I-W0194	April 15, 2005
Chewuch Water Lease	1-9-05-I-W0339	August 5, 2005
Chewuch Diversion Dam Fish Passage Renovation	1-9-05-F-W0385	September 29, 2005
Tiffany, Ramsey, and East Chewuch Allotment Management Plan Revisions	13260-2006-I-0016	December 8, 2005
Eightmile Vegetation Management	13260-2006-I-0099	March 22, 2006
North Leroy Borrow Pit	13260-2006-I-0221	June 13, 2006
Fulton Diversion Dam Fish Passage Renovation	13260-2006-P-0025	October 31, 2006
Tripod Fire Salvage Project	13260-2007-I-0130	June 22, 2007
West Chewuch Road Relocation	13260-2007-I-0192	September 27, 2007
Fulton Diversion Ditch Piping and Rip Rap Repair	13260-2008-I-0013	November 7, 2007
Chewuch Diversion Dam Modification	13260-2008-F-0138	October 1, 2008
Fulton Diversion Dam Repair	13260-2009-I-0018	November 3, 2008
Cub Creek Bridge/Culvert	13260-2009-I-0090	April 27, 2009
Fulton Streambank Protection Repair	13260-2009-F-0116	July 13, 2009

Project Name	FWS Reference	Date
Twentymile Creek Ford Gradient Restoration (ARBO)	13260-2008-F-0138	August 26, 2009

* This list does not include projects that were determined to have "no effect" on bull trout, or projects that were covered under the Programmatic for Selected Forest Management Activities (USFWS ref. 1-9-2003-I-W0102, 1-09-2005-I-W0172, and 13260-2008-I-0133). This programmatic covers only activities that result in "not likely to adversely affect" determinations, based on conformance with specific design criteria.