BIOLOGICAL OPINION

for the

Effects to Bull Trout from Continued Implementation of Land and Resource Management Plans and Resource Management Plans as Amended by the Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana, and Portions of Nevada (INFISH), and the Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH).

Agencies

U.S. Forest Service (Regions 1,4, and 6)
Bureau of Land Management (OR, WA, ID, MT)

Consultation Conducted
by

U.S. Fish and Wildlife Service (Regions 1 and 6)

BIOLOGICAL OPINION
for the

Effects to Bull Trout from Continued Implementation of Land and Resource Management Plans and Resource Management Plans as Amended by the Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana, and Portions of Nevada (INFISH), and the Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH).

Agencies: U.S. Forest Service (Regions 1,4, and 6)
Bureau of Land Management (OR, WA, ID, MT)

Consultation Conducted By: U.S. Fish and Wildlife Service (Regions 1 and 6)

Date Issued: AUG 14

Approved By: _____
Regional Director, Region 1

_____
Deputy Regional Director, Region 6

Table of Contents

Topic		Page Number
I.	Background/Consultation History	2
II.	Biological Opinion	2
	Description of the Proposed Action	2
	Purpose and Function of LRMPs	3
	Amended LRMP Direction per PACFISH and INFISH	5
	LRMP Protections that Exceed Standards	6
	ACS Strategy — Components and Objectives	6
	Summary of the Management Area Categories	21
	Monitoring and Adaptive Management Provisions	22
	Additional Agency Commitments	23
III.	Status of the Species	26
	Listing History	26
	Description	27
	Status	27
	Historic and Current Distribution	28
	Life History Characteristics	29
	Habitat Requirements	29
IV.	Environmental Baseline	31
	Status of the Species Within the Action Area	32
	Klamath River Distinct Population Segment	33
	Columbia River Distinct Population Segment	34
	Threats to the Species	37
	Other Actions Considered in the Environmental Baseline	48
	PACFISH/INFISH Implementation	48
	Habitat Conservation Plans	50
	PL 104-19	51
	Non-federal actions in the Action Area	52
	Conservation Actions by non-Federal Entities	54
	Fisheries Management by Non-Federal Entities	56
V.	Effects of the Action	59
	Service Assumptions	59
	ACS Component-Related Effects	61
	Effects of Specific Management Actions	69
	Spatially Directed Effects--Management Area Categories	84
VI.	Cumulative Effects	90
VII.	Conclusion	91
VIII.	Incidental Take Statement	91
	Amount and Impacts of Anticipated Incidental Take	92
	Reasonable and Prudent Measures	94
	Terms and Conditions	96
IX.	Conservation Recommendations	99
X.	Closing Statement - Reinitiation	102

Topic		Page Number
XI.	Literature Cited	103
XII.	Appendices	122

Appendix 1. List of Major Documents used as Sources of Best Available Information.

Appendix 2. A Framework to Assist in Making Endangered Species Act Determinations of Effect for individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale. U.S. Fish and Wildlife Service. February 1998.

Appendix 3. Interagency letters of direction (dated January 27, 1998 and February 6, 1998) regarding the conference/consultation process for bull trout.

Appendix 4. October 28, 1997 letter to Russ Strach (NMFS) from Jack Williams (BLM).

Appendix 5. Habitat Characteristics Important to Bull Trout (Temperature, Habitat Complexity, Connectivity, Substrate Composition and Stability), and Management Issues (Roads, Floodplain and Riparian Protection) That Affect These Habitat Characteristics.

Appendix 6. Interagency memorandum (dated June 19, 1998) to amend the biological assessment for the PACFISH/INFISH LRMP Section 7 consultation on bull trout.

Biological Opinion
for the
EFFECTS TO BULL TROUT FROM CONTINUED IMPLEMENTATION OF LAND AND RESOURCE MANAGEMENT PLANS AND RESOURCE MANAGEMENT PLANS AS AMENDED BY THE INTERIM STRATEGY FOR MANAGING FISH-PRODUCING WATERSHEDS IN EASTERN OREGON AND WASHINGTON, IDAHO, WESTERN MONTANA, AND PORTIONS OF NEVADA (INFISH), AND THE INTERIM STRATEGY FOR MANAGING ANADROMOUS FISH-PRODUCING WATERSHEDS IN EASTERN OREGON AND WASHINGTON, IDAHO, AND PORTIONS OF CALIFORNIA (PACFISH).

INTRODUCTION

The U.S. Fish and Wildlife Service (Service) has reviewed the biological assessment (BA) addressing effects to the threatened bull trout (*Salvelinus confluentus*) from continued implementation of U.S. Forest Service (USFS) Land and Resource Management Plans (LRMPs) and Bureau of Land Management (BLM) Resource Management Plans (RMPs) as amended by the Interim Strategy for Managing Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada (INFISH: USDA and USDI 1995a) and the Interim Strategy for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH: USDA and USDI 1995b). A June 15, 1998 request for consultation from the USFS and BLM was received on June 16, 1998. Activities administered by the USFS are carried out under the existing direction of LRMPs. BLM activities are administered under the direction of RMPs or Management Framework Plans. For convenience, all plan documents are referred to in this document as LRMPs.

This document represents the Service's biological opinion (BO) on the effects of continued implementation of the LRMPs as amended by PACFISH and INFISH on listed bull trout in accordance with section 7 of the Endangered Species Act of 1973, as amended (ESA)(16 U.S.C. 1531 et seq.). This BO is based on the information provided in the June 15, 1998 BA (USDA and USDI 1998a) and a June 19, 1998 letter amending the BA (USDA and USDI 1998b). In the BA, the USFS and BLM determined that the action is not likely to jeopardize the continued existence of the listed species, but that it may affect and likely adversely affect the bull trout. No critical habitat has been designated for this species, therefore, none was determined to be affected.

In addition to the information contained in the BA, the best available information from several other sources was used in this analysis. A list of those sources is included in Appendix 1. A complete administrative record of this consultation is on file in the Service's Oregon State Office, 2600 S.E. 98th Avenue, Suite 100, Portland, Oregon 97266.

The BA and transmittal letter also requested consultation on the effects of the LRMPs on

proposed critical habitat for the Lost River (*Deltistes luxatus*) and shortnose suckers (*Chasmistes brevirostris*). However, the Service, USFS and BLM subsequently agreed to confine this opinion to bull trout, and evaluate the effects to proposed critical habitats for the two sucker species in a separate conference opinion to be prepared at a later date. In addition, the analysis in the BA addressed the effects of the LRMPs on the Jarbidge River population of bull trout, which was proposed for listing as threatened on June 10, 1998 (USDI 1998b). Conferencing on bull trout for this DPS will also be addressed in a separate conference opinion.

In a separate plan-level programmatic BO, the Service is providing similar analyses of the effects of continued implementation of the USFS LRMPs and BLM RMPs, as amended by the Northwest Forest Plan Record of Decision (USDA and USDI 1994).

I. BACKGROUND/CONSULTATION HISTORY

The bull trout was proposed for listing as threatened in the Columbia River Basin and endangered in the Klamath River Basin on June 13, 1997 (USDI 1997). The final rule listing the Klamath and Columbia River Basin distinct population segments (DPSs) of bull trout as threatened was published on June 10, 1998 (USDI 1998a). The effective date of the listing was July 10, 1998.

Section 7 regulations (50 CFR §402.16) require reinitiation of formal consultation where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and a new species is listed or critical habitat designated that may be affected by the action. This BO addresses the effects of continued implementation of the LRMPs as amended by PACFISH and INFISH standards and guidelines where listed DPSs of bull trout occur in Idaho, Montana, Oregon, and Washington.

II. BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Recent decisions by the USFS and BLM have resulted in the addition of interim aquatic strategies to LRMPs within the geographic range of the Columbia and Klamath River bull trout DPSs. Forests and BLM Districts with anadromous fish have modified their LRMPs either through amendment (USFS) or instruction memorandum (BLM) by the PACFISH. The USFS, through the INFISH, amended LRMPs where PACFISH was not already in place. The BLM, via instructional memoranda, applied INFISH direction to bull trout watersheds. The agencies also consult on site-specific actions conducted under the direction of the LRMPs that may affect listed species. This BO addresses LRMPs, as modified by PACFISH and INFISH, for the Columbia and Klamath River bull trout DPSs. Additional features of the proposed action were provided by letter dated June 19, 1998 (USDA and USDI 1998b) and considered as part of the proposed action. Among the DPSs, this BO considers the effects to bull trout from 24 USFS and 16 BLM LRMPs in the states of Washington, Oregon, Idaho, Montana, and Nevada.

Purpose and Function of LRMPs

Within the range of the DPSs of bull trout, LRMPs provide direction and standards for broad classes of project activities and land and water management practices that may affect bull trout. LRMPs provide policy guidance for various federal activities carried out on the forest or management area. While all of the USFS and BLM administrative units implement many of the same land-use practices, the level of activities and outputs will vary depending on local conditions. Although LRMPs set important parameters for authorization of specific projects, with some exceptions, LRMPs do not themselves authorize the projects. Actual authorization of projects depends on analysis of site-specific effects, and consistency with appropriate management direction and applicable legal requirements.

The action area encompasses all or parts of the following National Forests (NF) of the USFS, and Resource Areas (RA) of the BLM for the Columbia River and Klamath River DPSs of bull trout (USDA and USDI 1998a). These are:

Agency	DPS	Administrative unit (region or state)
USFS	Columbia River	Colville NF, Deschutes NF, Malheur NF, Ochoco NF, Okanogan NF, Umatilla NF, Wallowa-Whitman NF, Wenatchee NF, and Columbia River Gorge National Scenic Area (Pacific Northwest Region); Bitterroot NF, Clearwater NF, Flathead NF, Helena NF, Kootenai NF, Lolo NF, Beaverhead-Deerlodge NF, Idaho Panhandle NF, Nez Perce NF (Northern Region); Boise NF, Payette NF, Salmon-Challis NF, Sawtooth NF (Intermountain Region)
	Klamath River	Fremont NF, Winema NF (Pacific Northwest Region)
BLM	Columbia River	Baker RA, Central Oregon RA, Deschutes RA, Three Rivers RA, Malheur RA, Border RA, Wenatchee RA, (Washington-Oregon); Cascade RA, Cottonwood RA, Emerald Empire RA, Shoshone RA, Big Butte RA, Lemhi RA, Challis RA (Idaho); Garnet RA (Montana)
	Klamath River	Klamath Falls RA (Washington-Oregon)

LRMPs provide direction and standards for a large variety of projects and types of activities, including forest management, recreation, range management, mining, watershed restoration, fish and wildlife habitat management, fire and fuels management, land exchanges and acquisitions, and a variety of special uses. Specific actions associated with these program activities are described below.

Forest management generally consists of two categories of activities: timber harvest and associated actions, and silvicultural treatments used to develop desirable stand characteristics. Timber harvest and associated actions can include: road construction, landing construction, renovation and use, including quarry operation; yarding and skidding logs; clear-cutting or thinning treatments; salvage of dead or dying trees, and maintenance of existing roads. Road maintenance includes surface maintenance (blading), surface replacement, drainage maintenance and repair, vegetation management (brushing, limbing, seeding and mulching along roadways), slide repair, sign maintenance and repair, and maintenance, replacement and repair of major structures (bridges and major culverts). Silvicultural treatments include planting, prescribed burning, plantation maintenance and release (density management, precommercial thinning and control of competing vegetation), animal damage control, and fertilization.

Recreation consists of activities that provide for a wide range of developed and dispersed recreational opportunities. Developed recreation actions include campground maintenance, and recreation site and trail construction/maintenance. Dispersed activities include general public use of Federal lands (hunting, fishing, camping, hiking, etc), environmental education, and management of off-highway vehicles.

Range management activities on Federal lands include livestock grazing, and rangeland improvements (fencing, water development, livestock handling facilities, and vegetation management). Noxious weed control programs may be implemented in association with range management or other actions, such as silvicultural treatments.

Mining consists of two broad categories based on the method of extraction. Surface mining includes dredging, dispersed gold panning, and pit mining while underground mining utilizes tunnels or shafts to extract minerals. Activities associated with mining include roads and supporting structures and facilities, hazardous chemicals, water use and treatment.

Watershed restoration actions on Federal lands are an integral part of management to aid in the recovery of watershed health and water quality. Road decommissioning, road drainage improvement, surfacing, culvert upgrades, and sediment source stabilization through seeding and planting are typical restoration actions.

Fish and wildlife management actions on Federal lands may include stream and riparian habitat surveys; surveys for fish (smolt traps, snorkling, spawning ground counts, electrofishing), amphibians, and fish habitat projects such as direct habitat improvements to increase habitat complexity, riparian planting, channel and bank stabilization, and fish passage improvements. Typical wildlife management activities include winter range burning, access management, snag management, tree topping and falling, and water developments.

Fire and fuels management actions include the suppression of wildfire and prescribed fire used to meet resource management objectives. Prescribed burning is used for fuels management for wildfire hazard reduction (underburning), restoration of desired vegetation conditions,

management of habitat and silvicultural treatments, i.e., site preparation (broadcast burning or pile burning). Pump chances, or water withdrawal sites, are created as water sources for fire suppression. Usually located next to roads, these sites are typically small excavated ponds or short spurs for vehicle access to streams or lakes.

Land exchanges and acquisitions are made to benefit a variety of uses and values. Land tenure adjustments are made to improve public access, acquire important habitats or resources and improve the efficiency of managing Federal lands.

Because Federal lands are a source of forest products for domestic and commercial uses, a variety of special uses occur on Federal lands. Some products include Christmas trees, firewood, mushrooms, ferns, boughs, mosses and similar products. Both the USFS and BLM administrative units issue permits for the collection of these products.

The USFS and BLM also issue a variety of permits for the use of Federal lands. Permits may be issued for utility and powerline corridors, communications sites, domestic and municipal water lines and diversions, and hydroelectric facilities. Road use permits are issued to allow for the transportation of commercial commodities on FS and BLM managed roads. Road right-of-ways are issued to private individuals and companies for the construction and use of access roads across Federal lands.

Because a wide variety of activities and projects are directed by the amended LRMPs, and many of these require interdisciplinary team development, watershed analysis, compliance with the National Forest Management Act (NFMA) and National Environmental Policy Act (NEPA) and other analysis and documentation before they can proceed, it is not the Service's intent to fully evaluate effects of individual projects in this BO. This BO focuses primarily (and necessarily quite broadly) on the land management direction, standards and guidelines (S&Gs), objectives, assumptions, and major components of LRMPs, PACFISH and INFISH ACS components, and individual LRMP standards that may affect bull trout. Individual projects that may affect bull trout are subject to Endangered Species Act requirements, and will be addressed as agreed to in the January 27, 1998 letter of direction.

Amended LRMP Direction For PACFISH and INFISH

PACFISH and INFISH provide programmatic direction for management of lands administered by the USFS and BLM. Both are interim strategies intended to provide protection against extinction or further endangerment of fish stocks and to maintain long-term management options, such as those being considered by the Interior Columbia Basin Ecosystem Management Project (ICBEMP) Draft Environmental Impact Statement.

PACFISH and INFISH share similar goals, objectives, standards, and guidelines, which are collectively considered the ACS. For PACFISH, management direction is applied to all

proposed and ongoing management activities for the mitigation of environmental effects relative to the ACS. Seven general components of the ACS are:

1. Establish riparian goals and objectives to maintain and restore fish habitat.
2. Delineate Riparian Habitat Conservation Areas (RHCAs).
3. Establish standards and guidelines for the management of RHCAs.
4. Establish criteria and process to designate key watersheds.
5. Establish criteria and process to guide watershed analysis.
6. Emphasize the need for watershed restoration actions
7. Establish requirements for effectiveness and implementation monitoring.

Similar components are included in INFISH. However, application of PACFISH and INFISH strategies differs between the USFS and BLM. For the USFS, the strategies are amended to regional guides and LRMPs, whereas the BLM addresses the strategies through instruction memoranda for individual states.

LRMP Protections that Exceed Plan Standards

Some USFS and BLM administrative units had existing LRMP management direction specific to aquatic resources that was more stringent than that contained in the INFISH and PACFISH ACS. Based on USDA and USDI (1998a), the majority of the National Forests (16) reported standards and guidelines or specific management direction that were more stringent than those provided by amendment with the ACS. These specific measures came about either through actions implemented to benefit other threatened, endangered or sensitive species, such as salmon and grizzly bear, or specific standards for aquatic habitat management. The majority of the BLM administrative units that responded to requests indicated no specific standards or guidelines more stringent than exists in LRMPs amended by the aquatic strategies. Those BLM units reporting more restrictive management guidelines (4) indicated they were a result of specific management area plans prior to the implementation of the ACS and measures brought about through consultation for listed salmon stocks.

ACS Strategy - Components and Objectives

The ACS strategy includes aspects designed to provide for protection of aquatic species and their habitats.

1. Riparian Goals--Riparian goals establish an expectation of the characteristics of healthy, functioning watersheds, riparian areas, and associated fish habitats. Because the quality of water and fish habitat in aquatic systems is inseparably related to the integrity of upland and riparian areas within the watersheds, the goals encompass both aquatic and terrestrial processes. The goals are to maintain or restore:
   (1) water quality, to a degree that provides for stable and productive riparian and aquatic ecosystems;

(2) stream channel integrity, channel processes, and the sediment regime (including the elements of timing, volume, and character of sediment input and transport) under which the riparian and aquatic ecosystems developed;

(3) instream flows to support healthy riparian and aquatic habitats, the stability and effective function of stream channels, and the ability to route flood discharges;

(4) natural timing and variability of the water table elevation in meadows and wetlands;

(5) diversity and productivity of native and desired non-native plant communities in riparian zones;

(6) riparian vegetation, to:

  (a) provide an amount and distribution of large woody debris characteristic of natural aquatic and riparian ecosystems;

  (b) provide adequate summer and winter thermal regulation within the riparian and aquatic zones; and

  (c) help achieve rates of surface erosion, bank erosion, and channel migration characteristic of those under which the communities developed.

(7) riparian and aquatic habitats necessary to foster the unique genetic fish stocks that evolved within the specific geo-climatic region; and

(8) habitat to support populations of well-distributed native and desired non-native plant, vertebrate, and invertebrate populations that contribute to the viability of riparian-dependent communities.

2. Riparian Management Objectives (RMOs)--In the development of PACFISH, landscape-scale interim RMOs describing good habitat for anadromous fish were developed, using stream inventory data for pool frequency, large woody debris, bank stability and lower bank angle, and width to depth ratio. Applicable published and unpublished scientific literature was used to define favorable water temperatures. All of the described features may not occur in a specific segment of stream within a watershed, but all generally should occur at the watershed scale for stream systems of moderate to large size (3rd to 6th order streams).

This material was reviewed in regard to its applicability to inland native fish. It has been determined that the RMOs described in PACFISH are good indicators of ecosystem health. The analysis that led to development of the RMOs involved watersheds in Oregon, Washington, and Idaho that include inland native fish as well as anadromous fish. With the exception of the temperature objective, which has been modified, the RMOs represented a good starting point to describe the desired condition for fish habitat.

Under INFISH, these interim RMOs apply where watershed analysis has not been completed. The components of good habitat can vary across specific geographic areas. Interim RMOs are considered to be the best watershed scale information available; Federal land managers are encouraged to establish site-specific RMOs through watershed analysis or site-specific analysis.

RMOs should be refined to better reflect conditions that are attainable in a specific watershed or stream reach based on local geology, topography, climate, and potential vegetation. Establishment of RMO's requires completion of watershed analysis to provide the ecological basis for the change. However, interim RMOs may be modified by amendment in the absence of watershed analysis where watershed or stream reach specific data support the change. In all cases, the rationale supporting RMOs and their effects are documented.

The interim RMOs for stream channel conditions provide the criteria against which attainment or progress toward attainment of the riparian goals is measured. Interim RMOs provide the target toward which managers aim as they conduct resource management activities across the landscape. It is not expected that the objectives would be met instantaneously, but rather would be achieved over time. However, the intent of interim RMOs is not to establish a ceiling for what constitutes good habitat conditions. In addition, interim RMOs are meant to lead to watershed specific RMOs developed through watershed analysis. Actions that reduce habitat quality, whether existing conditions are better or worse than objective values, would be inconsistent with the purpose of this interim direction. Without the benchmark provided by measurable RMOs, habitat may suffer continual erosion.

As indicated below, some of the objectives would apply to only forested ecosystems, some to non-forested ecosystems, and some to all ecosystems regardless of whether or not they are forested. Objectives for relevant environmental features have been identified, including one key feature and five supporting features. These features are good indicators of ecosystem health, are quantifiable, and are subject to accurate, repeatable measurements. They generally apply to 3rd to 6th order watersheds.

Under the ACS, interim RMOs would apply to watersheds occupied by anadromous and inland native fish. Application of the interim RMOs would require thorough analysis. That is, if the objective for an important feature such as pool frequency is met or exceeded, there may be some latitude in assessing the importance of the objectives for other features that contribute to good habitat conditions. For example, in headwater streams with an abundance of pools created by large boulders, fewer pieces of large wood might still constitute good habitat. The goal is to achieve a high level of habitat diversity and complexity through a combination of habitat features to meet the life-history requirements of the fish community inhabiting a watershed. Specific RMOs address pool frequency that varies by channel width, water temperature, large woody debris, bank stability, lower bank angle, and stream width/depth ratio, as examples.

3. Riparian Habitat Conservation Areas (RHCAs)--Interim RHCAs would be delineated in every watershed on USFS and BLM lands within the geographic range of bull trout. RHCAs are portions of watersheds where riparian-dependent resources receive primary emphasis, and management activities are subject to specific S&Gs. RHCAs include

traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems by (1) influencing the delivery of coarse sediment, organic matter, and woody debris to streams; (2) providing root strength for channel stability; (3) shading the stream; and (4) protecting water quality (Naiman et al. 1992).

The RHCAs under the ACS strategy would be nearly identical to those under the Idaho Conservation Strategy (Idaho Department of Fish and Game (IDFG) 1995). The main difference is that, under the Idaho Conservation Strategy, RHCAs would apply only in key watersheds. However, since their key watersheds are large and cover much of the National Forest System lands in Idaho, there would be little difference between the two Strategies in regard to RHCAs in Conservation Areas within occupied bull trout habitat.

Widths of interim RHCAs that are adequate to protect streams from non-channelized sediment inputs should be sufficient to provide other riparian functions, including delivery of organic matter and woody debris, stream shading, and bank stability (Brazier and Brown 1973, Gregory et al. 1984, Steinblums et al. 1984, Beschta et al. 1987, McDade et al. 1990, Sedell and Beschta 1991, Belt et al. 1992). The effectiveness of riparian conservation areas in influencing sediment delivery from non-channelized flow is highly variable. A review by Belt et al. (1992) of studies in Idaho (Haupt 1959a, 1959b; Ketcheson and Megehan 1996; Burroughs and King 1985, 1989; and elsewhere (Trimble and Sartz 1957, Packer 1967, Swift 1986) concluded that non-channelized sediment flow rarely travels more than 300 feet and that 200-300 foot riparian "filter strips" are generally effective at protecting streams from sediment from non-channelized flow.

Interim RHCA widths apply where watershed analysis has not been completed. Site-specific widths may be increased where necessary to achieve riparian management goals and objectives, or decreased where interim widths are not needed to attain RMOs or avoid adverse effects. Establishment of RHCAs would require completion of watershed analysis to provide the ecological basis for the change. However, interim RHCAs may be modified by amendment in the absence of watershed analysis where stream reach or site-specific data support the change. In all cases, the rationale supporting RHCA widths and their effects are documented.

The standard widths of interim RHCAs fall into four categories of stream or water bodies:

> *Category 1 - Fish-bearing streams*: Interim RHCAs consist of the stream and the area on either side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet, including both sides of the stream channel), whichever is greatest.

Category 2 - Permanently flowing non-fish-bearing streams: Interim RHCAs consist of the stream and the area on either side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year flood plain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet, including both sides of the stream channel), whichever is greatest.

Category 3 - Ponds, lakes, reservoirs, and wetlands greater than 1 acre: Interim RHCAs consist of the body of water or wetland and the area to the outer edges of the riparian vegetation, or to the extent of the seasonally saturated soil, or to the extent of moderately and highly unstable areas, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance from the edge of the maximum pool elevation of constructed ponds and reservoirs or from the edge of the wetland, pond or lake, whichever is greatest.

Category 4 - Seasonally flowing or intermittent streams, wetlands less than 1 acre, landslides, and landslide-prone areas: This category includes features with high variability in size and site-specific characteristics.

At a minimum, the interim RHCAs must include:

a. the extent of landslides and landslide-prone areas;

b. the intermittent stream channel and the area to the top of the inner gorge;

c. the intermittent stream channel or wetland and the area to the outer edges of the riparian vegetation;

d. for Priority Watersheds, the area from the edges of the stream channel, wetland, landslide, or landslide-prone area to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest;

e. for watersheds not identified as Priority Watersheds, the area from the edges of the stream channel, wetland, landslide, or landslide-prone area to a distance equal to the height of one-half site potential tree, or 50 feet slope distance, whichever is greatest.

In non-forested rangeland ecosystems, the interim RHCA width for permanently flowing streams in categories 1 and 2 is the extent of the 100-year flood plain.

4. Standards and Guidelines— S&Gs of the ACS apply to all RHCAs and to projects and activities in areas outside of RHCAs that would degrade conditions in RHCAs. The

S&Gs address ten management issues in RHCAs and associated areas: timber management, roads management, grazing management, recreation management, minerals management, fire and fuels management, lands, general riparian area management, watershed and habitat restoration, and fisheries and wildlife restoration.

Timber Management

TM-1. Prohibit timber harvest, including fuelwood cutting, in RHCAs, except as described below. Do not include RHCAs in the land base used to determine the Allowable Sale Quantity, but any volume harvested can contribute to the timber sale program.

a. Where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuelwood cutting in RHCAs only where present and future woody debris needs are met, where cutting would not retard or prevent attainment of other Riparian Management Objectives, and where adverse effects on listed anadromous fish can be avoided. For watersheds with listed salmon or designated critical habitat, complete Watershed Analysis prior to salvage cutting in RHCAS.

b. Apply silvicultural practices for RHCA to acquire desired vegetation characteristics where needed to attain RMOs. Apply silvicultural practices in a manner that does not retard attainment of RMOs and that avoids adverse effects on listed anadromous fish.

Roads Management

RF-1. Cooperate with Federal, Tribal, State, and county agencies, and cost-share partners to achieve consistency in road design, operation, and maintenance necessary to attain RMOs.

RF-2. For each existing or planned road, meet the RMOs and avoid adverse effects on listed anadromous fish by:

a. completing Watershed Analyses prior to construction of new roads or landings in RHCA.

b. minimizing road and landing locations in RHCA.

c. initiating development and implementation of a Road Management Plan or a Transportation Management Plan. At a minimum, address the following items in the plan:

1. Road design criteria, elements, and standards that govern construction and reconstruction.

2. Road management objectives for each road.

3. Criteria that govern road operation, maintenance, and management.

4. Requirements for pre-, during-, and post-storm inspections and maintenance.

5. Regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives.

6. Implementation and effectiveness monitoring plans for road stability, drainage, and erosion control.

7. Mitigation plans for road failures.

d. avoiding sediment delivery to streams from the road surface.

1. Outsloping of the roadway surface is preferred, except in cases where outsloping would increase sediment delivery to streams or where outsloping is infeasible or unsafe.

2. Route road drainage away from potentially unstable stream channels, fills, and hillslopes.

e. avoiding disruption of natural hydrologic flow paths.

f. avoiding sidecasting of soils or snow. Sidecasting of road material is prohibited on road segments within or abutting RHCAs in watersheds containing designated critical habitat for listed anadromous fish.

RF-3. Determine the influence of each road on the RMOs. Meet RMOs and avoid adverse effects on listed anadromous fish by:

a. reconstructing road and drainage features that do not meet design criteria or operation and maintenance standards, or that have been shown to be less effective than designed for controlling sediment delivery, or that retard attainment of RMOs, or do not protect designated critical habitat for listed anadromous fish from increased sedimentation.

b. prioritizing reconstruction based on the current and potential damage to listed

anadromous fish and their designated critical habitat, the ecological value of the riparian resources affected, and the feasibility of options such as helicopter logging and road relocation out of RHCA.

c. closing and stabilizing or obliterating, and stabilizing roads not needed for future management activities. Prioritize these actions based on the current and potential damage to listed anadromous fish and their designated critical habitat, and the ecological value of the riparian resources affected.

RF-4. Construct new, and improve existing, culverts, bridges, and other stream crossings to accommodate a 100-year flood, including associated bedload and debris, where those improvements would/do pose a substantial risk to riparian conditions. Substantial risk improvements include those that do not meet design and operation maintenance criteria, or that have been shown to be less effective than designed for controlling erosion, or that retard attainment of RMOs, or that do not protect designated critical habitat from increased sedimentation. Base priority for upgrading on risks to listed anadromous fish and their designated critical habitat and the ecological value of the riparian resources affected. Construct and maintain crossings to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure.

RF-5. Provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams.

Grazing Management

GM-1. Modify grazing practices (e.g., accessibility of riparian areas to livestock, length of grazing season, stocking levels, timing of grazing, etc.) that retard or prevent attainment of RMOs or are likely to adversely affect listed anadromous fish. Suspend grazing if adjusting practices is not effective in meeting RMOs and avoiding adverse effects on listed anadromous fish.

GM-2. Locate new livestock handling and/or management facilities outside of RHCA. For existing livestock handling facilities inside the RHCA, assure that facilities do not prevent attainment of RMOs or adversely affect listed anadromous fish. Relocate or close facilities where these objectives cannot be met.

GM-3. Limit livestock trailing, bedding, watering, salting, loading, and other handling efforts to those areas and times that will not retard or prevent attainment of RMOs or adversely affect listed anadromous fish.

GM-4. Adjust wild horse and burro management to avoid impacts that prevent attainment of RMOs or adversely affect listed anadromous fish.

Recreation Management

RM-1. Design, construct, and operate recreation facilities, including trails and dispersed sites, in a manner that does not retard or prevent attainment of the RMOs and avoids adverse effects on listed anadromous fish. Complete Watershed Analysis prior to construction of new recreation facilities in RHCA. For existing recreation facilities inside RHCA, assure that the facilities or use of the facilities will not prevent attainment of RMOs or adversely affect listed anadromous fish. Relocate or close recreation facilities where RMOs cannot be met or adverse effects on listed anadromous fish avoided.

RM-2. Adjust dispersed and developed recreation practices that retard or prevent attainment of RMOs or adversely affect listed anadromous fish. Where adjustment measures such as education, use limitations, traffic control devices, increased maintenance, relocation of facilities, and/or specific site closures are not effective in meeting RMOs and avoiding adverse effects on listed anadromous fish, eliminate the practice or occupancy.

RM-3. Address attainment of RMOs and potential effect on listed anadromous fish and designated critical habitat in Wild and Scenic Rivers, Wilderness, and other Recreation Management plans.

Minerals Management

MM-1. Avoid adverse effects to listed species and designated critical habitat from mineral operations. If the Notice of Intent indicates a mineral operation would be located in a RHCA, or could affect attainment of RMOs, or adversely affect listed anadromous fish, require a reclamation plan, approved Plan of Operations (or other such governing document), and reclamation bond. For effects that cannot be avoided, such plans and bonds must address the costs of removing facilities, equipment, and materials; recontouring disturbed land to near pre-mining topography; isolating and neutralizing or removing toxic or potentially toxic materials; salvage and replacement of topsoil; and seed bed preparation and revegetation to attain RMOs and avoid adverse effects on listed anadromous fish. Ensure Reclamation Plans contain measurable attainment and bond release criteria for each reclamation activity.

MM-2. Locate structures, support facilities, and roads outside RHCAs. Where no alternative to siting facilities in RHCAs exists, locate and construct the facilities in ways that avoid impacts to RHCAs and streams adverse effects on listed anadromous fish. Where no alternative to road construction exists, keep roads to the minimum necessary for the approved mineral activity. Close, obliterate and revegetate roads no longer required for mineral or land management activities.

MM-3. Prohibit solid and sanitary waste facilities in RHCAs. If no alternative to locating mine waste (waste rock, spent ore, tailings) facilities in RHCA exists, and releases can be

prevented and stability can be ensured, then:

a. analyze the waste material using the best conventional sampling methods and analytic techniques to determine its chemical and physical stability characteristics.

b. locate and design the waste facilities using the best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials. If the best conventional technology is not sufficient to prevent such releases and ensure stability over the long term, prohibit such facilities in RHCA.

c. monitor waste and waste facilities to confirm predictions of chemical and physical stability, and make adjustments to operations as needed to avoid adverse effects to listed anadromous fish and to attain RMOs.

d. reclaim and monitor waste facilities to assure chemical and physical stability and revegetation to avoid adverse effects to listed anadromous fish and to attain the RMOs.

e. require reclamation bonds adequate to ensure long-term chemical or physical stability and successful revegetation of mine waste facilities.

MM-4 For leasable minerals, prohibit surface occupancy within RHCA for oil, gas, and geothermal exploration and development activities where contracts and leases do not already exist, unless there are no other options for location and RMOs can be attained and adverse effects to listed anadromous fish can be avoided. Adjust the operating plans of existing contracts to (1) eliminate impacts that prevent attainment of RMOs and (2) avoid adverse effects to listed anadromous fish.

MM-5 Permit sand and gravel mining and extraction within RHCA only if no alternatives exist, if the action(s) will not retard or prevent attainment of RMOs, and adverse effects to listed anadromous fish can be avoided.

MM-6 Develop inspection, monitoring, and reporting requirements for mineral activities. Evaluate and apply the results of inspection and monitoring to modify mineral plans, leases, or permits as needed to eliminate impacts that prevent attainment of RMOs and avoid adverse effects on listed anadromous fish.

Fire/Fuels Management

FM-1. Design fuel treatment and fire suppression strategies, practices, and actions so as not to prevent attainment of RMOs, and to minimize disturbance of riparian ground cover and vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could perpetuate or be

damaging to long-term ecosystem function, listed anadromous fish, or designated critical habitat.

FM-2. Locate incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities outside of RHCA. If the only suitable location for such activities is within the RHCA, an exemption may be granted following a review and recommendation by a resource advisor. The advisor will prescribe the location, use conditions, and rehabilitation requirements, with avoidance of adverse effects to listed anadromous fish a primary goal. Use an interdisciplinary team, including a fishery biologist, to predetermine incident base and helibase locations during pre-suppression planning, with avoidance of potential adverse effects to listed anadromous fish a primary goal.

FM-3. Avoid delivery of chemical retardant, foam, or additives to surface waters. An exception may be warranted in situations where overriding immediate safety imperatives exist, or, following a review and recommendation by a resource advisor, and a fishery biologist, when the action agency determines an escape fire would cause more long-term damage to anadromous fish habitats than chemical delivery to surface waters.

FM-4. Design prescribed burn projects and prescriptions to contribute to the attainment of the RMOs.

FM-5. Immediately establish an emergency team to develop a rehabilitation treatment plan to attain RMOs and avoid adverse effects on listed anadromous fish whenever RHCA are significantly damaged by a wildfire or a prescribed fire burning out of prescription.

Lands

LH-1. Require instream flows and habitat conditions for hydroelectric and other surface water development proposals that maintain or restore riparian resources, favorable channel conditions, and fish passage, reproduction, and growth. Coordinate this process with the appropriate State agencies. During relicensing of hydroelectric projects, provide written and timely license conditions to the Federal Energy Regulatory Commission (FERC) that require fish passage and flows and habitat conditions that maintain/restore riparian resources and channel integrity. Coordinate relicensing projects with the appropriate State agencies.

LH-2. Locate new hydroelectric ancillary facilities outside RHCA. For existing ancillary facilities inside the RHCA that are essential to proper management, provide recommendations to FERC to assure that the facilities will not prevent attainment of the RMOs and that adverse effects on listed anadromous fish are avoided. Where these objectives cannot be met, provide recommendations to FERC that such ancillary facilities should be relocated. Locate, operate, and maintain hydroelectric facilities that must be located in RHCA to avoid effects that would retard or prevent attainment of the RMOs

and avoid adverse effects on listed anadromous fish.

LH-3. Issue leases, permits, rights-of-way, and easements to avoid effects that would retard or prevent attainment of the RMOs and avoid adverse effects on listed anadromous fish. Where the authority to do so was retained, adjust existing leases, permits, rights-of-way, and easements to eliminate effects that would retard or prevent attainment of the RMOs or adversely affect listed anadromous fish. If adjustments are not effective, eliminate the activity. Where the authority to adjust was not retained, negotiate to make changes in existing leases, permits, rights-of-way, and easements to eliminate effects that would prevent attainment of the RMOs or adversely affect listed anadromous fish. Priority for modifying existing leases, permits, rights-of-way, and easements will be based on the current and potential adverse effects on listed anadromous fish and the ecological value of the riparian resources affected.

LH-4. Use land acquisition, exchange, and conservation easements to meet RMOs and facilitate restoration of fish stocks and other species at risk of extinction.

General Riparian Area Management

RA-1. Identify and cooperate with Federal, Tribal, State and local governments to secure instream flows needed to maintain riparian resources, channel conditions, and aquatic habitat.

RA-2. Trees may be felled in RHCA when they pose a safety risk. Keep felled trees on site when needed to meet woody debris objectives.

RA-3. Apply herbicides, pesticides, and other toxicants, and other chemicals in a manner that does not retard or prevent attainment of RMOs and avoids adverse effects on listed anadromous fish.

RA-4. Prohibit storage of fuels and other toxicants within RHCA. Prohibit refueling within RHCA unless there are no other alternatives. Refueling. sites within a RHCA must be approved by the USFS or BLM and have an approved spill containment plan.

RA-5. Locate water drafting sites to avoid adverse effects to listed anadromous fish and instream flows, and in a manner that does not retard or prevent attainment of RMOs.

Watershed and Habitat Restoration

WR-1. Design and implement watershed restoration projects in a manner that promotes the long-term ecological integrity of ecosystems, conserves the genetic integrity of native species, and contributes to attainment of RMOs.

WR-2. Cooperate with Federal, State, local, and Tribal agencies, and private landowners to develop watershed-based Coordinated Resource Management Plans (CRMPS) or other cooperative agreements to meet RMOs.

WR-3. Do not use planned restoration as a substitute for preventing habitat degradation (i.e., use planned restoration only to mitigate existing prob not to mitigate the effects of proposed activities).

Fisheries and Wildlife Restoration

FW-1. Design and implement fish and wildlife habitat restoration and enhance actions in a manner that contributes to attainment of the RMOs.

FW-2. Design, construct, and operate fish and wildlife interpretive and other user-enhancement facilities in a manner that does not retard or prevent attainment of the RMOs or adversely affect anadromous fish. For existing fish and wildlife interpretive and other user-enhancement facilities inside RHCA assure that RMOs are met and adverse effects on listed anadromous fish are avoided. Where RMOs cannot be met or adverse effects on listed anadromous fish avoided, relocate or close such facilities.

FW-3. Cooperate with Federal, Tribal, and State wildlife management agencies to identify and eliminate wild ungulate impacts that prevent attainment of RMOs or adversely affect listed anadromous fish.

FW-4. Cooperate with Federal, Tribal, and State fish management agencies to identify and eliminate adverse effects on native anadromous fish associated with habitat manipulation, fish stocking, fish harvest, and poaching.

5. Key and Priority Watersheds--Key and priority watersheds are important to "at risk" fish. These watersheds are considered to be currently in good condition, or have a high potential for restoration. Both key (PACFISH) and priority watersheds (INFISH) are equivalent in the ACS relative to bull trout.

In both PACFISH and INFISH, the ACS is designed to conserve fish populations by protecting and recovering aquatic habitat on Federal lands. All watersheds with listed anadromous fish or critical habitat for listed anadromous fish are designated as key watersheds in the PACFISH area. Therefore, the key watershed designations due to Federal listings under ESA include the Snake River salmon and steelhead Evolutionarily Significant Units (ESUs) and the Upper Columbia River steelhead ESU. The Middle Columbia River portion of the PACFISH area has no Federally listed anadromous fish, thus no key watershed designations. The INFISH priority watersheds were designated to protect and conserve inland native fish habitat and populations, although a priority was extended to bull trout populations within the INFISH area. As a result of this

prioritization, priority watersheds are only located where bull trout are currently distributed.

The key or priority watershed networks were established for the conservation of habitat for anadromous fish or resident fish, specifically Federally listed salmon ESUs and bull trout populations for the PACFISH and INFISH, respectively. An analysis of the key and priority watershed networks within the DPSs or specific analysis areas addressed in the BA found the Federal land designated as key or priority watersheds ranges from 0 to 41 percent. The Columbia River and Klamath River bull trout DPSs have 41 and 20 percent of the Federal land designated as key or priority watersheds within their range, respectively.

6. Watershed Analysis Watershed analysis is a systematic procedure for determining how a watershed functions in relation to its physical and biological components. This is accomplished through consideration of history, processes, landform, and condition.

Generally, watershed analysis would be initiated where the interim RMOs and the interim RHCAs widths do not adequately reflect specific watershed capabilities, or as required in the S&Gs before specific projects are initiated. The guidelines and procedural manuals being developed by the Interagency Watershed Analysis Coordination Team and other potentially relevant procedures (e.g., the Cumulative Watershed Effects Process for Idaho, etc.) would be considered and used, where appropriate, in development of a watershed analysis protocol. Eventually, any watershed analysis would follow the final guidance on "Ecosystem Analysis at a Watershed Scale, Federal Guide for Watershed Analysis"(often referred to as the "Federal Guide": USDA et al. 1995). Currently there are two memoranda available (dated November 1, 1995 and October 16, 1996) that include new information and modules to be used. In addition, there is a draft riparian module (February 1997) specific to intermittent streams, but which suggests use also on perennial streams. At this time, the modules that accompany the Federal Guide are optional and USFS and BLM units often opt to use different techniques of analysis, depending on their time frames and budgets for analysis.

Watershed analysis is a prerequisite for determining which processes and parts of the landscape affect fish and riparian habitat, and is essential for defining watershed- specific boundaries for RHCAs and for RMOs. Watershed analysis can form the basis for evaluating cumulative watershed effects; defining watershed restoration needs, goals and objectives; implementing restoration strategies; and monitoring the effectiveness of watershed protection measures, depending upon the issues to be addressed in the watershed analysis. Watershed analysis employs the perspectives and tools of multiple disciplines, especially geomorphology, hydrology, geology, aquatic and terrestrial ecology, and soil science. It is the framework for understanding and carrying out land use activities within a geomorphic context, and is a major component of the evolving science of ecosystem analysis.

Watershed analysis consists of a sequence of activities designed to identify and interpret the processes operating in a specific landscape. Since the concept of watershed analysis was first introduced, there has been much discussion as to the procedures and detail that a watershed analysis should complete. Under the Northwest Forest Plan, watershed analysis has been conducted, and there are varying levels of analysis completed in those analyses. It is recognized that the components and intensity of the analysis would vary depending on level of activity and significance of issues involved. Following are the general process steps for watershed analysis:

1. Characterization of the Watershed.
   a. Place the watershed in a broader geographic context.
   b. Highlight dominant features and processes within the watershed.

2. Identification of Issues and Key Questions.
   a. Key questions and resource components.
   b. Determine which issues are appropriate to analyze at this scale.

3. Description of Current Condition.

4. Description of Reference Conditions.
   a. Establish ecologically and geomorphically appropriate reference conditions for the watershed.

5. Interpretation of Information.
   a. Provide a comparison and interpretation of the current, historic, and reference conditions.

6. Recommendations.
   a. Provide conclusions and recommendations to management.

The process described above is significantly streamlined to allow managers to focus watershed analysis to address specific issues and management needs. This can include modification of RMOs, RHCAs, or identification of restoration and monitoring needs. The state-of-the art for watershed analysis is still developing and the processes are flexible.

7. Watershed Restoration--Watershed restoration comprises actions taken to improve the current conditions of watersheds to restore degraded habitat, and to provide long-term protection to natural resources, including riparian and aquatic resources.

The approach did not attempt to develop a restoration strategy given the short time period for implementation of the interim direction in the ACS. It was expected that land managers would utilize the information from watershed analysis and project development

to initiate restoration projects where appropriate and funds were available. Priority watersheds have the highest priority for restoration efforts.

8. Monitoring Monitoring is an important component of the INFISH and PACFISH interim direction. The primary focus is to verify that the S&Gs are applied during the project implementation.

Monitoring to assess whether protective measures are effective to attain riparian goals and management objectives has been considered a lower priority given the initial, short time frame for the interim direction of the ACS. Complex ecological processes and long time frames are inherent in the RMOs, and that type of monitoring would not likely generate conclusive results within the initial 18 months the ACS was to be in place. Nevertheless, monitoring is a critical to component of the ACS. Land managers have been urged to utilize current monitoring efforts, and section 7 monitoring results from PACFISH areas where on the same land management unit to establish a baseline for determining the effectiveness of these S&Gs. Priority watersheds have the highest priority for monitoring efforts.

A third type of monitoring (validation monitoring) is intended to ascertain the validity of the assumptions used in developing the interim direction. Because of the initial, short-term nature of the management direction, no specific requirements were included in the ACS for validation monitoring.

Summary of Management Area Categories

Each LRMP describes the level of goods and services provided with implementation. There is considerable variability between plans as to the level of production. Even within a single plan the range of goods and services is expected to vary with budget and natural changes in the capability of the land. In order to display the total level of goods and services represented by all the LRMPs in the BA, some of the geographic information system data themes developed for the ICBEMP Plan were used (USDA and USDI 1998a). The Management Area Categories (MACs) layer was developed for BLM and USFS lands within the project area in an effort to provide a consistent display of management direction and support assessing the overall effects on the ecosystem. The focus of the categories is to describe existing management direction. These categories were used to display current conditions and assess effects of planned management activities to the species covered in this assessment. Potential roadless areas and predicted road density data layers were also used as another indicator of management activity.

The eight MACs identified are:

1. Natural, Unmodified Environments
2. Special Natural Areas
3. Essentially Unmodified Forested and Grassland Ecosystems

4. Natural Appearing, but Modified for Human Use and Occupancy
5. Modified Forest Ecosystems
6. Modified Rangelands
7. Areas Modified by Human Occupation and Activities
8. Modified Non-Sustainable Areas

For the analysis in the BA, the eight categories were collapsed into three areas of management activities: Undeveloped Areas, categories 1, 2, and 3; Developed Areas, categories 4, 5, and 6; and Highly Developed Areas, categories 7 and 8. In order to assess effects, the management activity areas were then compared against species presence, represented by known strong and depressed populations of bull trout in the three DPSs. Bull trout were also compared against potential roadless areas, areas having no or very low predicted road density in contiguous blocks greater than 5,000 acres in size, and predicted road density categories.

Monitoring and Adaptive Management Provisions

A specific monitoring plan was developed as a part of the PACFISH decision (PACFISH Record of Decision, Appendix E-1 through E-12). This monitoring strategy was framed around three aspects of monitoring: 1) implementation monitoring to determine if the S&Gs are followed; 2) effectiveness monitoring to see if the implementation of S&Gs achieved the desired goals and objectives; and 3) validation monitoring to determine if there is a cause-and-effect relationship between management activities and the fish habitat being managed. A proposal for effectiveness monitoring was submitted by technical staff to the Regional Executives of the USFS and BLM in June of 1995. The Regional Executives chose not to implement the effectiveness or validation monitoring portion of the plan. They did, however, recommend to the ICBEMP science team the effectiveness portion of the PACFISH plan for consideration in the ICBEMP monitoring package. An interagency implementation monitoring network was established in 1995 and was comprised of technical staff and line officers for the BLM, USFS, Service, and National Marine Fisheries Service (NMFS). Summary reports and individual site visit information are available for 1995, 1996, and 1997. The 1996 and 1997 PACFISH review also included a limited review of some INFISH areas.

The INFISH decision also stressed the importance of monitoring to ensure proper implementation and effectiveness of the S&Gs in the aquatic strategy. Instead of establishing a specific monitoring strategy, the Forests were "urged to utilize current Forest Plan monitoring efforts, and Section 7 monitoring results from PACFISH areas where on the same Forest..." (INFISH Record of Decision, Appendix A-15). A special request to the Forests for their monitoring results was initiated in January 1995. This request went to all INFISH Forests and was the only coordinated gathering of monitoring data for INFISH for all USFS units. In 1996, the Northern Region of the USFS requested monitoring data of its Forests and this data is also available. A similar request was not made in USFS Pacific Northwest and Intermountain Regions. No coordinated gathering of monitoring data was made for the BLM.

Provisions for adaptive management are not specifically addressed in either PACFISH or INFISH. Although existing data and data generated from forest plans and section 7 activities may be available for evaluation, the action does not provide for monitoring the efficacy or evaluating assumptions of activities implemented pursuant to the action. Moreover, the action does not provide a framework for identifying areas of uncertainty concerning management activities, formulating testable hypotheses, generating additional data for performing tests of hypotheses, and evaluating the results of the tests relative to the management activities.

Additional Agency Commitments

In a letter to the Service, the USFS and BLM adopted commitments in implementing the ACS and requested that they be amended to the BA for this action(USDA and USDI 1998b). The Service has included the commitments in developing this BO and they are summarized below:

1. Restoration and improvement: The USFS and BLM, in cooperation with the NMFS and the Service, will develop and implement strategies that will integrate and coordinate restoration, protection and evaluation measures (construction/maintenance, flood repair, watershed, and fish habitat improvements, etc.) to expeditiously achieve restoration objectives at multiple scales (DPS, metapopulation, watershed). Restoration opportunities will be identified through an agreed upon approach using existing funding, information and programs, and incorporating new information as it becomes available. Initial strategy development will be completed by March 1, 1999.

2. Standards and guidelines: The USFS and BLM will complete prior commitments in the PACFISH and INFISH decisions, and use the conclusions in the PACFISH/INFISH reviews and the land management plan BA for bull trout and suckers.

Prior commitments to be emphasized are:

a. Road evaluation and Planning (PACFISH and INFISH) standards RF-2 and RF-3). Implementation of these existing standards in PACFISH/INFISH is necessary to understand and begin reducing impacts from roads on streams with habitat for ESA listed and proposed fish. Achievement of PACFISH/INFISH RF-2 and RF-3 will be a priority.

i) Using existing information and road definitions, the Service will be provided with road inventories on the management units in the three bull trout DPSs within 120 days of BO signature. This information should include a description of road definitions and survey methodology used. Information gaps will be identified and a schedule will be developed to provide information to the Service within two years.

ii) As part of watershed analyses, road inventories, and other appropriate information will be used to collaborate with NMFS and Service in developing

restoration strategies. Restoration strategies will be used to identify key processes needing attention, prioritize key locations and project types, address implementation and scheduling issues and provide a preliminary estimate of costs. These strategies will serve as the primary framework for implementation of integrated restoration activities.

iii) continue updating the road inventories. Incorporate new information consistent with 2.a.i. (above).

b. To complete the commitments made in the aquatic strategies for culvert replacement, fish passage, grazing facilities in RHCAs, recreation facilities, and minerals management the implementation of these existing standards in PACFISH/INFISH are necessary to understand and begin reducing impacts from these management activities on streams with habitat for ESA listed and proposed fish. Achievement of PACFISH/INFISH RF-4 and RF-5, GM-2, RM-1, and MM-2 will be a priority.

3. Key and priority watershed networks: reexamine the structure and function of INFISH priority and PACFISH key watershed networks to ensure the protection and recovery of bull trout and listed sucker metapopulations.

a) Identify and clarify the primary functions of key, priority, and special emphasis watershed.

b) Identify special emphasis watersheds (within 60 days of BO signature) to ensure a comprehensive refugia network for the protection and recovery of bull trout and listed suckers.

c) Completing watershed analysis in existing INFISH priority watersheds, and special emphasis watersheds as identified in 3b above, is a priority (required in PACFISH and INFISH standards, TM-1, RF-2, RM-1). Project decisions will be guided by the results of watershed analysis.

d. Priorities and schedules for watershed analysis will be developed concurrently with #1 (above) and updated annually.

4. Watershed analysis: Watershed analysis will be conducted according to "Ecosystem Analysis at the Watershed Scale", Field Guide for Watershed Analysis, 1995, as updated (USDA et al. 1995). In general watershed analysis will not be project-driven but undertaken to generate an information base and recommendations for use in project planning.

5. Monitoring: To improve monitoring efforts, to make the level of monitoring commensurate with the level of on-the-ground activities, and to provide feedback on the effects of activities, the USFS and BLM will develop a mechanism for improved monitoring accountability and

oversight. Interagency collaboration in the development of this mechanism is necessary to ensure a common understanding of expectations.

a. Consider NMFS' expectations for monitoring in the 1995 LRMP Opinion (section IX.I. and Appendix A-10), when updating the PACFISH monitoring strategy.

b. Activate the PACFISH interagency effectiveness monitoring subgroup including areas covered by INFISH, (within 120 days of signature) to develop a monitoring strategy including a range of monitoring alternatives commensurate with anticipated land management activity levels, funding, and staffing levels.

c. Incorporate INFISH areas into PACFISH implementation monitoring efforts.

d. Improve the current implementation monitoring process by expanding regional/state level USFS/BLM line officer involvement in PACFISH/INFISH implementation oversight and review.

6. Long-term Conservation and Recovery: USFS and BLM will use their authorities in carrying out programs for the conservation of endangered and threatened species as consistent with section 7(a)(1) of ESA.

a. Using PACFISH, INFISH, watershed analysis and other information, develop a conservation approach to protect and restore existing high quality habitats and the connectivity between them. The USFS and BLM will review existing roadless and low density areas (as defined in ICBEMP science assessment team) to assess their importance to listed species habitat.

b. As a foundation for the development of a long-term conservation and recovery strategy, the USFS and BLM will develop a mechanism for improved accountability and oversight to ensure PACFISH and INFISH direction is fully implemented. Interagency collaboration in the development of this mechanism is necessary to ensure a common understanding of expectations.

1. Provide a mechanism (within 120 days of signature), that ensures full implementation of programmatic aquatic conservation measures at all organizational levels for the bull trout and sucker species addressed in the BA.

2. Provide a strategy which will be used if funding or priorities prevent full implementation of the aquatic conservation measures. Annually, upon receipt of the initial budget, review the fiscal year priorities and program of work for attainment of fish conservation measures. Identify highest priority work for available funds and identify and document significant shortfalls in funding or staffing.

7. The USFS and BLM, in coordination with the Service, will complete section 7 consultation at the watershed level by May 1999. The watershed consultation will follow the approach agreed to in the January 27, 1998, letter of direction on bull trout conferencing, with modifications as agreed to by the agencies. After the effective date of the bull trout listing, and until the watershed consultations are completed, all ongoing and proposed actions must conform to INFISH and PACFISH guidelines and these seven commitments.

III. STATUS OF THE SPECIES

Listing History

On October 30, 1992, the Service received a petition to list the bull trout (*Salvelinus confluentus*) as an endangered species throughout its range. On June 6, 1994, the Service concluded that listing of bull trout throughout its range was not warranted due to unavailable or insufficient data regarding threats to, and status and population trends of, the species within Canada and Alaska. However, the Service determined that sufficient information on the biological vulnerability and threats to the species, along with higher priority listing efforts, were available to support a warranted but precluded finding to list the bull trout within the coterminous United States.

On November 1, 1994, a suit was filed in the Federal District Court of Oregon (Court) arguing that the warranted but precluded finding was arbitrary and capricious. The Service again issued the 12-month finding for the coterminous population of bull trout on June 12, 1995. On November 13, 1996, the Court issued an order and opinion remanding the original finding to the Service for further consideration, and included requirements that the Service limit its review to the 1994 Administrative Record. The reconsidered 12-month finding based on the 1994 Administrative Record was delivered to the Court on March 13, 1997. In that reconsidered 12-month finding, the Service concluded that the 1994 Administrative Record provided evidence of discreteness and significance for five DPSs: 1) Coastal/Puget Sound; 2) Klamath River; 3) Columbia River; 4) Jarbidge River; and 4) Saskatchewan River. Bull trout were delineated into distinct population segments because bull trout occur in widespread but fragmented habitats and have several life history patterns. In addition, the threats to the fish are diverse, and the quantity and quality of information regarding the population status and trends of bull trout varies greatly. The Columbia River population segment includes the entire Columbia River basin and all its tributaries, excluding the isolated bull trout populations found in the Jarbidge River in Nevada. The reconsidered 12-month finding based on the 1994 Administrative Record concluded that listing was warranted for the Columbia River and Klamath River population segments, and not warranted for the Coastal/Puget Sound, Jarbidge River, and Saskatchewan River population segments.

In a stipulation between the Service and plaintiffs filed with the Court on April 11, 1997, the Service agreed to issue a proposed rule in 60 days to list the Klamath River population of bull trout as endangered and the Columbia River population of bull trout as threatened based solely on the 1994 record. The Service published the proposed rule on June 13, 1997 (USDI 1997). On

June 10, 1998, the Service published the final rule listing the Klamath River and Columbia River DPSs as threatened (USDI 1998a), with an effective date of July 10, 1998.

Description

For years, the bull trout and Dolly Varden (*Salvelinus malma* Girard) were combined under one name, the Dolly Varden (*Salvelinus malma* Walbaum). In 1991, with the support of the American Fisheries Society, they were recognized as two distinct species. Two of the most useful characteristics in separating the two species are the shape and size of the head (Cavender 1978). The head of a bull trout is more broad and flat on top, being hard to the touch, unlike Dolly Varden. Bull trout have an elongated body, somewhat rounded and slightly compressed laterally, and covered with cycloid scales numbering 190-240 along the lateral line. The mouth is large with the maxilla extending beyond the eye and with well developed teeth on both jaws and head of the vomer (none on the shaft). Bull trout have 11 dorsal fin rays, 9 anal fins, and the caudal fin is slightly forked. Although they are often olive green to brown with paler sides, color is variable with locality and habitat. Their spotting pattern is easily recognizable showing pale yellow spots on the back, and pale yellow and orange or red spots on the sides. Bull trout fins are tinged with yellow or orange, while the pelvic, pectoral, and anal fins have white margins. Bull trout have no black or dark markings on the fins.

Status

The Service recognizes 141 subpopulations in the Columbia River DPS within Idaho, Montana, Oregon, and Washington with additional subpopulations in British Columbia. Bull trout in this DPS are threatened by habitat loss and degradation, passage restrictions at dams, and competition from non-native brook trout (*Salmo fontinalis*) and lake trout (*S. namaycush*).

The State of Washington classifies bull trout as a State Priority Species. This Priority designation is given to those wildlife species that are of concern due to their population status and their sensitivity to habitat alteration (Mongillo 1993). Oregon has classified the bull trout as a sensitive/critical species, whose existence is being threatened in Oregon (Oregon Department of Fish and Wildlife 1993; Oregon Department of Fish and Wildlife 1995). California listed bull trout as an endangered species in October 1980 (USDI 1998a), however, they are now considered to be extinct within California. The American Fisheries Society listed bull trout as a species of concern in all of its range (California, Idaho, Montana, Nevada, Oregon, Washington; Alberta and British Columbia) except Alaska, as a result of present or threatened destruction, modification, or curtailment of its habitat or range and introduction of exotic species (Williams et al. 1989). Bull trout have been categorized by some as an indicator species of forest and ecosystem health, since many biologists believe bull trout to be particularly sensitive to environmental change (Mongillo 1993; Rieman and McIntyre 1993).

Rangewide, populations are generally isolated and remnant. Migratory life histories have been lost or limited throughout the range (Goetz 1994; Jakober 1995; Montana Bull Trout Scientific

Group (MBTSG) 1998; Pratt and Huston 1993; Ratliff and Howell 1992; Rieman and McIntyre 1993, 1995) and fluvial bull trout populations in the upper Columbia River portion of the DPS appear to be nearly extirpated. Resident populations existing in headwater tributary reaches are isolated and generally low in abundance (Thomas 1992). Bull trout in Flathead Lake and Lake Pend Oreille appear to be declining, while the Swan Lake adfluvial population appears to be the healthiest remaining population and is increasing (USDI 1997). Generally, where status is known and population data exists, bull trout populations in the entire Columbia River DPS are declining (Thomas 1992; Pratt and Huston 1993; Schill 1992). Presently bull trout in the Columbia basin occupy about 45 percent of their estimated historic range (Quigley and Arbelbide 1997). Of the 141 subpopulations, 75 are at risk of natural extirpation through physical isolation. Many of the remaining bull trout occur as isolated subpopulations in headwater tributaries, or in tributaries where the migratory corridors have been lost or restricted. Few bull trout subpopulations are considered "strong" in terms of relative abundance and subpopulation stability. Those few remaining strongholds are generally associated with large areas of contiguous habitats such as portions of the Snake River basin in Central Idaho, the Upper Flathead Rivers in Montana, and the Blue Mountains in Washington and Oregon.

Historic and Current Distribution

The historic range of bull trout was restricted to North America (Cavender 1978; Haas and McPhail 1991). Bull trout have been recorded from the McCloud River in northern California, the Klamath River basin in Oregon and throughout much of interior Oregon, Washington, Idaho, western Montana, and British Columbia, and extending into Hudson Bay and the St. Mary's River in Saskatchewan.

Bull trout are believed to be a glacial relict (McPhail and Lindsey 1986), and their broad distribution has probably contracted and expanded periodically with natural climate change (Williams et al. 1997). Genetic variation suggests an extended and evolutionarily important isolation between populations in the Klamath and Malheur Basins and those in the Columbia River basin (Leary et al.1993). Populations within the Columbia River basin are more closely allied and are thought to have expanded from common glacial refugia or to have maintained higher levels of gene flow among populations in recent geologic time (Williams et al. 1997).

Bull trout are now extinct in California and only remnant populations are found in much of Oregon (Ratliff and Howell 1992). A small population still exists in the headwaters of the Jarbidge River, Nevada, which represents the present southern limit of the species' range.

It is unlikely that bull trout occupied all of the accessible streams at any one time. Distribution of existing populations is often patchy even where numbers are still strong and habitat is in good condition (Rieman and McIntyre 1993,1995). Habitat preferences or selection is likely important (Dambacher and Jones 1997; Goetz 1994; Rieman and McIntyre 1995) but more stochastic extirpation and colonization processes may influence distribution even within suitable habitats (Rieman and McIntyre 1995).

eliminated due to stream habitat alterations, including seasonal or permanent obstructions, detrimental changes in water quality, increased temperatures, and the alteration of natural stream flow patterns. Migratory corridors tie seasonal habitat together for anadromous, adfluvial, and fluvial forms, and allow for dispersal of resident forms for recolonization of recovering habitats (Rieman and McIntyre 1993). Dam and reservoir construction and operation 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, and dams and reservoirs alter the natural hydrograph, thereby affecting forage, water temperature, and water quality (USDI 1997).

Channel Stability and Stream Flow

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. These areas can be eliminated or degraded by management activities (Rieman and McIntyre 1993).

Bull trout are also sensitive to activities that alter stream flow. Incubation to emergence may take up to 200 days during winter and early spring. The fall spawning period and strong association of juvenile fish with stream channel substrates make bull trout vulnerable to flow pattern changes and associated channel instability (Fraley and Shepard 1989; Pratt 1992; Pratt and Huston 1993; Rieman and McIntyre 1993).

Patterns of stream flow and the frequency of extreme flow events that influence substrates are anticipated to be important factors in population dynamics (Rieman and McIntyre 1993). With 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 common in some parts of the range (Rieman and McIntyre 1993). Channel dewatering tied to low flows and bed aggradation has also blocked access for spawning fish resulting in year class failures (Weaver 1992).

Surface/groundwater interaction zones, which are typically selected by bull trout for redd construction, are increasingly recognized as having high dissolved oxygen; constant cold water temperatures; and increased macro-invertebrate production (R. Edwards, University of Washington, pers. comm. 1998).

IV. ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, state, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area which have undergone section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in

progress. Such actions include, but are not limited to, previous timber harvests and other land management activities.

Status of the Species Within the Action Area

The Service evaluated the status and distribution of bull trout for each subpopulation in the Klamath River and Columbia River distinct population segments. The complete review of this evaluation is found in a status summary compiled by the Service (USDI 1998b), and a synopsis of the summary is presented here.

To facilitate evaluation of current bull trout distribution and abundance for both the Klamath River and Columbia River DPSs, the Service analyzed data on bull trout relative to subpopulations because fragmentation and barriers have isolated bull trout throughout their current range. A subpopulation is considered a reproductively isolated group of bull trout that spawns within a particular area of a river system. In areas where two groups of bull trout are separated by a barrier (e.g., an impassable dam or waterfall, or reaches of unsuitable habitat) that allows only individuals upstream access to those downstream (i.e., one-way passage), both groups were considered subpopulations. In addition, subpopulations were considered at risk of extirpation from naturally occurring events if they were : 1) unlikely to be reestablished by individuals from another subpopulation (i.e., functionally or geographically isolated from other subpopulations); 2) limited to a single spawning area (i.e., spatially restricted); and either 3) characterized by low individual or spawner numbers; or 4) primarily of a single life-history form. For example, a subpopulation of resident fish isolated upstream of an impassable waterfall would be considered at risk of extirpation from naturally occurring events because the subpopulation had low numbers of fish that spawn in a restricted area. In such cases, a natural event such as a fire or flood affecting the spawning area could eliminate the subpopulation, and reestablishment from fish downstream would be prevented by the impassable waterfall. However, a subpopulation residing downstream of the waterfall would not be considered at risk of extirpation from naturally occurring events because there would be establishment potential by fish from the subpopulation upstream. Because resident bull trout may exhibit limited downstream movement (Nelson 1996), the Service's determination of subpopulations at risk of extirpation from naturally occurring events may overestimate the number of subpopulations that are likely to be reestablished.

The status of subpopulations was based on modified criteria of Rieman et al. (1997), including the abundance, trends in abundance, and the presence of life-history forms of bull trout. The Service considered a subpopulation "strong" if 5,000 individuals or 500 spawners likely occur in the subpopulation, abundance appears stable or increasing, and life-history forms were likely to persist; and "depressed" if less than 5,000 individuals or 500 spawners likely occur in the subpopulation, abundance appears to be declining, or a life-history form historically present has been lost. If there was insufficient abundance, trend, and life-history information to classify the status of a subpopulation as either "strong" or "depressed", the status was considered "unknown."

Even though bull trout may move throughout entire river basins seasonally, spawning and juvenile rearing appear to be limited to the coldest streams or stream reaches. The lower limits of habitat used by bull trout are strongly associated with gradients in elevation, longitude, and latitude, that likely approximate a gradient in climate across the Basin (Goetz 1994). The patterns indicate that spatial and temporal variation in climate may strongly influence habitat available to bull trout (see Meisner 1990 for an example with another char). While temperatures are probably suitable throughout much of the northern portion of the range, predicted spawning and rearing habitat are restricted to increasingly isolated high elevation or headwater "islands" toward the south (Goetz 1994; Rieman and McIntyre 1995).

Life History Characteristics

Two distinct life-history forms, migratory and resident, occur throughout the range of bull trout (Pratt 1992; Rieman and McIntyre 1993). Migratory forms rear in natal tributaries before moving to larger rivers (fluvial form), lakes (adfluvial form), or the ocean (anadromous) to mature. Migratory bull trout may use a wide range of habitats ranging from 1st to 6th order streams and varying by season and life stage.

Most bull trout spawning occurs between late August and early November (McPhail and Murray 1979; Pratt 1992). Hatching occurs in winter or early spring, and alevins may stay in the gravel for extended periods. Growth is variable with different environments, but first spawning is often noted after age four, and the fish may live 10 or more years (Mc Phail and Murray 1979; Pratt 1992, Rieman and McIntyre 1993). Although spawning typically occurs in 2nd to 5th order streams, juveniles may move upstream of reaches used by adults for spawning, presumably to forage in other accessible waters (Fraley and Shepard 1989; Ratliff 1992). Seasonal movements by adult bull trout may range up to 300 kilometers (km) as migratory fish move from spawning and rearing areas into overwinter habitat in the downstream reaches of large basins (Bjornn and Mallet 1964; Fraley and Shepard 1989).

Habitat Requirements

Bull trout are sensitive to environmental disturbance at all life stages, and have very specific habitat requirements. Bull trout growth, survival, and long-term population persistence appear to be dependent upon five habitat characteristics: cover, channel stability, substrate composition, temperature, and migratory corridors (Rieman and McIntyre 1993). Cover includes undercut banks, large woody debris, boulders, and pools which are used as rearing, foraging and resting habitat, and protection from predators (USDI 1997). Deep pools also help minimize and moderate stream temperatures and offer refuge from warmer water temperatures during summer low-flow conditions. Stream temperatures and substrate types are especially important to bull trout.

Temperature

Cold water temperatures are required for successful bull trout spawning and development of embryos and juveniles; cold water temperature also influence the distribution of juveniles (Bjornn and Reiser 1991; Goetz 1989; McPhail and Murray 1979; Pratt 1992; Fraley and Shepard 1989). Bull trout are associated with the coldest stream reaches within basins.

Bull trout spawning typically occurs in areas influenced by groundwater (Allan 1980; Shepard et al. 1984; Ratliff 1992; Fraley and Shepard 1989). In a recent investigation in the Swan River drainage, bull trout spawning site selection occurred primarily in stream reaches directly influenced by groundwater upwellings or directly downstream of these upwelling reaches (Baxter and Hauer, *in prep.*). In addition, warmer summer stream temperatures, as well as extreme winter cold temperatures that can result in anchor ice, may be moderated by cold water upwellings.

In one study by Goetz (1994) juvenile bull trout were not found in water temperatures above 12 degrees Celsius (degrees C). Many studies show that temperatures must drop below 9 or 10 degrees C before spawning occurs (McPhail and Murray 1979; Riehle 1993). Egg survival decreases as water temperature increases, with higher survival levels documented at 2-4 degrees C (McPhail and Murray 1979). The best bull trout habitat in several Oregon streams have temperatures which seldom exceed 15 degrees C (Buckman et al. 1992; Ratliff 1992; Ziller 1992).

Fine Sediment

Preferred spawning habitat includes low gradient streams with loose, clean gravels (Fraley and Shepard 1989). Fine sediments fill spaces between the gravel that are needed by incubating eggs and fry. Because bull trout eggs incubate about seven months in the gravel they are especially vulnerable to fine sediments and water quality degradation (Fraley and Shepard 1989). Juveniles are similarly affected, as they also live on or within the stream bed cobble (Oliver 1979; Pratt 1984).

Bull trout are more strongly tied to the stream bottom and substrate than other salmonids (Pratt 1992). Substrate composition has repeatedly been correlated with the occurrence and abundance of juvenile bull trout (Rieman and McIntyre 1993) and spawning site selection by adults (Graham et al. 1981; McPhail and Murray 1979). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985) but may also limit access to substrate interstices that are important cover during rearing and overwintering (Goetz 1994; Jakober 1995).

Migratory Corridors

Migratory bull trout ensure interchange of genetic material between populations, thereby promoting genetic variability. Unfortunately, migratory bull trout have been restricted or

Based on abundance, trends in abundance, and the presence of life-history forms, bull trout were considered strong in 13 percent of the occupied range in the interior Columbia River basin (Quigley and Arbelbide 1997). Using various estimates of bull trout range, Rieman et al. (1997) estimated that bull trout were strong in 6 to 24 percent of the subwatersheds in the Columbia River basin. Bull trout declines have been attributed to the effects of land and water management activities, including forest management and road building, mining, agricultural practices, livestock grazing (Furniss et al. 1991; Meehan 1991; Nehlsen et al. 1991; Craig and Wissmar 1993; Frissell 1993; McIntosh et al. 1994; Platts et al. 1995); isolation and habitat fragmentation from dams and agricultural diversions (Rode 1990; Mongillo 1993; Jakober 1995); fisheries management practices, poaching and the introduction of non-native species (Rode 1990; Bond 1992; Howell and Buchanan 1992; Washington Department of Wildlife [WDW] 1992; Donald and Alger 1993; Leary et al 1993; Pratt and Huston 1993; Rieman and McIntyre 1993; MBTSG 1996a; Palmisano and Kaczynski, Northwest Forest Resources Council (NFRC), *in litt.* 1997).

Klamath River Distinct Population Segment

Historical records suggest that bull trout were once widely distributed and exhibited diverse life-history traits in the Klamath River basin (Gilbert and Evermann 1894; Dambacher et al. 1992; Ziller 1992; Oregon Chapter of the American Fisheries Society (OCAFS) 1993). The earliest records of bull trout in the basin are from Fort Creek (formerly Linn Creek), a tributary to the Wood River (L. Dunsmoor and C. Bienz, Klamath Tribe, *in litt.* 1997). Records from the late 1800s suggest that migratory fish (adfluvial) inhabited Klamath Lake (OCAFS 1993). Other migratory bull trout (i.e., fluvial) were evidently present in some of the larger streams in the basin as recently as the early 1970s (Ziller 1992). Bull trout are thought to have been extirpated from the Sycan River, the South Fork of the Sycan River, and four streams in the Klamath River basin (Cherry, Sevenmile, Coyote, and Callahan creeks) since the 1970s.

Currently, bull trout in the Klamath River basin occur only as resident forms isolated in higher elevation headwater streams (Goetz 1989) within three watersheds: Upper Klamath Lake, Sprague River, and Sycan River (Light et al. 1996). Factors contributing to isolation include habitat degradation, water diversion, and habitat fragmentation (OCAFS 1993; Light et al. 1996). In addition, long distances separate each isolated subpopulation (Schroeder and Weeks, OCAFS, *in litt.* 1997). According to Light et al. (1996), bull trout occupy approximately 38.2 km (22.9 mi) of streams in the Klamath River basin. More recently, Buchanan et al. (1997) indicated that bull trout occupy approximately 34.1 km (20.5 mi) of streams. The risk of extinction for Klamath River bull trout over the next 100 years was recently estimated at 70 to 90 percent (K. Schroeder and H. Weeks, OCAFS, *in litt.* 1997). The Service identified seven bull trout subpopulations in three watersheds (number of subpopulations in each watershed): Upper Klamath Lake (2), Sycan River (1), and Sprague River (4). The Service considers six of the subpopulations at risk of extirpation caused by naturally occurring events due to their isolation, single life-history form and spawning area, and low abundance (USDI 1998a).

Columbia River Distinct Population Segment

The Columbia River DPS includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of the Columbia River Basin, and presently occur in 4 percent of the estimated historical range (Quigley and Arbelbide 1997). The Columbia River population segment is composed of 141 subpopulations. For discussion and analysis, the Service considered four geographic areas of the Columbia River basin: 1) lower Columbia River (downstream of the Snake River confluence), 2) mid-Columbia River (Snake River confluence to Chief Joseph Dam), 3) upper Columbia River (upstream from Chief Joseph Dam), and 4) Snake River and its tributaries (including the Lost River drainage).

Lower Columbia River Geographical Area

The lower Columbia River area includes all tributaries in Oregon and Washington downstream of the Snake River confluence near the town of Pasco, Washington. The Service identified 20 subpopulations in watersheds of nine major tributaries of the lower Columbia River (number of subpopulations in each watershed): the Lewis River (2), Willamette River (3), White Salmon River (1), Klickitat River (1), Hood River (2), Deschutes River (3), John Day River (3), Umatilla River (2), and Walla Walla River (3). The present distribution of bull trout in the lower Columbia River basin is less than their historic range (Buchanan et al. 1997; Oregon Department of Fish and Wildlife (ODFW) 1993). Bull trout are thought to be extirpated from several tributaries in five river systems in Oregon: the Middle Fork Willamette River, the North and South Forks of the Santiam River, the Clackamas River, the upper Deschutes River (upstream of Bend, Oregon) and the Crooked River (tributary to the Deschutes River) (Buchanan et al. 1997).

Hydroelectric facilities and large expanses of unsuitable, fragmented habitat have isolated these subpopulations. Large dams, such as McNary, John Day, The Dalles, and Bonneville, separate four reaches of the lower Columbia River. Although fish may pass each facility in both upstream and downstream directions, the extent to which bull trout use the Columbia River is unknown. In addition, the nine major tributaries have numerous facilities, many of which do not provide upstream passage.

Migratory bull trout are present either with resident fish or exclusively in at least 13 of the 20 subpopulations in the lower Columbia River. Many migratory fish are adfluvial and inhabit reservoirs created by dams. However, this area includes the only extant adfluvial subpopulation in Oregon, which exists in Odell Lake in the Deschutes River basin (Ratliff and Howell 1992; Buchanan et al. 1997). The Metolious River-Lake Billy Chinook subpopulation is also found in the Deschutes River basin. It is the only subpopulation considered "strong" and exhibits an increasing trend in abundance. The Service considers 5 of the 20 subpopulations at risk of extirpation caused by naturally occurring events due to isolation, single life-history form and spawning area, and low abundance.

Mid-Columbia River Geographical Area

The mid-Columbia River area includes watersheds of four major tributaries of the Columbia River in Washington, between the confluence of the Snake River and Chief Joseph Dam. The Service identified 16 bull trout subpopulations in the four watersheds (number of subpopulations in each watershed): Yakima River (8), Wenatchee River (3), Entiat River (1), and Methow River (4). Historically, bull trout occurred in larger areas of the four tributaries and the Columbia River. Bull trout are thought to have been extirpated in 10 streams within the area: Satus Creek, Nile Creek, Orr Creek, Little Wenatchee River, Napecqua River, Lake Chelan, Okanogan River, Eightmile Creek, South Fork Beaver Creek, and the Hanford Reach of the Columbia River. Most bull trout in the mid-Columbia River geographic area are isolated by dams or unsuitable habitat created by water diversions.

Bull trout in the mid-Columbia River area are most abundant in Rimrock Lake of the Yakima River basin and Lake Wenatchee of the Wenatchee River basin. Both subpopulations are considered "strong" and either increasing or stable. The remaining 14 subpopulations are relatively low in abundance, exhibit "depressed" or unknown trends, and primarily have a single life-history form. The Service considers 10 of the 16 subpopulations at risk of extirpation because of naturally occurring events due to isolation, single life-history form and spawning area, and low abundance.

Upper Columbia River Geographic Area

The upper Columbia River geographic area includes the mainstem Columbia River and all tributaries upstream of Chief Joseph Dam in Washington, Idaho, and Montana. Bull trout are found in two large basins, the Kootenai River and Pend Oreille River, which include the Clark Fork River. Historically, bull trout were found in larger portions of the area. Numerous dams and degraded habitat have fragmented bull trout habitat and isolated fish into 71 subpopulations in 9 major river basins (number of subpopulations in each basin): Spokane River (1), Pend Oreille River (3), Kootenai River (5), Flathead River (24), South Fork Flathead River (3), Swan River (3), Clark Fork River (4), Bitterroot River (27), and Blackfoot River (1). Bull trout are thought to be extirpated in 64 streams and lakes of various sizes: Nespelam, Sanpoil, and Kettle rivers; Barnaby, Hall, Stranger, and Wilmont Creeks; 8 tributaries to Lake Pend Oreille; 5 tributaries to Pend Oreille River below Albeni Falls Dam; Lower Stillwater Lake; Arrow Lake (Montana); upper Clark Fork River, 12 streams in the Coeur d'Alene River basin; and approximately 25 streams in the St. Joe River basin (IDFG, *in litt.* 1995).

The upper Columbia River area contains "strongholds" for bull trout. Bull trout are considered strong in Hungry Horse Reservoir and Swan Lake. Trends in abundance are stable in Hungry Horse Reservoir, and increasing in Swan Lake. Although high numbers of bull trout are found in Lake Pend Oreille and the upper Kootenai River, trends in abundance are either negative or unknown. The high number of subpopulations (27) in the Bitterroot River basin, Montana, indicates a high degree of habitat fragmentation where numerous groups of resident bull trout are

restricted primarily to headwaters. The Service considers 50 of the 71 subpopulations at risk of extirpation because of naturally occurring events due to isolation, single life-history form and spawning area, and low abundance.

Snake River Geographical Area

Bull trout occupy portions of 14 major tributaries in the Snake River basin of Idaho, Oregon, and Washington. The Service identified 34 bull trout subpopulations in the Snake River basin. The area consists of two primary portions separated by Hells Canyon Dam. Downstream of Hells Canyon Dam, major tributaries that support bull trout include (number of subpopulations in each tributary): Tucannon River (2), Clearwater River (3), Asotin Creek (2), Grande Ronde River (1), Imnaha River (4), and Salmon River (2). Upstream of Hells Canyon Dam, major tributaries that support bull trout include: Pine Creek (4), Powder River (3), Malheur River (2), Payette River (4), Weiser River (2), and Boise River (2). Although bull trout distribution upstream of Hells Canyon Dam is limited primarily to the basin downstream of Shoshone Falls in southern Idaho, three geographically isolated bull trout subpopulations occur upstream of Shoshone Falls in the Little Lost River drainage. Bull trout subpopulations upstream of Hells Canyon Dam are generally low in abundance, fragmented, and isolated. The current distribution of bull trout in the Snake River basin is less than historically (Ratliff and Howell 1992; Batt 1996; Buchanan et al. 1997; Quigley and Arbelbide 1997), with recent extirpations documented in Eagle Creek (Powder River basin) and Wallowa Lake (Grande Ronde River basin) (Ratliff and Howell 1992; Batt 1996; Buchanan et al. 1997); and possibly in South Fork Asotin Creek (WDFW 1997). Numerous impassable dams and large expanses of unsuitable habitat have isolated subpopulations within the historic range. Isolation is most prominent upstream of Hells Canyon Dam (southwest Idaho and southeast Oregon). The basin downstream of Hells Canyon Dam is relatively intact, and connectivity among bull trout subpopulations may still occur.

Bull trout occupy large areas of contiguous habitat in the Snake River basin downstream of Hell's Canyon Dam, such as in the Clearwater River and Salmon River basins. High numbers of bull trout have been observed in the Tucannon River, Imnaha River, Clearwater River, Salmon River, and Malheur River subpopulations, however, trends in abundance are largely unknown or declining. The Service considers 10 of the 34 subpopulations at risk of extirpation because of naturally occurring events due to isolation, single life-history form and spawning area, and low abundance.

In summary, the Columbia River population segment of bull trout has declined in overall range and numbers of fish. Though still widespread, there have been numerous local extirpations reported throughout the Columbia River basin. In Idaho, for example, bull trout have been extirpated from 119 reaches in 28 streams (IDFG *in litt.* 1995) . The population segment is composed of 141 subpopulations indicating habitat fragmentation, isolation, and barriers that limit bull trout distribution and migration within the basin. Although some strongholds still exist, bull trout, generally, occur as isolated subpopulations in headwater lakes or tributaries where migratory fish have been lost.

Threats to the Species

Forest Practices/Road Impacts: Perhaps the greatest threat to bull trout involving forest practices and roads stems from the ongoing and latent adverse effects caused by over a century of logging. Latent threats are illustrated by approximately 2,300 land slides correlated with high logging road density on national forest lands in the Clearwater and Spokane rivers basins during high runoff events in 1995 and 1996 (L. McLaud, Idaho Conservation League, *in litt.* 1997; R. Patten, Panhandle National Forest, *in litt.* 1997). The same runoff events also triggered an estimated 2,000 land slides on adjacent non-Federal timber lands in the Clearwater River basin (McLaud, Idaho Conservation League, *in litt.* 1997). On over half of the non-wilderness lands within National Forests across northern Idaho and western Montana, the environmental effects of past forest practices now constrain forest management (USFS map, *in litt.*1994). For example, 70 percent of stream miles on the Wallowa-Whitman National Forest are degraded beyond LRMP standards for fine sediment and temperature parameters on the forest (Wissmar et al. 1994). On the Panhandle National Forest, Idaho, pool volumes, quality and frequency in managed watersheds (mainly watersheds with past timber extraction and road construction) were reduced compared to non-managed watersheds. Further, decreases in pool volume and frequency were correlated with decreases in the distribution and abundance of bull trout (Cross and Everest 1995). In the Lake Pend Oreille and Priest River basins of Idaho, 31 percent of streams in National Forest lands are degraded beyond LRMP standards, and 51 percent of streams are in the most degraded category (B. Kasun, USFS, *in litt.* 1993). Streams in the most degraded category generally do not support bull trout because of stream morphology changes, increased cobble embeddedness and high summer temperatures. Jones and Espinosa (1992) determined that 71 percent of the stream or watershed areas in the managed portion of the Clearwater National Forest, Idaho did not meet LRMP standards, and that streams in poor condition generally did not support bull trout. Similarly, 67 percent of the non-wilderness portion of the Nez Perce National Forest, Idaho did not meet LRMP standards, and streams in the most degraded category increased 12 percent over a five year period between 1987 and 1992 (Gloss and Gerhardt 1992).

In the Wenatchee National Forest, Washington, bull trout spawning and rearing is correlated with streams not subject to past timber harvest (Brown 1992). Timber harvest activities were responsible in the decline and isolation of bull trout in Pataha Creek, Washington (WDFW 1997), a tributary in the Tucannon River drainage. In the North Fork Boise River basin, Idaho, the majority of bull trout spawning and rearing habitat for the Arrowrock Reservoir subpopulation exists in the roadless headwaters of the Crooked, Bear, and North Fork Boise Rivers (USDA 1994).

The long-lasting effects of past timber management activities on aquatic habitats is illustrated by conditions in the 3,289 km^2 (1,270 mi^2) South Fork Salmon River watershed, Idaho. The watershed was first logged in the 1940's and logging activity peaked in 1961 (Chapman et al. 1991). Sedimentation in the South Fork Salmon River increased approximately 350 percent above pre-logging levels (Chapman et al. 1991). Resident and anadromous salmonids, including

bull trout, declined after timber extraction and associated road building. Despite a 25-year logging moratorium in the watershed, fish habitat has not returned to pre-logging quality, and salmon production has not recovered (Chapman et al. 1991).

A relationship between forest management, watershed conditions, aquatic habitat degradation, and loss of occupied bull trout range has been documented in the Spokane River basin, Idaho. Streambed aggradation and loss of pool habitat are attributed to forest management and associated roads in the basin (G. Kappesser, Panhandle National Forest, *in litt.* 1993). The loss of pool habitat correlates to reductions in bull trout range and abundance in managed watersheds (Cross and Everest 1995). Sixty-one percent of the basin's managed watersheds do not meet forest plan standards (B. Kasum, Panhandle National Forest, *in litt.* 1992).

The USFS classified watersheds in the Bitterroot National Forest, Montana, into three categories, "healthy," "sensitive," and "high risk" based on sediment yield from road construction and increased water yield and peak flow from timber harvest (Decker 1991 *in* MBTSG 1995a). About one third of all watersheds were assigned to each of the three categories. Bull trout with estimable numbers were found only in watersheds rated as "healthy" or "sensitive" (Clancy 1993). The effects of past forest practices, including road construction, continue to affect Bitterroot tributaries (MBTSG 1995a). Generally, bull trout numbers were higher where stream substrates were larger, but numbers tended to be lower in areas high in fine sediments (Clancy 1993). In contrast, habitat where brook trout, an introduced, non-native species that competes and hybridizes with bull trout, were found were characteristic of areas degraded by land use activities (Rich 1996). Eighty-five percent of the drainages classified as "high risk" supported brook trout (Clancy 1993).

Extensive logging activity has impaired water quality in many tributaries of the Blackfoot River, Montana, including the North Fork Blackfoot River (Montana Department of Health and Environmental Sciences (MDHES) 1994). Wide-spread canopy removal, alterations to riparian vegetation, and water irrigation returns have increased the historic temperature regime of the Blackfoot River (MBTSG 1995b; Pierce et al. 1997). Water temperatures in the mainstem Blackfoot frequently exceeded the bull trout preferred range of 15° C (60° F) in 1994, 1995 and 1996, making coldwater refuges during this time critical for bull trout (Pierce et al. 1997). The effect of forest practices was considered a limitation to bull trout restoration in the Blackfoot River drainage (MBTSG 1995b).

Timber management is the dominant land use in the Kootenai River watershed, Montana. Extensive road construction to support forestry activities exists throughout the watershed. Many reaches of streams in the Kootenai drainage have impaired water quality as a result of silviculture activities (MDHES 1994). As a result of salvage logging in 1996, the number of timber sales and clearcuts have substantially increased over the past three years (Kootenai National Forest 1997).

Past forest practices, including road construction, log skidding, riparian tree harvest, clearcutting,

and splash dams, are considered a cause in the historic decline of bull trout and have limited restoration opportunities in the Flathead Lake basin (MBTSG 1995c). This basin supports over 30 subpopulations in wilderness, national park, national forest, and private lands of Montana. Because bull trout are sensitive to habitat and water quality degradation, Fraley and Shepard (1989) considered timber harvest and road construction in both the North and Middle Fork Flathead River drainages to be threats to bull trout spawning and rearing habitat. Although forest practices have improved, effects of past activities still affect bull trout because the existing road systems continue to erode, cause sedimentation, and increase water yield to streams. Silvicultural activities have contributed to 323.2 km (202 mi) in 17 streams being classified as water quality impaired in the Flathead basin (MDHES 1994). Existing roads in two National Forests of Idaho (Boise and Payette) created slides and slumps during 1997, a high water year. In some areas of Montana and Idaho, culverts that are passage barriers for bull trout, are being replaced at road crossings (P. Batt, Governor of Idaho, *in litt.* 1997; P. Graham, Montana Department of Fish, Wildlife and Parks (MFWP) and B. Clinch, Montana Department of Natural Resources and Conservation (MDNRC), *in litt.* 1997).

Much of the forest in the Klamath River basin has been managed for timber production, with substantial activity beginning in 1940. Extensive harvesting, including partial cutting with overstory removal, clearcutting, and selective logging for old-growth pine occurred on private lands, and low intensity harvest occurred on some of the USFS lands. Past forest management activities in the Klamath River basin have temporarily reduced riparian vegetative cover and increased water temperature in some streams, including Threemile Creek (Light et al. 1996). Roads were built in the basin for access to timber, causing increased sedimentation and substrate embeddedness. Sediment from existing roads continues to degrade stream habitat (Light et al. 1996). Weyerhaeuser Timber Company began an improved road maintenance program in 1994 to reduce sediment inputs from roads on its lands adjacent to occupied bull trout stream reaches in the Klamath River basin, and U.S. Timberlands is presently continuing the practice (B. Johnson, U.S. Timberlands, pers. comm. 1997). Two recent timber harvest activities occurred on U.S. Timberlands property along Boulder Creek in 1994 and Long Creek in 1995 (Johnson, U.S. Timberlands, pers. comm. 1997). A review of the activities concluded that leaving buffer strips and obliterating existing roads left the riparian habitat in better condition than before the timber harvest (B. Johnson, U.S. Timberlands, pers. comm. 1997). No timber harvests are currently planned for areas adjacent to streams occupied by bull trout. Six of the seven bull trout subpopulations identified in the Klamath River basin have been affected by past forest management practices.

In summary, forestry activities that adversely affect bull trout and its habitat are primarily timber extraction and road construction, especially where these activities affect riparian areas. These activities, when conducted without adequate protective measures, alter bull trout habitat by increasing sedimentation, reducing habitat complexity, increasing water temperature, and promoting channel instability. Although certain forestry practices have been prohibited or altered in recent years to improve protection of aquatic habitats, the consequences of past activities continue to affect bull trout and their habitat. Within the Columbia River population

segment, approximately 74 percent of bull trout subpopulations are threatened by forestry management practices.

Livestock Grazing: Occupied bull trout habitat is negatively affected by livestock grazing (Howell and Buchanan 1992; Mullan et al. 1992; Platts et al. 1993; R. Uberuaga, Payette National Forest, *in litt.* 1993; Henjum et al. 1994; MBTSG 1995a,b,d; USDA and USDI 1996, 1997a). Livestock grazing degrades aquatic habitat by removing riparian vegetation, destabilizing streambanks, widening stream channels, promoting incised channels and lowering water tables, reducing pool frequency, increasing soil erosion, and altering water quality (Platts 1981; Kauffman and Krueger 1984; Henjum et al. 1994; Overton et al. 1993). These effects increase summer water temperatures, reduce cover, promote formation of anchor ice in winter, and increase sediment into spawning and rearing habitats.

Livestock grazing impacts on bull trout habitat may be minimized if grazing is managed appropriately for conditions at a specific site. Practices generally compatible with the preservation and restoration of bull trout habitat may include fences to exclude livestock from riparian areas, rotation schemes to avoid overuse of areas, and stock tanks so that livestock concentrate outside of riparian areas for water.

Livestock grazing has caused habitat degradation in stream reaches supporting bull trout. On Squaw Creek, a tributary of the Payette River, Idaho, livestock grazing has damaged streambank and riparian vegetation. While fencing and grazing changes are underway to reduce impacts in this area, future damage from grazing will not be eliminated (M. Huffman, Boise National Forest (BNF), *in litt.* 1997). Livestock grazing continues to affect bull trout habitat for spawning, rearing, and migration in Bear Valley Creek and its tributaries in the BNF, Idaho (T. Burton, BNF, pers. comm. 1997a). Livestock grazing was a factor in the decline of bull trout habitat in Pataha Creek, Washington (WDFW 1997). In Montana, severe overgrazing occurs in the Bitterroot River valley bottom streams and along the mainstem Clark Fork River in the Deerlodge valley, Flint Creek valley, and parts of Rock Creek, and limits bull trout restoration in these drainages (MBTSG 1995a,d; Maxell 1996). Overall, livestock grazing in portions of the Wieser, Grande Ronde, Imnaha, and Malheur rivers has degraded streamside habitat (Adams 1994; Buchanan et al. 1997). Of the 141 subpopulations the Service identified in the Columbia River population segment, approximately 50 percent were threatened by ongoing livestock grazing.

Intensive livestock grazing historically occurred throughout most of the Klamath River basin, and continues to be widespread (Light et al. 1996). Livestock grazing is a major land use within the Sprague River drainage, mostly in the lowland meadows and to a lesser extent in some forested areas. Grazing has been eliminated along bull trout streams on U.S. Timberlands property (B. Johnson, U.S. Timberlands, *in litt.* 1997) and adjacent National Forest lands. However, documented cattle trespass on Long and Deming creeks indicates that livestock continue to locally affect bull trout habitats (Light et al. 1996; Buchanan et al. 1997). The meadows in upper Long Creek exhibit bank instability and diminished availability of undercut

banks caused by livestock (Buchanan et al. 1997). Channelization and intense grazing by cattle degraded lower Sun Creek and an adjoining stream in the Klamath River basin and may have contributed to the extirpation of migratory bull trout in Sun Creek (Dambacher et al. 1992).

Agriculture: Agricultural practices, such as cultivation, irrigation, and chemical application can affect bull trout. Agriculture has been identified as a source of nonpoint source pollution in some areas within the range of bull trout (Washington Department of Ecology (WDE) 1992; MDHES 1994). These practices can release sediment, nutrients, pesticides and herbicides into streams, increase temperature, reduce riparian vegetation, and alter the hydrologic regime.

Irrigation diversions affect bull trout by altering stream flow and through entrainment and are discussed in more detail above. Bull trout may enter unscreened irrigation diversions and become stranded in ditches and agricultural fields. Streams are also channelized in some agricultural areas, reducing stream length and area of aquatic habitat, altering stream channel morphology, and diminishing aquatic habitat complexity.

Historical agricultural use in the Klamath River basin has had a profound effect on bull trout habitat in the larger tributaries and mainstem rivers (Buchanan et al. 1997). Channelization, water diversions, removal of streamside vegetation, and disturbances have altered the aquatic environment by elevating water temperature, reducing water quantity and quality, and increasing sedimentation (Light et al. 1996). Deming, Long, Threemile, and Sun Creeks have diversions immediately downstream of occupied bull trout habitat (Dunsmoor and Bienz, *in litt.* 1997). Unscreened diversions result in the transport of fish into irrigation canals (e.g., Deming and Sun creeks), often resulting in mortality (Light et al. 1996).

Approximately 47 percent of the bull trout subpopulations in the Columbia River population segment are affected by the past and ongoing effects from agricultural practices, including diversions. In 1988, the Idaho Department of Environmental Quality (IDEQ) conducted an assessment of nonpoint source pollution of the Salmon River basin. Of 4,080 km (2,550 mi) of streams assessed 1,374 km (859 mi) were affected by agricultural practices.

Dewatering of stream reaches as a result of irrigation has restricted bull trout migration and isolated bull trout into subpopulations. Examples include the Powder, Malheur, Grande Ronde, Umatilla, and John Day rivers in Oregon (Buchanan et al. 1997); the Tucannon, Snake, Yakima, Methow, and Walla Walla rivers in Washington (WDW 1992; WDFW 1997); the upper Salmon and Lemhi rivers in Idaho (Dorratcaque 1986; Chapman et al. 1991); and the Clark Fork, Blackfoot, and Bitterroot rivers in Montana (Clancy 1993; MBTSG 1995a,b,d; 1996b,c; Swanberg 1996). The mainstem Umatilla River is frequently dry during the irrigation season, effectively isolating bull trout (T. Cummings, Service, pers. comm. 1997). Moreover, two diversion facilities in the Umatilla River inhibit migration during portions of the year (Buchanan et al. 1997). Walla Walla River basin bull trout subpopulations are segregated in the Touchet River, Mill Creek, and South Fork and North Fork of the Walla Walla River by four irrigation diversion dams (Buchanan et al. 1997; WDFW 1997).

In 1988, the IDEQ conducted an assessment of nonpoint source pollution of the Salmon River basin. Of 4,080 km (2,550 mi) of streams assessed, an estimated 2,059 km (1,287mi) were affected by nonpoint sources, of which 1,374 km (859 mi) were affected by agricultural practices. Dewatering of stream reaches due to irrigation has restricted bull trout migration and isolated bull trout into subpopulations. Examples include the Powder, Malheur, Grande Ronde, Umatilla, and John Day rivers in Oregon (Buchanan et al. 1997); the Tucannon, Snake, Yakima, Methow, and Walla Walla rivers in Washington (WDW 1992; WDFW 1997); the upper Salmon and Lemhi rivers in Idaho (Dorratcaque 1986; Chapman et al. 1991); and the Clark Fork, Blackfoot, and Bitterroot rivers in Montana (Clancy 1993; MBTSG 1995a,b,d; 1996b,c; Swanberg 1996). The mainstem Umatilla River is frequently dry during the irrigation season, effectively isolating bull trout (M. Northrop, Umatilla National Forest, pers. comm. 1997). Moreover, two diversion facilities in the Umatilla River inhibit migration during portions of the year (Buchanan et al. 1997). Walla Walla River basin bull trout subpopulations are segregated in the Touchet River, Mill Creek, and South Fork and North Fork of the Walla Walla River by four irrigation diversion dams (Buchanan et al 1997; WDFW 1997). Streams are also channelized in agricultural areas, reducing stream length and area of aquatic habitat, altering stream channel morphology, and diminishing aquatic habitat complexity.

In Idaho, Dorratcaque (1986) documented chronic flow and passage problems on the Lemhi River, where the stream has been dewatered during the irrigation season. An irrigation diversion dewaters the upper Salmon River in Idaho from mid-July to the end of the irrigation season, preventing chinook salmon access to spawning areas. Juvenile chinook salmon, which are used as prey by bull trout, are, thereby, no longer available (Chapman et al. 1991). Stream flows in the Umatilla River basin in Oregon have been fully appropriated during the irrigation season since 1920 (Oregon Water Resources Division (OWRD), *in litt.* 1988). Over-appropriations have resulted in dewatered stream reaches that limit bull trout distribution within the basin. Similarly, the Oregon State Game Commission (OSGC) first recognized the negative effects of irrigation diversions on fisheries resources in the Deschutes River as early as 1950 (OSGC, *in litt.* 1950). In Washington, over 80 percent of the annual stream flow in the Yakima River basin is seasonally diverted for irrigation (WDW 1992). Bull trout in the basin are isolated into eight subpopulations in upper watershed tributaries by reduced summer flows and dams (WDW 1992). The lower reaches of the Walla Walla River in Washington are often dewatered during the irrigation season, isolating three bull trout subpopulations in perennial headwater reaches (Martin et al. 1992).

In 1991, Montana Fish Wildlife and Parks Department listed Montana streams that support or contribute to important fisheries and are substantially dewatered from diversions and appropriated stream flows (MFWP, *in litt.* 1991). Within the range of bull trout, 101 stream reaches totaling 958.4 km (599 mi) were listed as chronically dewatered due to irrigation withdrawals and an additional 220.8 km (138 mi) were listed as periodically dewatered. Although bull trout do not occur in all streams cited, all are within the range of bull trout and dewatering likely affects fish migration and connectivity among subpopulations.

The extirpation of bull trout in the mainstem Bitterroot River, Montana, and the loss of migratory fish are attributed to chronic dewatering of the mainstem Bitterroot and the lower reaches of most of its tributaries (Clancy 1993, 1996; MBTSG 1995a). Some diversions on the mainstem Bitterroot River are fish passage barriers or entrain downstream migrants into irrigation ditches (MBTSG 1995a). Nearly 104 km (65 mi) of 18 tributary streams are chronically dewatered in the Bitterroot River basin (MBTSG 1995a). Dewatering of tributary streams is a limitation to restoration of bull trout in the Bitterroot River basin (MBTSG 1995a) and the cause of habitat fragmentation isolating 27 subpopulations.

In the Clark Fork River basin, Montana, irrigation diversions, canals, and dams in the Jocko and lower Flathead rivers eliminated bull trout access to spawning and rearing areas; however, some of these structures are in the process of being modified (MBTSG 1996c; Hansen and DosSantos 1997; Montana Bull Trout Restoration Team [MBTRT] 1997). The lower reaches of the Jocko River are severely affected by grazing and irrigated agriculture (Hansen and DosSantos 1997). Because migratory bull trout can no longer ascend Grant Creek from the mainstem Clark Fork River due to irrigation diversions, only resident bull trout exist upstream (MBTSG 1996c; R. Berg, MFWP, pers. comm. 1997). Dewatering, irrigation return flows, and denuded riparian areas have increased water temperatures in the Blackfoot River and Clark Fork River basins, Montana (MBTSG 1995b,d). Water temperatures in the mainstem upper Clark Fork River frequently exceed 20° .C (68° F) and temperatures in tributaries, including the Little Blackfoot and Flint Creek, may exceed bull trout tolerance limits (MBTSG 1995d). In the Blackfoot River basin, irrigation returns have contributed to the warming of this historic coldwater river (MBTSG 1995b; Pierce et al. 1997). Irrigation diversions, particularly in the Little Blackfoot River and in Flint Creek of the upper Clark Fork River, are physical and thermal passage barriers to bull trout (MBTSG 1995d). Diversion for irrigation is the primary cause of 622 km (389 mi) of streams in the upper Clark Fork basin being chronically dewatered (MDHES 1994). Irrigation diversions also continue to limit restoration of migratory bull trout in the Blackfoot River basin (MBTSG 1995b). Recently, several diversions have been renovated to provide passage and eliminate ditch entrainment (MBTRT 1997).

Unscreened irrigation diversions in eastern Washington are known to trap or divert bull trout in Ahtanan Creek (Yakima River basin), Ingalls and Peshastin creeks (Wenatchee River basin), Roaring Creek (Entiat River basin), and Buttermilk, Little Bridge, Eagle, and Wolf Creeks (Methow River basin) (Hallock, Service, pers. comm. 1997). Channelization has altered 56 km (35 mi) of the Methow River (Mullan et al. 1992). Approximately 72 km (45 mi) of the lower Coeur d'Alene, St. Joe, and St. Maries rivers of the Spokane River basin have been channelized. These streams were once considered important rearing areas and migratory corridors for migratory (fluvial) bull trout. Approximately 47 percent of the bull trout subpopulations in the Columbia River population segment are affected by the past and ongoing effects from agricultural practices, including diversions.

Historical agricultural use in the Klamath River basin has had a profound effect on bull trout habitat in the larger tributaries and mainstem rivers (Buchanan et al. 1997). Channelization,

water diversions, removal of streamside vegetation, and disturbances have altered the aquatic environment by elevating water temperature, reducing water quantity and quality, and increasing sedimentation (Light et al. 1996). Deming, Long, Threemile, and Sun creeks have diversions immediately downstream of occupied bull trout habitat (Dunsmoor and Bienz, *in litt.* 1997). Unscreened diversions result in the transport of fish into irrigation canals (e.g., Deming and Sun creeks), often resulting in mortality (Light et al. 1996).

Hydroelectric, flood-control, or irrigation dams: Dams are not known to affect bull trout subpopulations in the Klamath River basin. However, bull trout passage is prevented or inhibited at hydroelectric, flood-control, or irrigation dams in almost every major river in the Columbia River basin except the Salmon River in Idaho. For instance, six dams were constructed without fish passage in the Boise River, Idaho, and of these, Arrowrock and Anderson Ranch dams isolate bull trout subpopulations. Historically, bull trout in the Boise River likely functioned as a single subpopulation with migratory adults moving among areas that are now isolated (Rieman and McIntyre 1995).

Similarly, bull trout were thought to have ranged throughout the Yakima River, Washington, prior to construction of several dams beginning in 1905 (WDFW 1997). Storage dams (Tieton, Bumping Lake, Keechelus Lake, Kachess Lake, and Cle Elum Lake dams) now isolate five of eight bull trout subpopulations in the Yakima River basin, with agricultural diversion dams isolating three additional bull trout subpopulations (WDFW 1997).

Operation of irrigation diversion dams also disrupts annual migrations of fluvial bull trout in five of seven spawning streams in the Methow River basin, Washington (WDFW 1997). In the mainstem Methow River, up to 79 percent of the average flow is removed from a 64 km (40 mi) reach, occasionally stranding and killing bull trout (Mullan et al. 1992). Due primarily to temperature constraints in partially dewatered tributaries to the Methow River, 60 percent of the total spawning and rearing areas for bull trout has been lost (Mullan et al. 1992; WDFW, *in litt.* 1995).

Also in Washington, bull trout in the North Fork Lewis River were separated into two subpopulations by the construction of Swift and Yale reservoirs, and the Condit Dam on the White Salmon River also isolated a subpopulation (WDFW 1997). In Oregon, bull trout were thought to have historically occurred throughout the Willamette River basin, but are presently found only in the McKenzie River basin. Dams in the basin (Trailbridge and Carmen) isolate bull trout into three subpopulations.

In the mainstem Clark Fork River, Idaho and Montana, bull trout moved and migrated freely from Lake Pend Oreille upstream to the headwaters of the Clark Fork and Flathead rivers prior to construction of five dams (Pratt and Huston 1993; MBTSG 1996b; Frissell 1997). The construction of Albeni Falls, Cabinet Gorge, Noxon Rapids, Thompson Falls, and Milltown dams isolated four bull trout subpopulations in the mainstem Clark Fork-Pend Oreille rivers. The uppermost dam, Milltown, isolates downstream fish from those in the upper Clark Fork River

and prevents fish downstream of the dam from moving into the Blackfoot River, a major tributary of the upper Clark Fork River. Annually, some bull trout congregate below Milltown Dam, attempting to move upstream. Radio-tagged bull trout collected below Milltown Dam and released above the dam moved into Rock Creek, a tributary to the upper Clark Fork system (Swanberg 1996).

Movement of bull trout from the mainstem Clark Fork River to the Flathead Lake system is prevented by Kerr Dam on the lower Flathead River. Sport harvest of bull trout from Lake Pend Orielle, Idaho, abruptly declined more than 50 percent after Albeni Falls and Cabinet Gorge dams blocked access to historic spawning streams and reduced adult numbers (Ellis 1940; Pratt and Huston 1993). Major tributaries of the Flathead River basin, Montana, were historically interconnected so that migratory bull trout were widely distributed throughout the drainage (MBTSG 1995c). Bull trout from the Flathead River system had access to the South Fork Flathead River drainage and the Swan River drainage. However, upstream passage from the Flathead River has been blocked by dams on the South Fork Flathead River (Hungry Horse Dam) and the Swan River (Bigfork Dam).

On the Kootenai River, Montana, Libby Dam is an upstream passage barrier to bull trout. The dam also has altered the flow regime, water temperature, and sediment load in the Kootenai River (MBTSG 1996d). Dam operation has typically reduced spring flows, which has made upstream passage over Kootenai Falls, located downstream of Libby Dam, impossible. Therefore, fish below the falls do not have the opportunity to interbreed with fish above (MBTSG 1996d). An additional effect of dams on bull trout is the loss of individuals from a subpopulation. During a 7-month study in the Boise River, bull trout were marked in Arrowrock Reservoir and 5 percent of them were recaptured in Lucky Peak Reservoir (U.S. Bureau of Reclamation (USBR), *in litt.* 1997). Lucky Peak Dam is downstream of the Arrowrock and Anderson Ranch subpopulations, and neither Lucky Peak Reservoir nor the reach downstream of the dam provide any known spawning habitat. Thus, fish entering Lucky Peak Reservoir are lost from the upstream subpopulations.

Urban Development: Residential development is not known to be a factor affecting existing bull trout subpopulations in the Klamath River basin. However, approximately 26 percent of the bull trout subpopulations in the Columbia River population segment are threatened by the effects of residential development. Development increases threaten to alter stream and riparian habitats through streambank modification and destabilization, increased nutrient loads, and increased water temperatures (MBTSG 1995a). Indirectly, urbanization within floodplains alters groundwater recharge by routing water into streams through drains rather than through more gradual subsurface flow (Booth 1991). Zoning and urban planning are often regulated at the County government level.

In Montana, rural residential development is rapidly increasing, particularly in drainages of the Bitterroot, Blackfoot, and Flathead rivers (MBTSG 1995a,b,c). The lower Bitterroot River is a

major non-point source of nutrient pollution, primarily from sewage effluent and land development (U.S. Environmental Protection Agency (USEPA) 1993 *in* MBTSG 1995a). Efforts to mitigate effects of rural development in the Blackfoot River basin have been encouraged by an active local group, the Blackfoot Challenge, which has been working to acquire conservation easements, among other projects. Residential development in the Flathead Lake system is considered a limitation for restoration of bull trout because of the threat to water quality from domestic sewage and changes to stream morphology (MBTSG 1995c).

Fire Management: Fire is also a component of the baseline affecting the two bull trout DPSs. The BA provided an analysis of the baseline conditions for fire. They noted that in forested areas of the ICBEMP area, departures from natural disturbance and successional processes due to human-related activities has resulted in substantive changes to vegetation structure and seral stage composition (USDA and USDI 1997a). These broad-scale changes in vegetative conditions have increased the probability that catastrophic wildfires and large-scale insect and disease events will occur. The three forest potential vegetation groups where historic fire regimes have been most changed include: Dry Forest Potential Vegetation Group, Moist Forest Potential Vegetation Group, and Cold Forest Potential Vegetation Group. Models were used to estimate the relations among various management activities, fire, vegetation groups, and bull trout.

At a broad-scale assessment level, adverse effects to forested bull trout watersheds on USFS and BLM administered lands from programs directed at restoring vegetation composition and structure and historic fire regimes under current plans have the potential to be significant. This is based on existing plan decisions which continue to support fire suppression policies and direct the use of traditional vegetation management techniques; and the inherent complexity of ecosystems combined with incomplete knowledge of how aquatic systems respond to various types of anthropogenic disturbances. Although the local effects of fire on aquatic systems have occasionally resulted in the loss of fish populations from stream reaches (Bozek and Young 1994; Rieman et al. 1997), these are more subtle and less damaging than changes from traditional vegetation management practices (silvicultural prescriptions and road building). Amendments to current plans with PACFISH and INFISH objectives and S&Gs will mitigate potential adverse effects but will not, by themselves, reduce effects to a level where conservation and restoration goals for bull trout are being met.

However, when forest restructuring priorities are more closely examined within the ICBEMP area, potential conflicts with conservation and restoration needs across the range of bull trout decrease, based on the following information: 1) In general, the greatest departure from historic range of variability in forest structure and composition has been in the dry forest potential vegetation group. This has resulted in the greatest departure from the historic fire regime of all types of forest potential vegetation groups (nonlethal/mixed-severity to lethal); 2) the dry forest type primarily occurs at low and mid-elevations; and 3) bull trout are generally more restricted to the moist and cold forest types which occur at higher elevations. As this separation is not complete, a strategy is needed at the programmatic level which provides consistency in how

administrative units address conflicts between forest restructuring objectives and the conservation and restoration of bull trout in order to meet the requirements of ESA.

The BA presented a strategy, based on a broad landscape perspective of risk and opportunities to bull trout, that could be used to-guide the distribution and intensity of forest restoration activities (Rieman and Clayton 1997).

Mining: Mining effects are not known to be a factor affecting bull trout subpopulations in the Klamath River basin. In the Columbia River population segment, approximately 20 percent of the bull trout subpopulations are threatened by past, ongoing, or potential future mining activities.

Mining severely impacts large portions of the Spokane River basin. Effects include roading, stream diversion and alteration, watershed degradation from airborne emissions, and the discharge of massive quantities of waste materials, including the release into the South Fork Coeur d'Alene River of 72 million tons of hazardous mine wastes laden with heavy metals such as lead, zinc, and cadmium (Coeur d'Alene tribe of Idaho et al. 1991). During the early 1930s, the South Fork Coeur d'Alene River and about 20 miles of the lower Coeur d'Alene River were considered devoid of aquatic life due to mining waste discharge (Ellis 1940). The Bunker Hill Superfund Site is located on the South Fork Coeur d'Alene River in Idaho. Although some aquatic species have returned to the river, bull trout are not among them. In Montana, bull trout have not recolonized the upper mainstem Clark Fork River where mining-related stream degradation extirpated all fish prior to the turn of the century (MBTSG 1995d; Titan Environmental Corp. 1997). The lingering effects of mining operations over the past century in the Butte and Anaconda reaches of the upper Clark Fork River has resulted in four Superfund sites being designated. Mining continues to impair water quality in 558 km (349 mi) of stream in these reaches (MDHES 1994). Eleven fish kills documented between 1959 and 1991 were attributed to mining contamination of the river (Titan Environmental Corporation 1997).

Numerous abandoned mines, such as the Blackbird and Cinnabar mines in the Salmon River drainage of Idaho, degrade water quality where toxic heavy metals continue to leach from mine sites into streams or groundwater. Old mine tailings in the floodplains of Newsome Creek, American River, and Crooked River, tributaries to the Clearwater River in Idaho, continue to prevent recovery of riparian areas (N. Gearhardt, Nez Perce National Forest, pers. comm. 1997). In Idaho, mine tailings abandoned decades ago contaminated a tributary of the Middle Fork Boise River with heavy metals, including arsenic, during flood flows in 1997 when migrating bull trout were present (R. Barker, Idaho Statesman, *in litt.* 1997; S. West, IDEQ, *in litt.* 1997). In Montana, historic mining in many tributaries of the Middle Clark Fork River has impaired water quality in 245 km (153 mi) of stream (MDHES 1994). The MBTSG (1995b) ranked mining in the Blackfoot River drainage as a limitation to bull trout restoration. Many mines exist in the western and southern portions of the Blackfoot River basin causing direct loss of bull trout habitat and contamination of waters from mine effluents (MBTSG 1995b). Fishes in the upper Blackfoot River are still affected by the washout of the Mike Horse tailings dam in 1975, which

spilled contaminated tailings into the Blackfoot River (MBTSG 1995b). Research in the Blackfoot drainage demonstrated that heavy metal contaminants released in the headwaters affect chemical trends, metal concentrations, metal bioavailabilty, and fish for 25 km (15.6 mi) from the contaminant source (Moore et al. 1991).

New open-pit mines using cyanide leach pads are planned for watersheds currently occupied by bull trout in the Middle Fork Boise River basin, Idaho, and in the Stibnite area of the East Fork South Fork Salmon River, Idaho (G. Visconty, Boise National Forest, *in litt.* 1996; Payette National Forest (PNF), *in litt.* 1996). In Montana, a large underground copper-silver mine proposed for Rock Creek in the lower Clark Fork River basin is currently in the permitting process. Tailings would be stored at the confluence of Rock Creek and the Clark Fork River (MBTSG 1996b; R. Stewart, USDI, *in litt.* 1995). Rock Creek is one of only two bull trout core areas in this subpopulation (MBTSG 1996b). A large open-pit gold mine using cyanide heap leach processing is proposed for the upper Blackfoot River basin, Montana. Much of the ore body occurs below the water table, requiring pumping of groundwater. Thus, the hydrology of the upper Blackfoot River system could be affected and an increase in contamination risks could result (S. Cody, USEPA, *in litt.*1997; K. McMaster, Service, *in litt.* 1997).

The North Fork Flathead River headwaters in Canada contain a large coal deposit that could be developed (MBTSG 1995c). Mining this deposit could destroy spawning habitat and degrade water quality in the Montana portion of the Flathead River system (MBTSG 1995c).

Other Actions Considered in the Environmental Baseline

PACFISH and INFISH Implementation

Because PACFISH and INFISH have been implemented since 1995 in areas occupied by the Columbia and Klamath River bull trout DPSs, effects of their implementation to the present are considered as part of the environmental baseline. Land management agencies have accomplished various road mitigation, closure, and obliteration projects over the last two years, but often in association with, or to counterbalance further road construction or reconstruction. Road standards RF-2 and RF-3 in PACFISH describe a comprehensive approach to identifying and repairing or obliterating roads which cause degradation of habitat for listed anadromous fish. Most National Forests and BLM Districts in the Snake River basin have not implemented key portions of these standards: they have not completed transportation plans, have not evaluated the effects of the majority of existing roads on listed species, and have not funded and implemented rehabilitation and obliteration activities accordingly.

Since PACFISH went into effect, NMFS has noted a decrease in the number of USFS and BLM actions NMFS found likely to adversely affect (requires formal consultation) the listed anadromous fish species. NMFS also noted, however, that several of the formal consultations were on actions in the South Fork and Middle Fork Salmon River subbasins. This presents a concern because of the high value of those subbasins as strongholds for chinook salmon,

steelhead, and bull trout. In spite of direction in the PACFISH amended LRMPs, other laws have made it difficult for USFS and BLM to avoid adverse affects from mining actions, water conveyances, issuance of road use permits enabling a variety of activities on non-Federal lands, and timber salvage under the Rescissions Act timber rider (Section 2001 of Public Law 104-19; enacted July 1995).

Aspects of the LRMPs themselves contribute to the development of actions that would degrade, or hinder improvement of, baseline conditions. A few examples of these types of actions can be found in NMFS' consultation records since 1995, but many more have been modified to minimize adverse effects through discussions held under the process for streamlining section 7 consultation. Some of the features of LRMPs which have reduced their effectiveness in improving baseline conditions are listed below.

(1) LRMPs lack a coordinated, clearly defined strategy to conserve anadromous fish species, and do not schedule the development of such a strategy. This type of strategy should include not just the measures outlined in PACFISH to prevent degradation, but would also prioritize watersheds based on species' biological requirements and would establish a schedule and actions to be taken to achieve the functioning aspects of those watersheds at appropriate rates.

(2) LRMPs lack direction and methodology to analyze collections of actions within watersheds--usually 5th and 6th field hydrologic unit code (HUC) scale--so that combined effects are adequately addressed.

(3) LRMPs lack direction and methodology to determine and track fish habitat conditions related to land management activities at the subbasin scale (3rd and 4th field HUCs).

(4) LRMPs contain goals and standards both for production of goods and services and resource conservation without a clear, coordinated approach to achieving realistic and legally required levels of both.

(5) Goals, objectives, standards, and guidelines in the LRMPs are numerous and open to interpretation, and thus lead to actions varying from no effect to jeopardy to the listed species.

(6) Road rehabilitation and obliteration, measures to reduce impacts on grazing allotments, and other restoration activities have been inadequately planned, funded, and monitored; therefore, the USFS and BLM have been greatly limited in actively improving baseline aquatic conditions over the last three years.

In summary, in their consultation regarding the effects of the LRMPs and ACSs on steelhead, NMFS concluded that, while the addition of PACFISH to the LRMPs likely resulted in actions allowing natural recovery processes to take place in many areas, other laws and shortcomings of

LRMPs themselves have reduced the effectiveness of LRMPs in avoiding adverse effects on the environmental baseline since 1995 (U.S. Department of Commerce [USDC] 1998). Also, because natural recovery generally takes place over many years or decades, some of the positive effects from improved land management practices on Federal land are not yet evident. Given those considerations, and assuming that land management practices on non-Federal land in the two basins have not changed substantially over the last two years, habitat conditions for anadromous fish likely remain much as in 1995. That is, most managed watersheds remain in at-risk or non-functional condition due to the effects of past and present land management activities on one or more key elements of habitat for listed anadromous fish species.

In considering both PACFISH and INFISH, the BA (USDA and USDI 1998a) concluded that indefinite extension of PACFISH and INFISH aquatic conservation strategies delays the recovery of bull trout and increases the risk that key population segments will be irretrievably lost. The PACFISH and INFISH aquatic conservation strategies maintain a fragmented network of habitats in degraded condition, where they presently exist, because they lack a comprehensive management strategy which protects and restores bull trout watersheds. The interim direction does not provide adequate assurance that future actions will not result in adverse effects to listed bull trout DPSs.

Habitat Conservation Plans

The effects to bull trout of implementing both the Washington State Department of Natural Resources (DNR) and Plum Creek I-90 Habitat Conservation Plans (HCPs) are included in the environmental baseline. Both HCPs have undergone section 7 consultation for Northern Spotted Owls and other listed species.

The DNR HCP does not propose riparian and wetland conservation strategies for the DNR east-side planning units, which includes the project area. Current Washington State Forest Practice Rules would apply in managing riparian areas in the project area. The current rules allow harvest activities throughout the whole Riparian Management Zone up to the edge of a stream. Impacts of near-stream harvest which negatively affect bull trout include increased stream bank erosion, increased stream sedimentation, decreased canopy cover causing increased stream temperatures, and decreased large woody debris recruitment (elements in pool formation and instream cover). Subpopulations most at risk in the east-side planning units are the Klickitat and White Salmon River subpopulations, due to the large DNR-managed land base and remnant level status of these subpopulations. The lack of a comprehensive riparian and wetland conservation strategy for the east-side planing units continues to place east-side bull trout subpopulations at risk from timber and non-timber resource activities.

The Plum Creek I-90 Multi-Species HCP includes a Riparian Management Strategy which incorporates watershed analysis and the maintenance and protection of Riparian Habitat Areas. These measures are intended to ensure greater protection of aquatic and riparian resources than under existing State and Federal regulations. Populations most affected by this HCP are in the

Yakima River Basin. The Service is currently conducting section 7 consultation evaluating the effects of this HCP on bull trout.

Public Law (PL) 104-19

In July 1995, Congress passed PL 104-19, often referred to as the Rescissions Act. Signed on July 25, 1995, PL 104-19 included provisions directing the USFS and the BLM to expedite salvage sales. These provisions expired on December 31, 1996. As part of the procedures established to expedite salvage sales, Section 2001 of the Rescissions Act broadened the definition of salvage sales, eliminated administrative appeals of such sales by the public, abridged judicial review, and in effect temporarily suspended environmental and natural resource laws that would otherwise apply to such sales. In signing this legislation, President Clinton directed the involved Federal agencies to implement the salvage provisions in an environmentally sound manner, and to continue to use the streamlining procedures, coordination, and consultation actions that were already underway as a result of previous direction from the Administration (USDC 1996).

The interagency memorandum of agreement (MOA) that resulted from the President's direction established the framework for salvage sale activity under the Rescissions Act. Federal agencies covered by the MOA included USFS, BLM, FWS, NMFS, and USEPA. In addition to overall direction, the MOA included 11 specific items, one of which called for a national review of the salvage program (USDC 1996).

The agency heads instructed the interagency review team to address four objectives in carrying out the review process. Those objectives, together with a brief summary of their findings, as excerpted from the report, are presented below.

Objective 1. Determine agency compliance with the 11 items in the MOA and related guidance, and identify actions to enhance compliance.

> There was substantial variation in field compliance with various MOA items. There was a direct correlation between the level of understanding and acceptance of the MOA at the field level and compliance with its provisions.

Objective 2. Determine whether the MOA has been effective in establishing process necessary for achieving environmentally sound timber salvage sales.

> The MOA provided direction that was an adequate basis for effective planning and management processes. However, at the time of the report, practical establishment of the processes on the ground was still developing. The review team recommended increased oversight and accountability at several organizational levels.

Objective 3. Evaluate the effectiveness and time/cost savings associated with the streamlined

consultation process, which was developed prior to PL 104-19 and incorporated in the MOA, and determine the potential applicability of the streamlined consultation process for future use.

Where the streamlined process was completed in a collaborative manner with true teamwork between the agencies, the process ran more smoothly, there were fewer setbacks and delays, sale preparation times lines were generally reduced, and the sales were more likely to be designed to conserve threatened and endangered species or minimize adverse effects to these species.

Objective 4. Identify any additional actions to further enhance interagency collaboration.

Several actions were identified. Some of the more significant were:
- leadership needs to be asserted at all organizational levels to assure collaboration occurs as envisioned by the MOA.
- agencies should conduct interagency site visits and workshops to share successes and focus on improvement.
- the agencies should jointly develop and use program design criteria to improve ecosystem approaches to management and increase efficiency.

Non-Federal Actions in the Action Area

Forest Practices: Oregon, Washington, Idaho, and Montana each have adopted a Forest Practice Act (FPA) or other legislation consisting of rules and regulations addressing forest management on State, Federal, and private lands. In general, the legislation establishes best management practices (BMPs) to be implemented on forests, such as streamside management zones (Montana Department of State Lands 1994), activities allowed in riparian areas, restrictions on harvest adjacent to streams, and location of road construction. The application of BMPs is voluntary in some States. Although audits show that compliance with BMPs is high in Idaho (H. Malany, Idaho Forest Practice Act Advisory Committee Member, *in litt.* 1997) and Montana (Mathieus 1996), the Service is not aware of evaluations of various States' BMPs relative to the protection of bull trout habitat and processes affecting water quality, such as sediment delivery, water temperature, recruitment of woody debris, and bank stability. In Idaho, half of timber sales audited resulted in contributions of sediment to streams, largely from inadequately maintained roads (Zaroban et al. 1997). Even with high implementation rates, Idaho's forestry BMPs have been ineffective at maintaining beneficial uses, including cold water biota (McIntyre 1993). In Montana, McGreer (1994) noted that the Montana legislation may adequately provide for woody debris and bank stability, but it may be inadequate for temperature control and sedimentation. The MDNRC has discontinued timber harvest and grazing in areas directly adjacent to streams containing bull trout (P. Flowers, MDNRC, *in litt.* 1996). In the Washington Department of Natural Resources HCP Draft Environmental Statement (USDI et al. 1996) it is stated that, "Forest Practices Riparian Management Zone widths may not always ensure protection of riparian components because minimum widths, as specified by the Washington Forest Practices Rules (WFPR), are insufficient to protect riparian ecosystems." The WFPR are much less

restrictive with regard to timber harvest and associated activities in the proximity of streams than the S&Gs within Riparian Reserves on Federal lands under the Northwest Forest Plan. Based on current information, the Service is unable to conclude that State FPAs and related legislation are adequate to protect bull trout habitat.

Water Quality Standards: Under sections 303 and 304 of the Clean Water Act (CWA), States or the USEPA set water quality standards, which combine designated beneficial uses and criteria established to protect those uses. Water bodies that are identified as failing water quality standards are designated by States under section 303(d) as water quality limited (MDHES 1994; USEPA 1994; Oregon Department of Environmental Quality [ODEQ] 1996), and subject to development of management plans to restore water quality and protect designated uses. These management plans, or total maximum daily loads (TMDLs), address both point and non-point sources of pollutants within a watershed. BMPs are used with TMDLs to address non-point sources of pollution, such as mining, forestry, and agriculture; however, regulatory authority to enforce the BMPs varies among the states. It is estimated that 10 percent of the total length of streams within the ICBEMP assessment area, including the Klamath River and Columbia River basins, are listed as water quality limited. This may underestimate the true extent and distribution of streams with impaired water quality potentially affecting bull trout (USDA and USDI 1997b). In the Klamath River basin, stream reaches designated as water quality limited (i.e., cited on the 303(d) list of Oregon for various water quality standards (ODEQ 1996)) are estimated to apply to six of the seven bull trout subpopulations. In the Columbia River basin, water bodies designated as water quality limited by Oregon, Washington, Idaho, and Montana are estimated to apply to at least 64 of the 141 bull trout subpopulations.

Relative to water temperature, Oregon established a water quality criterion of 10° C (50° F) as a weekly average based on daily maximum temperatures in bull trout spawning and rearing waters (OAR 340-41-685 and OAR 340-41-026); however, water bodies where these criteria would apply have not been identified. In Washington, temperature criteria for waters vary among the different classifications that are assigned to each water body, and range from 16 to 22° C (60.8 to 71.6° F) (Chapter 173-201 WAC). Washington is reviewing these standards with the intent of creating more appropriate water quality standards; however, whether the criteria specifically are for bull trout is unknown. In Idaho, USEPA disapproved the state's temperature criteria applications within the geographic range of bull trout (USEPA 1997). The USEPA determined that the criteria did not provide adequate protection for bull trout relative to two designated uses--cold water biota and salmonid spawning (maximum daily average of 13° C (55.5° F) and 9° C (48.2° F) for each respective use). In July 1997, USEPA promulgated a temperature criterion of 10° C (50° F) during June through September in designated stream areas, as a weekly average based on daily maximum temperatures for spawning and rearing of bull trout (USEPA 1997). To date, the State has not adopted USEPA's promulgated criterion, but has adopted 12° C as a daily average during June-August for juvenile rearing and 9° C for September and October for spawning. Additionally, Idaho has established a geographical area where these criteria would apply. It is unknown whether USEPA will approve the State's criteria and withdraw the promulgated rule. In Montana, the temperature criterion applied to waters with

bull trout is 19° C (66° F); temperature can be raised 0.6° C (1° F) by discharges, but water temperature may not exceed 19.5°C (67° F) (Administrative Rules of Montana 1996).

In accordance with Section 319 of the CWA, States also develop programs to address non-point sources of pollution such as agriculture, forestry, and mining. The effectiveness of controlling water pollution from these activities has been mixed. The State of Washington monitored the effectiveness in meeting water quality criteria for temperature in riparian areas on forest lands and concluded that regulations for stream shading were inadequate to meet criteria (Sullivan et al. 1990). In summary, it is uncertain whether the CWA can provide sufficient protective measures for conservation of bull trout. Temperature regime is one of the most important factors affecting bull trout distribution (Adams and Bjornn 1997, Rieman and McIntyre 1995). Given the known temperature requirements of bull trout (Buchanan and Gregory 1997), criteria developed by the four States may not be conducive to either spawning, incubation, rearing, migration, or combinations of these life-history stages.

Conservation efforts by non-Federal entities

All four States within the range of the Klamath River and Columbia River DPSs of bull trout have regulations affecting bull trout and their habitat. Idaho, Montana, and local or county organizations have recently developed or are developing conservation plans to maintain and restore bull trout, primarily through stream habitat protection.

Idaho: In 1995, Idaho Governor Phil Batt initiated a conservation plan to restore bull trout populations in Idaho. The mission of the Governor's Plan, approved in July 1996, is to ". . . maintain and/or restore complex interacting groups of bull trout populations throughout their native range in Idaho" (Batt, *in litt.* 1997). Although the harvest of bull trout is closed throughout Idaho and State-sponsored survey and monitoring has increased (S. Mealey, IDFG, *in litt.* 1997), few on-the-ground recovery actions for bull trout have been implemented to date.

Other efforts include a 1994 conservation agreement (CA) between the Idaho Department of Transportation (IDOT) and the Service to protect bull trout (USDI and IDOT, *in litt.* 1994), and recent conservation activities by the IDFG that were funded by Section 6 of the ESA. The IDOT finished only one passage restoration project under the CA, and recently declined to renew the CA (R. Howard, Service, pers. comm. 1997). Since 1994, IDFG has used Section 6 funds to begin several habitat restoration actions in northern and southwestern Idaho. Aside from enacting restrictive fishing regulations, few protective or restoration projects have been completed that substantially reduce threats to bull trout throughout the Columbia River Basin.

Oregon: Beginning in 1992 and 1993, several interagency bull trout working groups were formed in Oregon (R. Rosen, ODFW, *in litt.* 1995). These working groups have been instrumental in gathering additional status information and developing preliminary conservation strategies for bull trout in their respective basins. These efforts are encouraging signs of bull trout conservation, but the outcome has not yet been demonstrated.

The Upper Klamath Basin Bull Trout Conservation Strategy (Light et al. 1996) was developed by the Klamath Basin Bull Trout Working Group in response to the limited and shrinking distribution and number of bull trout. The Working Group, formed in 1993, is composed of representatives from the Service, Oregon Department of Fish and Wildlife, Fremont and Winema National Forests, Crater Lake National Park, PacifiCorp, USBR, Sprague River Water Users Association, Klamath Basin Water Users Protective Association, U.S. Timberlands, and Klamath Tribes. The defined goals of this group as identified in the Conservation Strategy are--(1) secure existing bull trout populations and (2) restore populations to some of their former distribution (Light et al. 1996). Phase 1 has concentrated on addressing threats to bull trout from non-native salmonids and addressing problems related to stream temperatures. Phase 2 will involve expanding the number of subpopulations by reestablishing bull trout in high quality headwater habitats, effectively increasing the size of the Klamath River metapopulation and making it more resilient to natural disturbance (Light et al. 1996).

All habitats currently occupied by bull trout in the Klamath River basin are managed by Working Group members. From 1993 through 1996, conservation actions (phase 1) were implemented by the Working Group, including--watershed assessments; fish distribution, abundance, and spawning surveys; collection of stream temperature and sediment data to help identify limiting factors; brook trout eradication efforts in Long, Sun, and Threemile creeks; reduction or elimination of grazing along bull trout habitat owned by U.S. Timberlands; road system improvements, closures, and rehabilitation; and barrier management to prevent access of non-native fishes (Johnson, U.S. Timberlands, *in litt.* 1997; Buchanan et al. 1997). Habitat improvement projects have also been implemented in areas historically occupied by bull trout, such as the 9,700 ha (24,000 ac) Nature Conservancy preserve at Sycan Marsh (P. Rexroat, The Nature Conservancy, *in litt.* 1997) and the Sun Pass State Forest on lower Sun Creek. These ongoing conservation efforts have been complicated by recent private land ownership changes and lack of an approved recovery plan that identifies specific conservation tasks and actions.

In addition to the Klamath Basin Bull Trout Working Group, a Federally-authorized, interagency and entity group, the Upper Klamath Basin Working Group, was established in 1994. This group, composed of Federal, State, county, city, tribal, environmental, local business, agricultural and ranching, and local community members, works on a consensus-based approach to Klamath basin ecosystem issues. The group focuses on ecosystem restoration projects and has funded bull trout conservation efforts, such as riparian fencing and road maintenance and obliteration projects.

Washington: The Washington Department of Fish and Wildlife released the final Environmental Impact Statement (EIS) for the proposed Wild Salmonid Policy in September 1997 (WDFW 1997). The EIS focused on salmon and steelhead, referring to bull trout and other wild salmonids in an ancillary manner. It described problems and challenges facing the recovery of anadromous and resident salmonids throughout Washington. Regardless of the alternative ultimately selected by the Washington State Fish and Wildlife Commission as the Wild Salmonid Policy, implementation of the policy will suggest guidelines for actions taken by the WDFW and will

not be binding on other State, tribal, and private entities. Uncertainties will remain regarding implementation and effect of the policy on bull trout conservation in Washington.

Montana: In Montana, Governor Marc Racicot appointed the Bull Trout Restoration Team in 1994 to produce a plan that maintains, protects, and increases bull trout populations. The team appointed a scientific group that has subsequently prepared eleven basin-specific status reports and two technical, peer-reviewed papers. A third technical paper is presently undergoing peer review. A Montana Bull Trout Recovery Plan, including a recovery goal, is also nearing completion. Watershed groups are being established in some areas to lead local bull trout restoration efforts. As of October 1997, some localized habitat restoration projects, such as removal of fish passage barriers, screening irrigation diversions, riparian fencing, stream restoration projects, and habitat monitoring, had been completed or were underway (P. Graham, MFWP, and B. Clinch, MDNRC, *in litt.* 1997). Likelihood of implementation of the restoration plan and the effect of the plan on future bull trout conservation in Montana is unknown.

Fisheries Management by Non-Federal Entities

Statewide angling regulations have become more restrictive in an attempt to protect bull trout throughout Idaho, Montana, Nevada, Oregon, and Washington and are considered by the Service to be adequate to protect the species from excessive take. The Service intends to continue to work with the States and Tribes in developing management plans and agreements with the objective of recovery and eventual delisting of the Klamath River and Columbia River distinct population segments. The special rule provided in the final rule regarding bull trout listing (USDI 1998) allows for take of bull trout within the Klamath River and Columbia River distinct population segments when it is in accordance with applicable State and Native American Tribal fish and wildlife conservation laws and regulations, as constituted in all respects relevant to protection of bull trout. The Service believes that this special rule will allow for more efficient management of the species, thereby facilitating its conservation.

Recreational fishing for other trout species continues in the basin, and, as a consequence, incidental fishing mortality of bull trout likely occurs (OCAFS 1993). Incidental bull trout mortality due to angling is unknown, but is not suspected to be suppressing bull trout subpopulations in the Klamath River basin (Light et al. 1996). However, Dunsmoor and Bienz (Klamath Tribe, *in litt.* 1997) consider angling to be a factor negatively affecting bull trout, especially subpopulations with low numbers and proximity to highway access, such as Threemile Creek.

Overharvest of bull trout in the Columbia River basin historically, likely contributed to their decline. In the past, harvest included legal recreational angling, poaching, and State-sponsored eradication programs (Thomas 1992). Bull trout were often targeted for removal by anglers and government agencies because bull trout preyed on salmon and other desirable species (Simpson and Wallace 1982; Bond 1992). As recently as 1990, State and Federal agencies instituted programs to eradicate bull trout through bounties and poisoning of waterways (Ratliff and

Howell 1992; ODFW 1993; Newton and Pribyl 1994; Palmisano and Kaczynski, NFRC, *in litt.* 1997). For instance, during the 1940's and 1950's in Oregon, several hundred bull trout migrating from Wallowa Lake to spawn in Wallowa River were trapped in a weir and exterminated (B. Smith, WDFW, *in litt.* 1997). Bull trout were recently re-introduced to Wallowa Lake in summer 1997 in an effort to re-establish the fish.

Mortality from incidental catch and release angling of bull trout and harvest as a result of misidentification still continues under existing fishing regulations. For example, about half or fewer of anglers surveyed were able to correctly identify bull trout from other salmonids in west-central Montana (Kelly et al. 1996; M. Long and S.P. Whalen, MFWP, *in litt.* 1997). Poaching of bull trout likely continues and can be especially detrimental to small, isolated subpopulations of migratory fish (WDFW 1992; Craig and Wissmar 1993; Pratt and Huston 1993; Long 1997). Approximately 21 percent of the bull trout subpopulations in the Columbia River population segment are threatened by the effects of poaching. A study in the Metolius River suggested that 2 of 22 radio-tagged adult bull trout were illegally harvested (Ratliff et al. 1996). Illegal harvest of bull trout in northwest Montana has been a recurring problem for over 50 years, especially in drainages of the Blackfoot, Kootenai, South Fork Flathead, and Clark Fork rivers (MBTSG 1995e; Swanberg 1996; Long 1997). In response, the MFWP instituted a program in 1994 funded by the Bonneville Power Administration to reduce the illegal harvest of bull trout, disperse information to improve anglers' fish identification skills, and increase understanding of the importance of native species (Long 1994). Additionally, the Montana legislature increased the penalties for bull trout poaching, and the Bonneville Power Administration, until recently, funded increased enforcement (M. Racicot, Governor of Montana, *in litt.* 1995).

Introductions of non-native species by the State fish and game departments and private parties across the range of bull trout has resulted in declines in abundance, local extirpations, and hybridization of bull trout (Bond 1992; Howell and Buchanan 1992; Leary et al. 1993; Donald and Alger 1993; Pratt and Huston 1993; MBTSG 1995a,c, 1996e; Platts et al 1995; Palmisano and Kaczynski, NFRC, *in litt.* 1997). Negative effects of interactions with introduced non-native species may be the most pervasive threat to bull trout throughout the Columbia River basin. Of the 141 subpopulations of bull trout in the Columbia River population segment, approximately 62 percent were threatened by competition, predation, or displacement by non-native species. Often one or more non-native species have been introduced into bull trout habitats.

Non-native fish threaten bull trout in physically unaltered habitats, including roadless areas, wilderness, and national parks. For instance, brook trout occur in tributaries of the Middle Fork Salmon River within the Frank Church-River of No Return Wilderness, (Thurow 1985; S. Achord, NMFS, *in litt.* 1994) and Sun Creek in Crater Lake National Park (Light et al. 1996). Glacier National Park has self-sustaining populations of introduced non-native species, including lake trout, brook trout, rainbow trout, Yellowstone cutthroat trout, lake whitefish (*Coregonus clupeaformis*), and northern pike (MBTSG 1995c). Although stocking in Glacier National Park was terminated in 1971, only a few headwaters lakes contain exclusively native species,

including bull trout.

Introduced brook trout threaten bull trout through hybridization, competition, and possibly predation (Leary et al. 1993; Thomas 1992; WDW 1992; Clancy 1993; Rieman and McIntyre 1993; MBTSG 1996a). Hybridization between brook trout and bull trout has been reported in Montana (MBTSG 1995a,d, 1996c,d,f; Hansen and DosSantos 1997), Oregon (Markle 1992; Ratliff and Howell 1992), Washington (WDFW 1997), and Idaho (Adams 1996; T. Burton, BNF, pers. comm. 1997b). Hybridization results in offspring that are frequently sterile (Leary et al. 1993), but some hybrids show gonadal development (Dunsmoor and Bienz, Klamath Tribe, *in litt.* 1997), raising concern of potential introgression. Hybrids may be significant competitors; Dunsmoor and Bienz (Klamath Tribe, *in litt.* 1997) noted that hybrids are aggressive and larger than resident bull trout, suggesting that hybrids may have a competitive advantage. Brook trout mature faster and have a higher reproductive rate than bull trout. This difference may favor brook trout over bull trout when they occur together, leading to replacement of bull trout with brook trout (Leary et al. 1993; Clancy 1993; MBTSG 1995a).

Opossum shrimp, a crustacean native to the Canadian Shield area, was widely introduced in the 1970s as supplemental forage for kokanee and other salmonids in several lakes and reservoirs across the northwest (Nesler and Bergerson 1991). The introduction of opossum shrimp in Flathead Lake changed the lake's trophic dynamics, and is widely believed to have been partially responsible for the expanding lake trout population, resulting in increased competition and predation on bull trout (T. Weaver, MFWP, *in litt.* 1993). Thus, opossum shrimp have had an indirect, negative effect on bull trout. Conversely, in Swan Lake, Montana, opossum shrimp and kokanee have become established and increased the availability of forage for bull trout, contributing to the significant increase in bull trout numbers in the Swan River basin (MBTSG 1996f). Introduced species, such as rainbow trout, may benefit large adult bull trout by providing supplemental forage (Faler and Bair 1991; Pratt 1992; ODFW, *in litt.* 1993). Introductions of non-native game fish result in increased angling and subsequent incidental catch and illegal harvest of bull trout (Rode 1990; Bond 1992; WDW 1992; MBTSG 1995c). Thus, the effects of introduced species on bull trout involve complex interactions that are dependent on several factors.

In 1992, chemical eradication of brook trout was initiated in Sun Creek of the Klamath River DPS (Buktenica 1997). The chemical treatment apparently killed a number of bull trout due to the difficulty of removing fish prior to treatment (Buktenica 1997). Other eradication programs relying on chemical treatments would likely have similar effects on bull trout. Ongoing management actions in Threemile and Long creeks focus on brook trout eradication via selective electrofishing, snorkel-spearing, trapping, and chemical treatments with the objective of expanding bull trout range. Brook trout have declined in Threemile Creek, but there has been no measurable change in brook trout numbers in Long Creek (Dunsmoor and Bienz, Klamath Tribe, *in litt.* 1997).

V. EFFECTS OF THE ACTION

Direct effects occur simultaneously with, or immediately after, implementation of the proposed actions. Indirect effects include future activities that are induced by these activities but occur after the action is completed. Effects of the action also include direct and indirect effects of interrelated and interdependent actions (see 50 CFR 402.02). Future actions with Federal involvement, not included in this biological opinion, and which potentially impact bull trout are not covered under this document but are subject to separate section 7 analysis and review.

Service Assumptions

The following assumptions were used by the Service to evaluate the proposed action. These assumptions frame the Service's expectation of impacts likely to occur as a result of the continued implementation of LRMPs as amended by PACFISH and INFISH.

1. Implementation of LRMPs, as amended by PACFISH and INFISH, includes components and objectives of an interim ACS that will result in reducing the risk of loss of populations and reduce the potential negative impacts to aquatic habitat in the short-term. The species will persist, but most likely not recover, under this direction.

2. PACFISH and INFISH are intended to be interim strategies that will be replaced by a long-term, comprehensive management strategy that integrates processes and functions from riparian, aquatic, and terrestrial ecosystems, includes a comprehensive aquatic conservation strategy for listed, proposed, and sensitive fish species, a spatially stratified and prioritized restoration strategy, and is based on an adaptive management process.

3. All actions in watersheds containing bull trout will be consistent with the riparian goals in PACFISH and INFISH. The determination of ACS consistency is a responsibility of land management agency line officers and is supported by sound, scientifically-based information preferably gained through watershed analysis.

4. S&Gs in the PACFISH and INFISH strategies will be strictly implemented as written, unless individual administrative units have other standards that are more restrictive and better protect and conserve aquatic resources. Suggestions made to administrative units during PACFISH implementation field reviews will be strongly considered when making management decisions.

5. All goals, objectives, standards, and guidelines in PACFISH that apply to anadromous fish also apply to bull trout in PACFISH areas.

6. Key, priority, and special emphasis watersheds will be identified and managed to conserve habitat for anadromous and resident fish and to provide a comprehensive refugia network for the protection and recovery of bull trout. The refugia network will include important high quality but unoccupied historical habitat for bull trout.

7. Non-key and priority watersheds containing bull trout will be managed to meet riparian goals in PACFISH and INFISH and in a manner that conserves habitat for anadromous and resident fish.

8. The USFS and BLM will work with the Service to develop and implement strategies that integrate and coordinate restoration, protection, and evaluation measures to expeditiously achieve restoration objectives at multiple scales.

9. Watershed analysis will be conducted using the Federal Guide "Ecosystem Analysis at the Watershed Scale" and will not be project-driven but undertaken to generate an information base and recommendations for use in project planning. The modules associated with the Federal Guide will be used until other modules can be proven to be as or more effective for watershed analysis. Interim RMOs and RHCAs will be refined through watershed analysis

10. Monitoring of PACFISH implementation will continue, but be expanded to include INFISH areas and to require regional/state level FS and BLM line officer involvement. An effectiveness monitoring strategy will be developed and initiated in a short time frame.

11. Project and watershed level consultations, using the section 7 consultation streamlining guidance and Level I and II team process have and will continue to operate to reduce the potential for take or adverse effects to bull trout at the project and watershed levels.

Although the LRMPs as amended by the PACFISH and INFISH aquatic conservation strategies (ACSs) were intended to preserve management options for anadromous (PACFISH) and inland native (INFISH) fishes for an interim period by reducing the risk of loss of populations and reducing potential negative impacts to aquatic habitat, the level of protection afforded individual aquatic species varies considerably. Certain activities that are consistent with the LRMPs and RMPs as amended by PACFISH and INFISH may not completely avoid take of individuals or loss/degradation of important habitats. For example, under MM-1, mineral operations may be located in RHCAs. The current environmental baseline affecting the various DPSs of bull trout is not the same in each case. Also, PACFISH and INFISH were not designed to be landscape-scale, long-term conservation strategies, which narrows their influence on aquatic resources. They focus only on riparian and instream habitats and do not integrate other watershed factors upslope that can greatly impact aquatic ecosystem functions and processes. The Service believes that incomplete or inconsistent application of S&Gs, differing interpretations of the intent of the interim ACSs' guidance among field units and within the interagency structure, inaccurate assumptions concerning the level of protection to bull trout offered by various components within the ACSs, and the narrow scope of these strategies may also contribute to take.

To determine the potential for effect of LRMPs as amended by PACFISH and INFISH on bull trout and their habitat, the Service constructed its analyses using the following three tiers of effects: 1) ACS Component-Related Effects: effects associated with components within the ACSs that pertain to all activities; 2) Specific Application Effects: effects of specific land

management activities associated with ACS S&Gs; and 3) Spatially Directed Effects: effects associated with LRMP-designated land management emphasis areas.

ACS Component-Related Effects

The eight goals of the PACFISH and INFISH strategies are similar and focus on riparian and instream habitat functions and processes. These goals give general direction to maintain and restore characteristics of healthy, functioning watersheds, riparian areas, and associated fish habitats. RMOs, RHCAs, Key Watersheds in PACFISH and Priority Watersheds in INFISH, watershed analysis, watershed restoration, and monitoring are components of the strategies that are designed to be an integral part of all actions and work in concert toward realizing the riparian goals. How these components are applied at the watershed and site-specific levels will affect the types and outcomes of actions and, therefore, will be overriding factors that influence the potential for take of the species as well as the potential of adverse effects on the habitat.

1) RMOs

Although existing LRMPs afforded riparian areas some protection, degradation of these areas continued. Interim RMOs were included in PACFISH and INFISH to halt the continued degradation by providing a consistent set of interim criteria for riparian areas and fish habitat that are good indicators of ecosystem health, are quantifiable, and are subject to accurate and repeatable measurements. These indicators were intended to serve as default "target" values that when achieved would provide a high level of habitat diversity and complexity for, and meet the needs of, the fish community inhabiting a watershed. In managed watersheds, where current habitat conditions are worse than the RMOs, implementation of the interim ACSs may result in some improvement for bull trout. In watersheds where habitat features are similar to RMOs, implementation of these strategies may support the persistence of bull trout, but recovery beyond their current status is uncertain. Effective indicators of stream habitat condition would provide criteria against which progress toward attainment of riparian goals could be measured. The Service has the following general concerns with RMOs as established by PACFISH and INFISH:

1) no decision framework was provided for land managers to decide which actions will retard or prevent attainment of RMOs;

2) no time frame for attainment of the RMOs were designated;

3) data requirements were not described for determining whether RMOs are met or for changing RMO values;

(4) no direct guidance was given to prevent degradation of areas that currently surpass the RMOs;

(5) both strategies allow RMOs to be adjusted based on site-specific rather than

watershed analysis;

(6) neither strategy provides clear guidance for management of areas where existing data, in lieu of watershed analysis, indicates that watershed or stream reach habitat capabilities could surpass the RMOs values; and

(7) application of RMOs throughout the areas where PACFISH and/or INFISH amend LRMPs and RMPs is not consistent.

The concern relating to the lack of direction as to data requirements needed to change RMOs was identified as a deficiency in the BA. Although default RMO values are used widely, there is an increasing tendency for administrative units to modify RMOs based on results from watershed analysis and site-specific analysis; however, RMOs have been modified using insufficient data for some ongoing projects, such as special use permits and some emergency flood and fire response actions (Appendix 4- letter to Russ Strach NMFS from Jack Williams BLM dated October 28, 1997).

More specifically, the Service has concerns about the RMO temperature variable in PACFISH and the absence of a criteria for sediment among RMOs for both strategies. Stream temperature and substrate composition may be particularly important characteristics of suitable habitats for bull trout (Lee et al. 1997). PACFISH RMOs were developed to accommodate the needs of anadromous fish species and are applied to streams in watersheds with anadromous fish. The moving average maximum temperature criteria identified in the PACFISH RMOs are too high for bull trout during most of its life stages (Appendix 5- Temperature section). Thermal barriers have contributed to the disruption and fragmentation of bull trout habitat (Buchanan et al. 1997: USEPA 1997; MBTSG 1998; WDFW 1997). Also, increases in stream temperatures can cause direct mortality, displacement by avoidance (Bonneau and Scarnechia 1996), or increased competition with species more tolerant of warm stream temperatures (Craig and Wissmar 1993 cited in 62 FR114 Proposed Rule; MBTSG 1998; Rieman and McIntyre 1993). Sediment is another important indicator of ecosystem condition since sedimentation can increase water temperatures, reduce pool depth, alter substrate composition, reduce interstitial space, and cause channels to braid (MBTSG 1998, Rieman and McIntyre 1993). Bull trout are more strongly tied to the stream bottom and substrate than other salmonids (Pratt 1992). They prefer loose, clear gravel for spawning (Fraley and Shepard 1989, McPhail and Murrey 1979), spend 220+ days in the gravel from egg deposition to emergence, and use interstitial spaces in substrate as cover during juvenile rearing and overwintering (Baxter and McPhail 1996; Goetz 1989; Jakober 1995; Pratt 1992; Thurow 1997). Although the Service recognizes the variability of sediment concentrations across the Columbia River and Klamath River DPSs, an RMO addressing sediment as an indicator of ecosystem condition should be considered as a criteria for determining the quality of habitat for bull trout.

2) RHCAs

Protection and management of RHCAs is a principal means by which the riparian goals and RMOs may be attained. RHCAs comprise the stream channel, adjacent riparian areas, unstable areas, and other areas that are directly linked to geomorphic, hydrologic, and ecological processes that determine the quality of fish habitat and that serve as connective corridors. As with the RMOs, default widths of RHCAs identified in the strategies can be modified using watershed or site-specific analysis. The BA points out the lack of process or guidelines describing the level of documentation and strength of rationale required to redefine RHCA boundary widths or justify activities within the RHCA boundaries. Similarly, the Service has identified the following concerns regarding RHCAs described in both strategies:

1) specific guidance is not given on the rigor of data required to modify RHCA boundary widths;

2) no guidance is given as to what types and levels of land management activities should be allowed in or adjacent to the RHCA; and

3) interim RHCA widths may not be adequate to fully protect fish habitats.

Ground disturbance within or outside of RHCAs, associated with activities such as timber harvest, mining, livestock grazing, road construction, or recreation activities, could increase sediment and pollutant delivery rates to streams; disrupt hydrologic connectivity for seeps, springs, and groundwater upwelling to the stream; and reduce habitat and channel complexity. In most situations, interim RHCAs would buffer streams from sediment and pollutants carried in unchannelized flows, but may not effectively protect streams from sediment produced in upslope areas and carried in channelized flows, such as through culverts (Belt et al. 1992). PACFISH and INFISH do not prevent potentially harmful activities, such as road building or mining, at the edge of the floodplain. These actions could result in increased sedimentation or other impacts to the floodplain, and hence the stream, during floods or when the stream changes its course within the floodplain. As described above in the discussion of the effects of RMOs on bull trout, sedimentation can have a negative effect on every life stage of bull trout due to the close relationship of the species to the stream substrate.

3) Key and Priority Watersheds

The Service has the following concerns regarding the designation and locations of key (PACFISH) and priority (INFISH) watersheds:

1) there is no process for adding or deleting key and priority watersheds dependent on new information;

2) designated PACFISH key watersheds do not sufficiently protect bull trout populations

where anadromous salmonids and bull trout do not coexist;

3) key and priority watersheds were only designated in areas where anadromous salmonids (PACFISH) or bull trout (INFISH) currently exist, so currently unoccupied, historical, high quality and important habitats do not receive the added protection given under these designations; and

4) key and priority watersheds have not adequately protected and reconnected high quality habitat and species strongholds for bull trout.

A widely held principle of managing for the survival and recovery of threatened and endangered aquatic species is that remaining stronghold areas for the species and high quality habitats be preserved and reconnected. The current network of key or priority watersheds was established for the conservation of habitat for anadromous fish or resident fish, specifically Federally listed salmon ESUs and bull trout populations for the PACFISH and INFISH, respectively. Refugia is a cornerstone of most species conservation strategies and are designated areas that either provide, or are expected to provide, high quality habitat (USDA and USDI 1998a). A system of key or priority watersheds that serve as refugia is crucial for maintaining and recovering habitat for Federally listed endangered and threatened species or species with viability concerns. The streams in Key or Priority watershed areas are intended to serve as cores of high quality habitat within a landscape containing large areas of low quality habitat and as population centers for recolonization during the recovery of degraded areas. This is particularly important for locally-distributed fish species such as bull trout.

Although key and priority watersheds of PACFISH and INFISH are not specifically defined to serve as fish "refugia", as noted in the BA, the description and selection criteria implies refugia as their function. Both strategies state that the intent of designating Key and Priority watersheds is to provide a pattern of protection across the landscape where habitat for either anadromous or inland native fish would receive special attention or treatment. Areas in good condition are to serve as anchors for the potential recovery of depressed fish stocks, and are to provide colonists for adjacent areas where habitat had been degraded by land management or natural events. Those areas of lower quality habitat with high potential for restoration are to become future sources of good habitat with implementation of a comprehensive restoration program. The USFS and BLM report 74 and 98 per cent of the occupied bull trout habitat on Federal lands in the Columbia and Klamath DPSs, respectively, is designated as key and/or priority watersheds; however, the quality of the riparian and aquatic habitats and watershed condition within those watersheds has not been evaluated (USDA and USDI 1998a). What is known is that 36 and 69 percent of the key and priority watersheds occupied by bull trout in the Columbia and Klamath DPSs, respectively, are allocated primarily for timber management, while 6 and 1 percent of the key and priority watersheds occupied by bull trout in the Columbia and Klamath DPSs, respectively, have a primary emphasis for range management (USDA and USDI 1998a). Although timber and range management can be conducted in a manner that is compatible with maintaining strong fish populations, key and priority watersheds may not meet their defined

purpose when their primary use is not clearly defined as the protection of high quality habitat and the conservation of species.

The current list of designated key and priority watersheds does not include all high quality areas and species population strongholds in bull trout currently occupied and historical habitats that are needed to adequately conserve and recover bull trout. The key watershed network in the PACFISH areas is based on the distribution of listed anadromous fish populations and, therefore, some stronghold populations and important high quality habitat for bull trout were not included in this network. The middle Columbia River portion of the PACFISH area does not contain anadromous fish but does have bull trout populations; subsequently, no key watersheds were designated in this area. The Northwest Forest Plan does include key watershed designations, which should be considered in project specific analysis of effects. Additionally, some bull trout population strongholds in the INFISH area were not designated as priority watersheds.

Inclusion of high quality, unoccupied bull trout habitat into the key and priority watershed networks was not a consideration. Although most administrative units in PACFISH and INFISH areas do not have information on the quality of habitat for bull trout, there are assumptions that can be made on where those habitats might be found. Bull trout are more likely to be found in areas with lower road densities, forested rather than unforested areas, in mid-size streams, on steeper, wetter, higher elevation and more erosive lands (Lee et al. 1997). Although roads are not the only factor depressing fish populations, they are a surrogate and are closely associated with many other land management actions that do affect aquatic systems (i.e. timber harvest, mining, recreation, fishing, and others). Roads have been, and continue to be a primary source of sediment impacts to developed watersheds (Furniss et al. 1991). Lee et al. (1997) found a pattern of decreasing strong populations of bull trout with increasing road density. Given these relationships, it could be suspected that the high quality areas that need protection may also be population centers for bull trout and will likely be found in roadless and less roaded areas. These areas might be more readily found in those management area categories (MACs) that are described as "natural and unmodified environments", "special natural areas" (including administratively withdrawn areas), and "essentially unmodified forest and grasslands" (USDA and USDI 1998a). According to the BA, approximately 48 and 28 percent of the strong and depressed bull trout populations in the Columbia and Klamath River DPSs, respectively, are in these three less developed MACs. LRMPs and RMPs amended by PACFISH and INFISH do not restrict road density or access into stronghold areas or roadless areas.

The USFS and BLM have committed to addressing some of the deficiencies in designated key and priority watershed identified above in their letter to the Service, dated June 19, 1998. In that letter they commit to identifying and clarifying the primary functions of key, priority, and special emphasis watersheds and to using these designated watersheds to develop a comprehensive refugia network. The Service supports this direction and encourages the USFS and BLM to make the identification of key, priority, and special emphasis watersheds a dynamic process that can be revised as new information on bull trout status and distribution is received.

4) Watershed Analysis

The Service is concerned that:

1) watershed analysis has not been emphasized nor consistently conducted and applied under PACFISH or INFISH;

2) the results and recommendations in those watershed analyses that have been completed are often not considered and included in project planning, design, and associated management decisions;

3) no process has been identified to prioritize watersheds for analysis; and

4) as identified in the BA, there are no examples in the PACFISH and INFISH areas of large-scale watershed analyses for long-term planning and management strategies.

5) the modules currently used in watershed analysis are optional. A consistent, scientifically documented approach needs to be developed for use in the analysis. Until that time, however, the draft modules are the best tool available.

The intent and function of watershed analysis is to provide a framework for understanding and carrying out land use activities within a geomorphic context; it remains a major component of the ecosystem analysis process and a key factor used to prioritize restoration and conservation actions. There is a broad agreement that risk to the species increases without watershed analysis unless actions are very limited in scope and excellent local knowledge is available (Appendix 4 - letter to Russ Strach NMFS from Jack Williams BLM dated October 28, 1997). To better control risk, the development and use of a method for prioritization of watersheds based on management needs and their importance to listed species, such as bull trout, is needed that enables a stratified approach to planning activities and restoration projects while increasing management effectiveness for the survival and recovery of those species. This stratified approach could be a major component within a long-term conservation and recovery strategy, such as the one that the USFS and BLM have committed, in their June 19, 1998, letter to the Service (see Appendix 6), to developing and implementing .

Since the adoption of the PACFISH and INFISH strategies nearly three years ago, the application and use of watershed analysis has proceeded slowly in all the bull trout DPSs. The Columbia River and Klamath River DPSs have watershed analyses completed for 8 and 20 percent of the Federal land, respectively (USDA and USDI 1998a). However, not all of these watershed analyses followed the process outlined in the Federal Guide, "Ecosystem Analysis at the Watershed Scale", and identified in the strategies as the method to use. As indicated by the PACFISH monitoring report for FY 1995-97, most land management decisions in the DPSs and analysis areas are made using site-specific analysis of stream reaches in a proposed project area. Although site-specific watershed analysis is used to modify RHCAs, in most cases land

management units have found it easier to use the RMOs and RHCAs rather than conduct the required watershed analysis to change the RMOs or the RHCAs. In some cases, modifications made to RHCAs have occurred but are not supported by adequate documentation, such as watershed analysis. On the other hand, there are examples where expensive, time-consuming analyses have been conducted but the data has not been integrated, the analyses are inconclusive, and the recommendations are not used when making management decisions.

There is also some concern regarding the scale of analysis being used to support modifications to RHCAs and RMOs. Too often, the scale of the analysis is limited to the immediate area of the project, poorly documented, and too specific to characterize the ecosystem processes and functions within the watershed. In general, information at both the watershed and site scales are needed: watershed analysis places the broader context on RHCAs and RMOs and defines whether and what changes are appropriate; site-specific information is needed to define precisely where the new RHCA boundaries should be placed (Appendix 4 - letter to Russ Strach NMFS from Jack Williams BLM dated October 28, 1997).

As pointed out in the BA, deficiencies found with the application of watershed analysis included inconsistent application under the current project-driven approach to analysis of a watershed, a lack of a clear understanding of what a watershed analysis entails, and the level of analysis necessary to affect a meaningful result. These deficiencies stem from the interim nature of the strategies and lack of consistent direction. Without full application of the "Watershed Analysis at the Ecosystem Scale" guidelines, decisions affecting aquatic habitats are being made without the information necessary to account for the habitat conditions and population needs of the species. In the letter from the USFS and BLM dated June 19, 1998, the land management agencies have committed to using the Federal Guide process, "Ecosystem Analysis at the Watershed Scale", to generate an information base and recommendations that will not be project driven but rather be used for planning projects in a watershed. The Service supports this commitment; it can reduce the risk to bull trout by ensuring that an understanding of ecosystem functions and processes and consideration of the potential impacts of actions on bull trout and their habitats have been incorporated into project planning.

5) Watershed Restoration

Neither PACFISH nor INFISH included a restoration plan or a process to develop a restoration plan given the expected short time period for implementation of these interim directions. The extension of these two strategies indefinitely until a more comprehensive strategy is developed negates this reasoning for postponement. Both strategies assumed no additional funding would be available for watershed restoration, but that some existing funds may be retargeted to initiate a watershed restoration program. No specific guidance, however, was given on how to prioritize restoration efforts. Both ACSs assume that watershed analysis would be used to establish restoration priorities for each watershed and that key and priority watersheds would have the highest priority for restoration efforts. To date, restoration has been conducted as budgets allow and emphasis has been placed on priority watersheds (Appendix 4 - letter to Russ Strach NMFS

from Jack Williams BLM dated October 28, 1997). The lack of implementation of prioritized, scheduled restoration projects, particularly riparian protection and road reduction projects, allows the environmental baseline to continue to degrade the status of bull trout and hinder recovery of their habitats. The USFS and BLM recognized in their BA the long-term negative effect that will occur to bull trout if restoration and improvement activities continue to be inadequately funded and lack a prioritization process tied to watershed analysis and listed species. In the Klamath River DPS, all bull trout populations are considered depressed (Lee et al. 1997). Approximately 70 percent of these populations are associated with roaded watersheds and would greatly benefit from restoration efforts in those areas (USDA and USDI 1998a). Likewise in the Columbia River DPS, 62 percent of the sub-watershed on USFS and BLM lands occupied by bull trout have moderate or greater (>0.7 miles/mi^2) road densities (USDA and USDI 1998a); these populations would benefit from a prioritized restoration strategy.

The commitment adopted by the USFS and BLM in their letter to the Service, dated June 19, 1998, goes a step beyond the PACFISH and INFISH approach of merely not hindering natural restoration processes. The commitment states simply that restoration strategies will be developed initially by March 1, 1999, and implemented to achieve restoration objectives at multiple scales that integrate restoration, protection, and evaluation measure . Development and initiation of these integrated, multi-scale restoration strategies will begin to reduce the negative effects to bull trout referred to in the BA, given that the restoration strategies include a basis for prioritizing restoration in areas where the greatest gains can be made for bull trout, include a schedule for the restoration projects, and remain dynamic documents that are modified annually to reflect priorities and opportunities determined through watershed analysis.

6) Monitoring

To help improve the quality of management activities, monitoring is needed to provide essential feedback to land managers on whether S&Gs are being met, whether S&Gs are effective, and whether goals and objectives are being achieved. In PACFISH, it is required that onsite monitoring occur to determine the level of implementation of PACFISH S&Gs, and that stratified effectiveness monitoring be initiated using statistically valid study techniques and methods. INFISH direction on monitoring is less defined, merely focusing monitoring on determining whether or not S&Gs were implemented and mentioning the need to initiate effectiveness monitoring, especially in priority watersheds. Due to the interim nature of the PACFISH and INFISH strategies, no specific requirements were included for validation monitoring to determine the validity of the assumptions used in developing the interim direction. For similar reasons, and the anticipation of an approaching completion of a more comprehensive ecosystem management strategy (ICBEMP), effectiveness monitoring has been postponed. Since 1995, an interagency team has annually monitored the implementation of the PACFISH strategy in USFS and BLM selected areas; INFISH areas had received only internal USFS reviews until 1997 when a few watersheds in INFISH areas were included in interagency PACFISH implementation field reviews.

The value of these field reviews is high, but adoption of a more rigorous, collaboratively developed schedule of reviews needs to occur. The reviews provide the land management agencies as well as the Service an avenue through which to discuss site-specific implementation problems and opportunities, to answer questions regarding the intent of S&Gs and strategy components, and to provide suggestions for better implementation of the strategy. The USFS and BLM outlined in the BA the problems and deficiencies found during PACFISH implementation monitoring reviews and noted the lack of a "formal" monitoring strategy in INFISH areas. To address the deficiencies they identified in the BA, the USFS and BLM committed to improve monitoring in their letter to the Service, dated June 19, 1998. In this commitment, the USFS and BLM agree to develop, collaboratively with the Service, a "mechanism for improved monitoring" that will include updating the PACFISH monitoring strategy, developing an effectiveness monitoring strategy, improving the current implementation monitoring process, and expanding the monitoring into the INFISH areas. The Service agrees with their recognized deficiencies and supports their commitment. The Service also identifies the need to not only develop but implement an effectiveness monitoring strategy as soon as possible, since without findings from such an analysis, it is difficult to ascertain without suppositions and assumptions whether or not the PACFISH and INFISH directions will provide for bull trout survival and recovery.

Effects of Specific Management Activities

A wide variety of activities are addressed and directed by LRMPs and RMPs; see the previous section on description of the action, or the BA (USDA and USDI 1998a) for more specific information. To determine the effects of these actions, the Service's analysis identified and grouped activities into categories used to designate S&Gs for PACFISH and INFISH, and rated them as high, moderate, or low, based on the potential to adversely affect bull trout. These S&Gs are listed in their entirety in the description of the action section of this biological opinion. Where a specific standard and guideline is indicated, please refer to that section for more specific information.

Timber Management

Timber management affects bull trout through a variety of impacts or alterations to watershed structural conditions and functional capacity. The primary pathways for negative impacts are through altering stream temperature patterns, hydrologic and sediment regimes, and reducing channel complexity as well as the structural features that maintain channel complexity. Potential adverse effects also include introduction of pollutants (fuels, fertilizers, pesticides, and herbicides) into watercourses while conducting harvest, site preparation, and stand maintenance activities.

Bull trout require colder water temperatures than most salmonids and these requirements vary by life cycle stages; for specific information on bull trout temperature requirements refer to the previous section describing the species and the temperature section of Appendix 5. According

to the BA (USDA and USDI 1998a), timber harvest has the potential to affect stream temperatures primarily through reducing streamside canopy levels. The potential for riparian vegetation to mediate stream temperatures is greatest for small to intermediate size streams and diminishes as streams increase in size, lower in the floodplain (Spence et al. 1996). Generally, small and intermediate streams represent the majority of total aggregate stream length within a watershed (Chamberlin et al. 1991). Given these relationships, maintaining adequate canopy conditions on small and medium sized streams (including intermittent streams) is necessary to avoid altering natural temperature regimes.

Groundwater entering streams (especially small streams) may be an important determinant of stream temperatures (Spence et al. 1996) or may provide localized thermal refugia in larger stream systems. Where groundwater flows originate above the neutral zone (16-18 meters below the surface in general) groundwater temperatures will vary seasonally, as influenced by air temperature patterns (Spence et al. 1996). Timber harvest from upland areas exposes the soil surface to greater amounts of solar radiation than under forested conditions (Carlson and Groot 1997), elevating daytime temperatures of both air and soil (Fleming et al. 1998, Buckley et al. 1998, Morecroft et al. 1998) and increasing diurnal temperature fluctuations (Carlson and Groot 1997). Relationships between shallow source groundwater flows and air and soil temperatures indicate that harvest activities in upland areas may increase stream temperatures via increasing temperature of shallow groundwater inflows. Other pathways for harvest actions to influence stream temperature include changing the volume and timing of peak flows, elevating suspended sediment levels, and altering channel characteristics (Chamberlin et al. 1991, Spence et al. 1996, USDA and USDI 1998a).

Bull trout are sensitive to hydrologic alterations due primarily to the extended period of time from egg deposition to fry emergence spent within the streambed. Hydrologic changes that alter normal bedload movement and scour and fill patterns can excavate or bury redds, exposing eggs to stream flow, and trapping or crushing eggs or fry. Increasing levels of fine sediments affects developing eggs by filling interstitial spaces within stream substrate, reducing or eliminating water flow through the redd, supply of oxygen to developing eggs, removal of waste products, and may be sufficient to reduce or eliminate the ability of juvenile fish to emerge from the redd. Additional information on biological requirements is contained in the habitat complexity and substrate composition and stability sections of Appendix 5. Hydrologic and sediment regimes can be altered by vegetation removal, site disturbance, and soil compaction associated with timber harvest (USDA and USDI 1998a). The nature and magnitude of these changes is mediated by local climatic, geologic, and topographic characteristics as well as re-vegetation patterns (Spence et al. 1996). Harvest and site preparation that disturbs soils such as tractor skidding, cable yarding, burning and scalping or scarification alter the ability of soils to accept water, increasing the potential for overland flow, and altering normal pathways for water entry to streams (Chamberlin et al. 1991). Canopy removal also alters the amount (Troendle and Olsen 1993), frequency, and intensity of precipitation delivery to forest floors. These disturbances may also lead to increased amounts of sediment introduced into streams and mobilization of sediments within the stream channel, mediated again by local conditions.

Land management activities can alter processes that create and maintain riparian and aquatic habitats, often resulting in reductions of habitat complexity and the diversity of aquatic species (Elmore and Beschta 1987, USDA et al. 1993, USDA and USDI 1998a). In watersheds containing bull trout, changes in habitat features associated with reductions in habitat complexity include decreases in: large woody debris, pool quality, channel stability, substrate quality, groundwater inflows, and suitable habitat serving as corridors between habitat patches (e.g. resulting from increases in water temperature [MBTSG 1998]). Refer to the section on habitat complexity in Appendix 5 for additional information.

The LRMPs as amended by PACFISH and INFISH contain a S&G for timber management (TM-1). The primary focus of this S&G is to modify management activities within the RHCA, excluding the land base identified as RHCAs from LRMP determinations of Allowable Sale Quantity. The S&G requires watershed analysis prior to salvage activities in RHCAs, and that silvicultural practices within RHCAs be applied where needed to achieve RMOs, in a manner that does not retard attainment of RMOs and avoids adverse effects to listed anadromous fish. S&Gs for general riparian area management (RA-2, RA-3, RA-4) address the storage and use for fuels and other toxicants, and application of pesticides, herbicides and other chemicals within RHCAs. Areas designated as key watersheds add an additional one-half site potential tree height or 50 feet of slope distance to the standard width for RHCAs. These S&Gs, along with RMOs and riparian goals, form the basis for protecting aquatic systems from timber management impacts (exclusive of road system impacts which are addressed later). While these S&Gs, as written, should limit impacts from management activities in RHCAs, they do not address the magnitude and extent of activities in upslope areas. Timber harvest outside of RHCAs has potential to alter temperature and hydrologic regimes, increase suspended sediment levels and may, under certain conditions, lead to mass wasting. The Service expects that upslope harvest has the potential for severest impacts where RHCAs are immature, stream large woody debris levels are below RMOs, where harvest activities occur on steep unstable slopes, and where bull trout occur outside of key and priority watersheds. Timber management activities are considered to present a moderate to high risk to bull trout under conditions identified above and where LRMP and RMP management focus is on timber production. Special emphasis watersheds, when identified, may lessen this risk under certain situations.

Roads Management

According to the BA (USDA and USDI 1998a): "The construction, use and maintenance of forest roads has been shown to be a primary source of sediment impacts in developed watersheds. Roads can alter both subsurface and surface water flows which, in turn, may alter both peak and base stream flows (USDC 1997, Jones and Grant 1996)." Lee et al. (1997), indicate that over 205,000 km of roads exist throughout the Columbia Basin on USFS and BLM managed lands, with an attendant high number of stream crossings which occur at higher densities on steep dissected terrain. Lee et al. (1997), also note that although improvements in road construction and logging methods can reduce sediment delivery to streams, sedimentation increases are unavoidable even when utilizing the most cautious logging and construction

methods. Bull trout are very sensitive to sediment increases, hydrologic alterations, and impacts to stream structure and function imposed by extensive road networks and high road densities. Roads are also conduits for a host of non-management related impacts such as noxious weed introductions, illegal transplants of predatory or competing non-native fishes, increased harvest pressure and potential for poaching, dispersed recreation impacts, and potential introduction of toxicants from spills and roadside application of herbicides. Additional information on the relationship of roads to bull trout biological characteristics are contained in the roads section of Appendix 5, and the road analysis contained in Lee et al. (1997).

S&Gs for road management are listed in the description of the action (RF-1 through RF-5). Major features of these S&Gs are:

RF-1) Encouraging interagency cooperation to achieve consistency in road design, operation and maintenance to attain RMOs;

RF-2) Limiting road impacts in RHCAs through minimizing new road and landing construction and requiring watershed analysis prior to construction of new roads or landings, initiating development and implementation of road or transportation management plans, addressing road surface and drainage elements to avoid sediment delivery to streams, and prohibiting sidecasting soils or snow from the road surface in RHCAs with designated critical habitat for listed anadromous fish;

RF-3) Addressing design and sediment problems on existing roads, prioritizing reconstruction efforts to eliminate identified problems, and closing and stabilizing or obliterating and stabilizing unneeded roads as prioritized to their impact to listed fish and value of riparian resources affected;

RF-4) Constructing and reconstructing culverts, bridges, and stream crossings to accommodate 100-year floods; and

RF-5) providing and maintaining fish passage at stream crossings.

There is no positive contribution from roads to physical or biological characteristics of watersheds or landscapes. Under present conditions, roads represent one of the most pervasive impacts of management activity to native fish communities. As stated above, even the most cautious construction methods are likely to yield some degree of impact. Although Lee et al., (1997) note that the threshold for negative response from road induced sedimentation and hydrologic modification to streams and watersheds is not well known, their analysis does identify overall patterns related to road densities. The correlation between bull trout status classification and geometric mean road density was significant ($p=0.0001$) and negative (Quigley et al. 1997). Bull trout were indicated as being: absent at geometric mean road densities (mi./mi.^{2}) at or above 1.31, depressed at or above 0.67, and strong at or above 0.18 (Lee et al. 1997). Correlation between bull trout status classification was significant ($p=0.0001$) and

negative for the arithmetic mean of upstream road density (mi./mi.^{2}) with bull trout being absent at a mean road density of 1.71, depressed at 1.36, and strong at 0.45 (Lee et al. 1997).

The Service expects that road system impacts are ongoing and will be most severe where RHCAs are non-functional and roaded, where roads and road crossings occur on steep unstable slopes, and where bull trout occur in watersheds with road densities (arithmetic mean for upstream areas) above 1.36 mi./mi.^{2}. Road impacts are considered to present a high risk to bull trout under the conditions identified above, where LRMP management focus is on intensive management for timber production, and with new road construction in inventoried and uninventoried roadless areas.

Grazing Management

Impacts of livestock grazing on stream habitat and fish populations can be separated into direct and chronic effects. Direct effects are those which contribute to the immediate loss of individual fish, and loss of specific habitat features (undercut banks, spawning beds, etc) or localized reductions in habitat quality (sedimentation, loss of riparian vegetation, etc.). Chronic effects are those which, over a period of time, result in loss or reductions of entire populations of fish, or widespread reductions in habitat quantity and/or quality.

Bull trout vulnerability to direct effects of grazing is greatest during early development stages. During early phases of their life cycle, fish have little or no capacity for mobility, and large numbers of embryos or young are concentrated in small areas. Cattle entering spawning areas can trample redds, and destroy or dislodge embryos and fry. Embryo and fry mortality can also result from localized sedimentation of spawning beds (Bjornn and Reiser 1991). Accumulations of silt, if delivered in sufficient quantity, can fill interstitial spaces in stream bed material impeding water flow through redds, reducing dissolved oxygen levels, and restricting removal of wastes from redds. As development progresses, vulnerability to mortality from direct effects decreases.

Direct effects to habitat include compacting stream substrates, collapse of undercut banks, destabilized stream banks and localized reduction or removal of herbaceous and woody vegetation along stream banks and within riparian areas (Platts 1991). Increased levels of sediment can result through the resuspension of material within existing stream channels as well as increased contributions of sediment from adjacent stream banks and riparian areas. Impacts to stream and riparian areas resulting from grazing are dependent on the intensity, duration, and timing of grazing activities (Platts 1989) as well as the capacity of a given watershed to assimilate imposed activities, and the pre-activity condition of the watershed (Odum 1981).

Chronic effects of grazing result when upland and riparian areas are exposed to activity and disturbance levels that exceed assimilative abilities of a given watershed. Both direct and indirect fish mortality are possible, and the potential for mortality extends to all life cycle phases. For example, following decades of high intensity season-long grazing, the Whitehorse Creek

watershed in Oregon had extensive areas of degraded upland and riparian habitat (USDI 1992). According to the USDI (1992), an extreme rain-on-snow event in late winter 1984 and subsequent flooding of area streams flushed adult and juvenile trout through area streams and into Whitehorse Ranch fields and the adjacent desert.

Increases in stream temperature and reduced allochthonous inputs following removal of riparian vegetation, increased sedimentation from in-stream, riparian and upland sources, and decreased instream, riparian and upland water storage capacity, work in concert to reduce the health and vigor of stream biotic communities (Armour et al. 1991, Platts 1991, USDI 1992, Chaney et al. 1990). Increased sediment loads reduce primary production in streams. Reduced instream plant growth and woody and herbaceous riparian vegetation limits populations of terrestrial and aquatic insects, the basic food source for juvenile and resident bull trout. Persistent degraded conditions adversely influence resident fish populations (Meehan 1991).

According to Chaney et al. (1990), strategies for protection or restoration of riparian areas must address the contribution of upland areas and their condition to the overall hydrologic regime. Further, strategies should include one or more of the following features:

> "Including the riparian area within a separate pasture with separate management objectives and strategies.
>
> Fencing or herding livestock out of riparian areas for as long as necessary to allow vegetation and stream banks to recover.
>
> Controlling the timing of grazing to: (a) keep livestock off stream banks when they are most vulnerable to damage; and (b) coincide with the physiological needs of target plant species.
>
> Adding more rest to the grazing cycle to increase plant vigor, allow stream banks to heal, or encourage more desirable plant species composition.
>
> Limiting grazing intensity to a level which will maintain desired species composition and vigor.
>
> Changing from cattle to sheep to obtain better animal distribution through herding.
>
> Permanently excluding livestock from riparian areas at high risk and with poor recovery potential when there is no practical way to protect them while grazing adjacent uplands."

S&Gs for grazing management are listed in the description of the action (GM-1 through GM-4). Major features of these S&Gs are:

GM-1) Modifying grazing practices (livestock access to RHCAs, length and timing of

the grazing season, stocking levels) or suspend grazing if RMOs are not being attained;

GM-2) Eliminate locating livestock handling and management facilities within RHCAs. Relocate or close existing facilities that cannot be modified to meet RMOs or avoid adverse effects to listed fish;

GM-3) Limiting management activities (trailing, bedding, watering, salting, loading) to times or locations that will not retard or prevent attainment of RMOs and that avoid adverse effects to listed fish; and

GM-4) Modify wild horse and burro management to achieve RMOs and avoid adverse effects to listed fish.

The Service expects that livestock grazing impacts will be most severe where RHCAs are non-functional and where range management programs are ineffective at ensuring that terms and conditions of grazing permits are met (including lacking effectiveness due to inadequate resources allocated to the program), where as a result of inadequate supervision, compliance with permit terms and conditions is low. Grazing management is considered to present a high risk to bull trout under conditions identified above, where LRMP and RMP management focus is on intensive grazing management. The Service expects a moderate risk to bull trout from grazing management activities where RHCAs are classified as "functioning at risk", documentation indicates that range management programs experience high levels of compliance with terms and conditions of grazing permits, and management direction is documented as sufficient to restore riparian conditions. The Service expects a low risk to bull trout where RHCAs are properly functioning and management is documented as sufficient to restore or maintain riparian conditions.

Recreation Management

According to the BA (USDA and USDI 1998a), recreation use has the potential to affect salmonid habitat by: 1) altering upland and riparian soil and vegetation conditions that may lead to increased erosion and runoff, loss of cover and food resources and reductions in water quality; and 2) instream changes that affect stream morphology, water quality, streamflow, substrate and debris. Angling as a result of recreational develop and trail maintenance and construction may lead to direct angling mortality (USDA and USDI 1998a).

S&Gs for recreation management are listed in the description of the action (RM-1 through RM-3). Major features of these S&Gs are:

RM-1) Designing, constructing and operating recreational facilities consistent with attainment of RMOs and requiring watershed analysis prior to locating new recreational facilities in RHCAs;

RM-2) Adjusting dispersed and developed recreation practices where necessary to allow attainment of RMOs and eliminating practices that cannot be modified to be consistent with attainment of RMOs or that continue to have adverse effects to listed fish;

RM-3) Addressing attainment of RMOs and potential effects to listed fish and designated critical habitat in Wild and Scenic, Wilderness, and other Recreation Management Plans.

The Service expects that recreation impacts will be most severe where dispersed or developed facilities are located in RHCAs that are non-functional. Recreation management is considered to present a moderate risk to bull trout under conditions identified above. The Service expects a low risk to bull trout where RHCAs are properly functioning and management is documented as sufficient to maintain riparian conditions.

Minerals Management

Appendix B of the BA compares occupied bull trout subwatersheds to model generated mineral deposit areas finding that, in general, there was little overlap (USDA and USDI 1998a). Comparisons with known or potential oil and gas reserves yielded similar results, with the majority of occupied subwatersheds occurring in areas with no or low potential (USDA and USDI 1998a). While this result may be true for hard-rock mineral mining and oil and gas, sand and gravel mining and recreational suction dredge, placer, and pan mining are activities that may also occur on federal lands. Small heap leach mines are numerous throughout the Columbia Basin (Lee et al. 1997). Impacts to streams from past mining activity may still affect habitat quality on federal lands within the range of bull trout ([Lee et al. 1997, MBTSG 1996] John Day, Grand Ronde, Imnaha and Powder River Basins in Oregon; Salmon and Couer d'alene River Basins in Idaho; and North Fork Flathead, Clark Fork, Kootenai, and Blackfoot River Basins in Montana, for example).

S&Gs for minerals management are listed in the description of the action (MM-1 through MM-6). Major features of these S&Gs are:

MM-1) Requiring a reclamation plan, approved plan of operations and reclamation bond for mineral operations in RHCAs;

MM-2) Avoid locating structures, support facilities and roads within RHCAs; if no alternatives exist construct facilities in a manner that avoids impacts to RHCAs and close, obliterate, and revegetate roads no longer required for mineral or land management activities;

MM-3) Addresses solid and sanitary wastes from mining activity in RHCAs;

MM-4) Prohibit or minimize impacts from surface occupancy for mineral, oil, gas, and geothermal exploration and development activities;

MM-5) Permit sand and gravel mining in RHCAs only if no alternative exists, and the activity will not prevent attainment of RMOs or adversely affect listed fish; and

MM-6) Development of inspection, monitoring and reporting requirements for mineral activities.

Increased sedimentation, chemical contamination, stream channel modification and destabilization, destruction of riparian vegetation, (Lee et al. 1997) and hydrologic impacts from associated roads are major impacts from mining activities. In addition to stream channel modification, liberation of stored sediments, and stream channel destabilization, suction dredge mining can potentially entrain fish embryos, juvenile salmonids and smaller mature fishes such as sculpin into the dredge works (Harvey et al. 1995). Mining effects can be severe when they occur in areas inhabited by rare fish; negative effects from mining can persist for decades.

The Service expects that mining impacts will be most severe when these activities are located near or upstream of bull trout spawning and rearing areas, where existing or new facilities are located in RHCAs particularly near or upstream of spawning and rearing areas, and when they occur in watersheds already degraded by past activities and management emphasis is on resource extraction. Minerals management is considered to present a high risk to bull trout under conditions identified above. The Service expects a moderate risk to bull trout where RHCAs are properly functioning and mining activity is restricted to small scale recreational placer or suction dredge mining in stream reaches used by bull trout primarily as migratory corridors. The Service expects a low risk to bull trout when minerals management activities occur outside of watersheds presently or historically occupied by bull trout.

Fire/Fuels Management

Management which is used to restore ecological structure, composition, and process is largely experimental and potentially risky (Rieman and Clayton 1997). Burn treatments can remove coarse wood, reduce large woody debris (LWD) recruitment, reduce canopy cover (leads to increased water temperatures), increase the likelihood of mass erosion on sites, and alter water yield and timing of peak and low flows (Spence et al. 1996; Rieman and Clayton 1997). These are all significant impacts to bull trout habitat.

According to the BA (USDA and USDI 1998a), ground disturbing activities associated with the suppression of wildfire may result in an increase in sediment delivery to streams. In addition, the use of prescribed burns may result in an increase of nutrients and fine sediment into streams. Increasing levels of fine sediments affects developing eggs by filling interstitial spaces within stream substrate, reducing or eliminating water flow through the redd and supply of oxygen to developing eggs, removal of waste products, and may be sufficient to reduce or eliminate the ability of juvenile fish to emerge from the redd. Due to bull trout's extended residency in the gravel (220+ days from egg deposition to emergence), eggs, alevins, and fry are highly vulnerable to the impacts resulting from the deposition of fine sediments.

Prescribed fire treatments can remove coarse wood, lessen LWD recruitment, and lower canopy cover. These can lead to reduced habitat complexity and increased stream temperature, habitat elements that are extremely important to bull trout.

Wildfire suppression also has the potential to impact bull trout. The BA acknowledges the potential for delivery of fine sediments and chemicals (oil and gasoline) from the construction and use of pump chances. The impacts from fine sediment have been described above.

The use of chemical fire retardants in wildfire suppression can have adverse impacts to bull trout. Retardants can have direct and indirectly effects on salmonids. Large quantities of retardant can cause direct mortality. Indirect effects of retardants include mortality of invertebrates and eutrophication of downstream reaches (Spence et al. 1996).

S&Gs for fires/fuels management are listed in the description of the action (FM-1 through FM-5). Major features of these S&Gs are:

FM-1) Design fuel treatment and fire suppression strategies, practices, and actions so as not to prevent attainment of RMOs, and to minimize disturbance of riparian ground cover and vegetation;

FM-2) Locate incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities outside of RHCAs;

FM-3) Avoid delivery of chemical retardant, foam, or additives to surface waters;

FM-4) Design prescribed burn projects and prescriptions to contribute to the attainment of the RMOs; and

FM-5) Immediately establish an emergency team to develop a rehabilitation treatment plan to attain RMO's and avoid adverse effects on inland native fish whenever RHCAs are significantly damaged by a wildfire or a prescribed fire burning out of prescription.

The Service expects that fires/fuels management impacts will be most severe where treatments affect RHCAs that are non-functional, where prescribed fires are difficult to manage/control, and where bull trout subpopulations are susceptible to extinction from stochastic events. In addition, standards and guidelines state that fuel treatment and fire suppression strategies "should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could perpetuate or be damaging to long-term ecosystem function or inland native fish", but this is not a requirement. Given the risky nature of prescribed fires and the sensitivity of bull trout to the resulting habitat changes, the Service feels that this activity has a high potential to create adverse impacts to bull trout. Fires/fuels management is considered to present a high risk to bull trout under conditions identified above, where LRMP and RMP management focus is on intensive fires/fuels management, especially using prescribed

wildfires, and the management strategies have not addressed and minimized the risk to bull trout. The Service expects a moderate risk to bull trout from fires/fuels management activities that affect RHCAs that are classified as "functioning at risk" or "properly functioning", where design of management strategies have addressed and minimized the risk to bull trout, and where bull trout subpopulations are not susceptible to extinction from stochastic events.

Lands

The LRMPs as amended by PACFISH and INFISH contain several S&Gs for "Lands" relating to hydroelectric facilities, rights of way, and land exchanges and easements. These S&Gs are summarized below (For exact language of the S&Gs, see description of the action).

> LH-1 This S&G requires that instream flows and habitat conditions for hydroelectric and other surface water development projects provide for maintained or improved riparian channel conditions and allow fish passage, survival and growth. It also requires the USFS to coordinate with other Federal and State Agencies during Federal Energy Regulatory Commission (FERC) licensing and relicensing.
>
> LH-2 This S&G requires the USFS to locate new hydroelectric facilities outside RHCAs. For existing facilities, the USFS provides recommendations to FERC to ensure that the facilities would not prevent attainment of the RMOs, and to ensure that adverse effects to inland fish are avoided. Where these objectives can not be met, the USFS is to provide recommendations to FERC on how and where to relocate existing facilities. If the projects can not be relocated outside of RHCAs, there is still the requirement to operate and maintain the projects to avoid or minimize effects.
>
> LH-3 The USFS is to issue leases, permits, rights of way and easements to avoid effects that would retard or prevent attainment of the RMOs or adverse effects to inland native fish. The S&G makes a distinction between existing permits for which authority is not retained and permits for which "authority is retained" by the USFS which allows them to further condition activities governed by the original permit. Where that authority is not retained USFS can still attempt to negotiate terms of the original permit. Priorities for negotiating and renegotiating permit are to be based on "current and potential adverse effects on inland native fish and the ecological value of the riparian resources affected."
>
> LH-4 The USFS is directed by this S&G to use land acquisition, land exchanges and conservation agreements to achieve the RMOs, and to facilitate restoration of fish stocks and other species at risk of extinction.

In LH-1, and LH-2, it is not clear what authority, if any, the USFS can exert on the FERC. It would appear from the language in the S&G that the USFS has this authority, but chooses only to make recommendations to FERC, like other federal agencies. The Service is not aware of any specific instances in which USFS has exerted any implied authority to deny a permit, or to cause

FERC to deny a permit, for a new hydroelectric facility. Similarly, the Service is not aware of any instances in which the USFS (based upon the strength of its recommendations to FERC) has caused any existing facility to be relocated outside of an RHCA. The effects of this S&G as worded could be negative, in that it does not appear to grant USFS sufficient authority, or acknowledge USFS's existing authority, to strongly influence FERC decisions on future projects or halt any FERC projects that are currently on USFS lands. While there may not be very many projects in this category, it is possible that any future hydroelectric projects or expansions of existing projects would not be adequately sited, or their effects minimized sufficiently, to avoid adverse impacts to bull trout.

In LH-3, it is particularly unclear how the USFS can successfully re-negotiate terms of any existing permit in cases where is has not retained authority. The priorities for negotiation of permit terms, however, appear to be ecologically appropriate.

LH-4 has the potential to be beneficial, as long as priority areas needed for bull trout conservation are not traded away or lost, and bull trout population connectivity issues (see Appendix 5) are fully considered when the land exchange proposals are being developed.

In general, it is difficult to assess the level of effects that would likely accrue from implementation of the four S&Gs relating to "Lands." However, the wording of these S&Gs leads the Service to conclude the effects will likely be adverse to bull trout and other inland resident fish species, particularly in the long-term. The documented adverse effects of hydroelectric project development to fish and aquatic life are numerous, generally irreversible, and occur regardless of the mitigation measures applied to reduce the level of effects. Adverse effects include loss of fish passage, disruption of hydrologic connectivity both laterally and longitudinally, changes in stream water temperature, altered patterns of nutrient cycling, and reduction in water quality and natural channel functioning. Reduced downstream bedload transport is typically a consequence of most major impoundments, and causes eventual loss or reduction in spawning areas through depletion of spawning substrates. The Service does not expect that the continuing adverse effects of existing hydroelectric projects are likely to be fully eliminated under application of LH-1 and LH-2. Therefore, the risk of these two S&Gs is probably moderate to high. Although existing hydroelectric operations are not found in all locations, where they do occur, the threats to bull trout populations are very likely significant and negative. Furthermore, the risks of planning, siting, and operation of new hydroelectric facilities based upon these S&Gs would be high.

In LH-3, by definition the USFS lacks authority to condition permits (such as road use permits) for which it has not retained authority. The S&G also implies that issuing permits, leases, and rights of way is somehow done, or can be accomplished "to avoid effects" Road reconstruction, maintenance activities and continued road use pursuant to non-renegotiable existing permits, or issuance of new permits based upon this S&G, could result in significant long-term adverse effects to bull trout and their habitats for the same reasons discussed in other sections of this BO dealing with roads. The Service, therefore considers the risks of this S&G to be moderate to

high.

LH-4 is the only S&G in the "Lands" category that the Service believes could offer some potential longer-term benefits to bull trout. However, there is still a risk that some land exchanges would not fully consider and explicitly address bull trout conservation and, in particular, the need for connected, high quality waters to support all life forms of the species. Therefore, the Service considers the overall risk of this S&G to be "moderate," with the potential to reduce the risks to "low" or even "positive benefit" through careful planning and analysis of individual land exchanges.

General Riparian Area Management

Generally, robust riparian areas are necessary for maintaining channel equilibrium that results in a variety of structural features and ecological functions in streams. Water temperature, substrate composition, cover, and hydraulic complexity are related to riparian composition and the distribution and abundance of bull trout (Lee et al. 1997).

S&Gs for general riparian area management are listed in the description of the action (RA-1 through RA-5). Major features of these S&Gs are:

RA-1) cooperating with other agencies and tribes to secure instream flows;

RA-2) allowing tree felling in RHCA when trees pose a safety risk;

RA-3) avoiding adverse affects to non-target species when applying toxicants;

RA-4) prohibiting storage of toxicants and refueling in RHCA; and

RA-5) locating water drafting sites to avoid adverse effects to inland native fish and instream flows.

The General Riparian Area Management category of activities, which is used by PACFISH and INFISH, is not specifically addressed in the BA (USDA and USDI 1998a). The BA does address some issues that are related to the S&Gs RA-1 through RA-5. For example, the BA addresses instream flows as part of the administration of special use permits (Categorized as *Lands* in INFISH), which are related to RA-1. The BA addresses fertilization and chemical treatments within conifer plantations within the discussion of timber management (related to RA-3). The management of fuels and fire retardant is related to RA-4, and is discussed with *Fire/Fuels Management*.

The activities related to general riparian management present a low to high risk to bull trout depending on the activity and the location of the activity. For example, if water developments or diversions are permitted within or upstream of the habitats of the species considered in the

assessment, a high risk to the species may exist. In contrast, removing a tree in an RHCA, that is a safety concern, is likely to have a low risk to bull trout.

Watershed and Habitat Restoration

The major watershed restoration activities discussed in the BA (USDA and USDI 1998a) focus on culvert replacement and road decommissioning. Analysis of the effects of roads is summarized in "Roads Management" above. Lee et al. (1997) state that forest management needs may be accomplished quickly by focusing on projects in heavily roaded watersheds. The BA (USDA and USDI 1998a) cites NMFS (USDC 1997) to support the probability that the net effect of watershed restoration activities will be beneficial to bull trout. Adverse affects to the species may occur in the short term, but the long term effects should be beneficial.

S&Gs for watershed and habitat restoration are listed in the description of the action (WR-1 through WR-2). Major features of these S&Gs are:

> WR-1) implementing watershed restoration projects that promote long term ecological integrity and contributed to attainment of the RMOs; and –
>
> WR-2) cooperating with other agencies, tribes, and private landowners to develop watershed-based management to meet RMOs.

Restoration activities considered here primarily include culvert replacement and road decommissioning. The primary adverse impacts from these activities are short term increases in fine sediment deposition and turbidity downstream of projects. Culvert replacement or upgrading should improve fish passage, decrease scouring effects of flood flows, and improve the transport of bedload and debris. Road decommissioning should improve watershed and habitat conditions provided drainage patterns are re-established, and access to significant sediment sources that require maintenance is available. Other activities considered as watershed restoration are road drainage improvement, surfacing, and sediment source stabilization through seeding and planting. Restoration is not to be used to mitigate or act as a substitute for preventing habitat degradation.

Watershed and habitat restoration presents a low to high risk to bull trout. Improved conditions, following the upgrading or replacement of culverts, may occur within days or months. The risk of adverse affects to bull trout is low for seeding, planting, drainage improvement, and most culvert upgrade and replacement activities. Roads that are decommissioned may continue to contribute sediment for a few years before sediment levels are effectively decreased. Abandonment of roads includes a risk of increased sediment following rehabilitation activities and sediment inputs from poorly monitored, eroding, abandoned roads. The risk of adverse affects to bull trout is moderate to high depending on the length and location of the road.

Fisheries and Wildlife Restoration

The BA (USDA and USDI 1998a) states that over 1,700 miles of habitat restoration has occurred, and increased activity in restoration and improvement of aquatic habitats is expected. The activities include improving stream channel diversity and stability, removing migration barriers, and managing riparian vegetation. The assessment also states that current programs for restoration and improvements have deficiencies that may negatively affect aquatic management and the species covered in the assessment. These deficiencies are primarily related to the lack of funding and prioritization of actions.

Delays in implementing needed restoration and improvement activities will have a long term negative effect to bull trout. Riparian rehabilitation and instream habitat enhancement structures may have short and long term benefits to bull trout.

The species addressed in this opinion can be negatively impacted by certain types of restoration activities. Instream habitat restoration projects may cause short term fine sediment pulses. Surveys and population sampling, such as smolt traps and electrofishing, will result in harassment, and may result in injury or death of individual fish.

Wildlife management activities include winter range burning, access management, snag management, tree topping and falling, and water developments. Burning is addressed in the *Fire and Fuels Management*, and access management is addressed in the *Roads Management* section above. Tree topping is expected to occur to scattered individual trees or small groups widely scattered over a large landscape. Trees that are cut within a riparian area should be left as riparian or instream woody debris if it assists in meeting RMOs. Water developments considered here are expected to be at small isolated springs or ephemeral channels, and should not adversely affect bull trout.

S&Gs for fisheries and wildlife restoration are listed in the description of the action (FW-1 through FW-4). Major features of these S&Gs are:

FW-1) implementing habitat restoration actions in a manner that contributes to attainment of the RMOs;

FW-2) constructing and operating fish and wildlife interpretive and other user-enhancement facilities in a manner that does not adversely affect inland native fish;

FW-3) cooperating with other agencies and tribes to identify and eliminate wild ungulate impacts that adversely affect inland native fish; and

FW-4) cooperating with other agencies and tribes to identify and eliminate adverse effects on native fish associated with habitat manipulation, fish stocking, fish harvest, and poaching.

Fisheries and wildlife restoration presents a low to moderate risk to bull trout. Improved conditions, following the installation of instream habitat restoration structures, may occur within days or months. Surveys and population sampling may continue to contribute to the take of individuals, but over the long term these surveys should improve the knowledge base for informed management decisions and result in a long term benefit for the species.

Wildlife habitat restoration projects are expected to have a low to moderate risk to bull trout. Projects within the RHCAs may have a moderate risk and those outside of the RHCAs are likely to have low risk. These projects, with the exception of winter range burning, are generally small in area affected and scattered over large landscapes.

Spatially Directed Effects -- Management Area Categories

The LRMPs describe levels of goods and services expected to be provided as plans are implemented. As noted in the BA (USDA and USDI 1998a), the range of goods and services actually delivered is expected to vary given budget and land capability changes over time. MACs were identified based on current information on management direction from each LRMP for use as an analysis tool in the ICBEMP. MACs are described in their entirety in the description of the action. The BA (USDA and USDI 1998a) summarized the eight categories to simplify analysis as follows:

Undeveloped Areas: Categories one, two, and three;
Developed Areas: Categories four five and six; and
Highly Developed Areas: Categories seven and eight.

Undeveloped areas are primarily Congressionally reserved or Administratively withdrawn from the land base administered by the USFS and BLM for production of the full range of goods and services identified in LRMPs, or are overlain by protective designations (such as wild and scenic rivers designation and RARE II inventoried roadless areas) that limit management activities. Although they represent relatively pristine habitats, they do not limit all activities that may adversely affect bull trout (such as mining, grazing, recreation, and fire and fuels management). The Service assumes that management focus on production of timber, forage, and mineral resources occurs primarily in developed and highly developed areas as described above. Distribution of the eight MACs across all management units by bull trout DPS is contained in Appendix A of USDA and USDI (1998a). Based on present condition and likely management direction as reflected by the three MAC categories described above, Table 1 summarizes the Service's expectation of risk of potential adverse effects to bull trout associated with major classes of activities as identified in USDA and USDI (1998a), as conditioned by the goals and RMO provisions of PACFISH and INFISH. Bull trout status and distributional information within MAC categories and in Key and Priority Watersheds is derived from analysis presented in USDA and USDI (1998a), and based on known or predicted status within sixth field hydrologic units (HUCs) expressed as acreage values for HUCs identified as containing strong or depressed local populations of bull trout. The Service's analysis presents this information as percentage

values within the indicated categories.

Table 1. Summary of existing fish status and distribution across management area categories, within Key and Priority Watersheds, and the Service's risk analysis of major activity classes for the portion of the Columbia River DPS within PACFISH and INFISH administered areas (L=low; M=moderate; H=high).

Fish Status and Management Activity	General Management Area Category		
	Undeveloped Areas (1,2, & 3)	Developed Areas (4, 5, & 6)	Highly Developed Areas (7 & 8)
Percent Strong (Total)	19.12	6.66	0.41
Percent Depressed (Total)	38.52	35.01	0.29
Percent Strong (Key and Priority Watersheds)	16.20	5.78	0.41
Percent Depressed (Key and Priority Watersheds)	29.44	22.17	0.26
Timber	L	H	H
Roads	L	H	H
Grazing	M	H	H
Mining/Minerals	M	H	H
Recreation	M	M	L
Fire/Fuels	M	M	M
Lands	L	M	H
General Riparian Area Management	L	M	M
Watershed and Habitat Restoration	L	M	L
Fisheries and Wildlife Restoration	L	M	L

As shown in Table 1, 57.64 percent of the total distribution of bull trout (Columbia River DPS) within the PACFISH and INFISH area occur in undeveloped MACs, and are exposed to moderate risk from grazing, mining, recreation, and fire and fuels management. Key and Priority watersheds contain 45.64 percent of the distribution within undeveloped MACs. Developed MACs contain 41.64 percent of the total distribution, with 27.95 percent of this distribution occurring in Key or Priority Watersheds. All activities were rated as high or moderate risk within developed MACs due to the management focus, relatively high intensity of management expected within these areas, and lack of coverage within Key or Priority Watersheds. Highly developed MACs contain 0.70 percent of the total distribution, with 0.67 percent of this distribution occurring in Key or Priority Watersheds. Low risk is expected for recreation and restoration activities as they are relatively unlikely to occur within this area. Fire and fuels and general riparian management are expected to present moderate risk due to the potential for these activities to occur within the category. High risk is expected from timber, roads, grazing, and mining due to degraded baseline conditions, the expectation that these actions will continue within the area, and lack of coverage in Key or Priority Watersheds. Overall, Key and Priority Watersheds capture 74.26 percent of the total bull trout (Columbia River DPS) distribution within the PACFISH and INFISH area.

Table 2 provides information for bull trout within the Klamath River DPS within the area administered under PACFISH and INFISH. The expected risk of potential adverse effects to bull trout from conducting the indicated management activities is similar as for the Columbia River DPS, but modified due to differences in status, distribution, and proportion of the distribution contained within Key or Priority Watersheds and the potential for activities to occur.

Table 2. Summary of existing fish status and distribution across management area categories, within Key and Priority Watersheds, and the Service's risk analysis of major activity classes for the portion of the Klamath River DPS within PACFISH and INFISH administered areas (L=low; M=moderate; H=high).

Fish Status and Management Activity	General Management Area Category		
	Undeveloped Areas (1,2, & 3)	Developed Areas (4, 5, & 6)	Highly Developed Areas (7 & 8)
Percent Strong (Total)	0.00	0.00	0.00
Percent Depressed (Total)	49.48	50.17	0.00
Percent Strong (Key and Priority Watersheds)	0.00	0.00	0.00
Percent Depressed (Key and Priority Watersheds)	49.48	48.44	0.35
Timber	L	M	M
Roads	L	H	H
Grazing	M	H	H
Mining/Minerals	M	M	M
Recreation	M	M	L
Fire/Fuels	M	M	M
Lands	L	M	H
General Riparian Area Management	L	M	M
Watershed and Habitat Restoration	L	M	L
Fisheries and Wildlife Restoration	L	M	L

As shown in Table 2, 49.48 percent of the total distribution of bull trout (Klamath River DPS) within the PACFISH and INFISH area occur in undeveloped MACs, and are exposed to moderate risk from grazing, mining, recreation, and fire and fuels management. Key and Priority Watersheds contain the entire 49.48 percent of the distribution within undeveloped MACs. Developed MACs contain 50.17 percent of the total distribution, with 48.44 percent of the distribution occurring in Key or Priority Watersheds. All activities were rated as high or moderate risk within developed MACs due to the management focus, relatively high intensity of management expected within these areas, and lack of coverage within Key or Priority Watersheds. Highly developed MACs contain 0.35 percent of the total distribution, all occurring in Key or Priority Watersheds. Low risk is expected for recreation and restoration activities as they are relatively unlikely to occur within this area. Timber, mining, fire and fuels, and general riparian management are expected to present moderate risk due to the potential for these activities to occur within the category. As noted in the environmental baseline, although mining impacts are not suspected to impact bull trout in the Klamath River DPS, the Service assumes

potential for gravel and sand mining from area streams exists, resulting in the moderate risk rating. Additional required buffer widths on intermittent streams is expected to moderate a portion of timber management impacts. High risk is expected from lands, roads, and grazing management, due to degraded baseline conditions and the expectation that these actions will continue within the area. Overall, Key and Priority Watersheds capture 98.27 percent of the total bull trout (Klamath River DPS) distribution within the PACFISH and INFISH area.

As indicated in USDA and USDI (1998a), under current direction, habitat for existing bull trout core areas would be preserved, but little rebuilding of habitat networks would occur. In part, this lack of emphasis on rebuilding habitat networks is due to exclusion of important fringe populations from the Key and Priority Watershed network, and expected low watershed restoration accomplishments (USDA and USDI 1998a). Additional analysis (USDA and USDI 1998a) indicates that substantial declines in the cumulative probability of occurrence for bull trout strongholds are predicted to result from continued implementation of PACFISH and INFISH, based primarily on projected increasing road densities under current direction. As previously stated, roads are a primary source of negative impact to native fish communities. This likely increase in road density is reflected by moderate and high probable impact expected in the developed and highly developed MACs (Tables 1 and 2), for timber and roads. The Service expects that where bull trout subpopulations are located within Key or Priority Watersheds, some negative effects of timber harvest will be mediated (such as temperature increases and a portion of the hydrologic impacts). However, due to increasing road densities associated with timber management, moderate to high impacts are expected overall.

Since livestock grazing is expected to be emphasized within the developed and highly developed MAC categories, high levels of impact are expected from this activity. Mining activity, although expected to be limited in existing protected areas, has potential for local and expansive, short and long term impact, as reflected in Tables 1 and 2. The Service expects recreation impacts to be lower in highly developed MACs, due to lack of pristine landscapes, and moderate for undeveloped and developed areas due to the potential for local negative effects to habitat, and the potential for adverse biotic impacts (illegal fish introductions, poaching, etc.). Due to the potential for local impacts fire and fuels management is expected to result in moderate impact across all MACs. Since the potential for impact by the variety of activities covered under standards and guides for lands varies with the nature of the project, the Service assumes that most of these will not occur in existing undeveloped areas, will likely occur in developed areas, and occur more extensively in highly developed areas. General riparian management, and restoration activities are not likely to occur extensively in undeveloped areas, due to their present condition; most activities are likely to occur in the developed MACs; although local short-term negative effects are possible, restoration activities should result in improved conditions overall.

In summary, a large proportion of the current bull trout distribution (57.64 percent in the Columbia River DPS; 49.48 percent in the Klamath River DPS) occurs within undeveloped areas as defined in USDA and USDI (1998a). In general activities within this summarized management category are expected to result in low to moderate risk to bull trout. Developed

MACs contain 41.64 and 50.17 percent of the bull trout distribution in the Columbia and Klamath River DPSs respectively. Management risk to bull trout ranges from moderate to high within this management area. Highly developed MACs contain a small amount of the bull trout distribution, (.7 and .35 percent in the Columbia and Klamath River DPSs respectively) with management risks that range from low to high, but are primarily high and moderate. Key and Priority Watersheds contain approximately 74 percent of the Columbia River DPS and 98 percent of the Klamath River DPS within the PACFISH and INFISH area. Analysis in USDA and USDI (1998a) and Lee et al. (1997) indicates that reductions in strong populations and further loss of fringe or depressed populations are expected under current management direction; based primarily on additional road-related management impacts, and lack of resources directed toward watershed and habitat restoration. Current implementation of PACFISH and INFISH varies across the area, and given the initial interim nature of the strategies, components addressing the road system, monitoring and watershed analysis have not been fully implemented. Given implementation history, eroded environmental baseline conditions, and the sensitivity of bull trout to management induced disturbance, the Service expects that the potential to jeopardize the existence of bull trout through continued implementation of LRMPs as amended by their respective strategies is high. However, other components of the proposed action apply, affect current direction, and management risks as evaluated by the Service.

In analyzing large geographic areas and general features of projects and activities as described in LRMPs and RMPs the Service cannot speak to the nature and extent of actual impacts of projects as implemented. For example, timber harvest is rated as having a high potential for adverse effects at this scale of analysis within developed and highly developed MACs. However individual timber sales may range in potential impact from high to low, given geologic, topographic, and climatic conditions, specific project location, local watershed conditions, and project specific mitigation. Further, as required by the ESA (Section 7 a(2)), activities having potential for adverse effects to listed species require section 7 analysis. The January 27, 1998, letter of direction specifies the approach that will be taken to complete the required analysis at the project level, and includes review at project specific and watershed levels. Additional modifications to the continuing implementation of LRMPs and RMPs as amended by PACFISH and INFISH were adopted by letter dated June 19, 1998 (USDA and USDI 1998b). Commitments identified in this letter are described in the description of the action, and are considered by the agencies (BLM, USFS, and Service) as part of the proposed action. The effect of these commitments on the Service's expectation of risk of potential adverse effects to bull trout associated with activities authorized by LRMPs and RMPs is described in Table 3 for the Columbia River DPS and Table 4 for the Klamath River DPS.

Table 3. Summary of existing fish status and distribution across management area categories, within Key and Priority Watersheds, and the Service's risk analysis of major activity classes for the proposed action as modified by the letter of June 19, 1998 for the Columbia River DPS (L=low; M=moderate; H=high).

Fish Status and Management Activity	General Management Area Category		
	Undeveloped Areas (1,2, & 3)	Developed Areas (4, 5, & 6)	Highly Developed Areas (7 & 8)
Percent Strong (Total)	19.12	6.66	0.41
Percent Depressed (Total)	38.52	35.01	0.29
Percent Strong (Key and Priority Watersheds)	16.20	5.78	0.41
Percent Depressed (Key and Priority Watersheds)	29.44	22.17	0.26
Timber	L	M	H
Roads	L	H	H
Grazing	L	M	H
Mining/Minerals	M	H	H
Recreation	M	L	L
Fire/Fuels	M	M	M
Lands	L	L	H
General Riparian Area Management	L	L	M
Watershed and Habitat Restoration	L	L	L
Fisheries and Wildlife Restoration	L	L	L

The Service assumes that short-term risks from continuing activities remain, especially in developed and highly developed MACs. Much of this risk is a "legacy" effect, due to eroded baseline conditions over much of the area, and can be expected to remain in the complete absence of additional action by the USFS and BLM. Although restoration activities have short term risks associated with their implementation, long-term positive effects will result. Coordination on development of long-term conservation strategies should help sequence restoration actions in a manner that helps alleviate short-term adverse effects. Given the pervasive negative impact of roads on aquatic species and their habitat, moving forward on development of comprehensive plans addressing road system-related effects is extremely important to bull trout conservation. Similar reduction in risk is expected for the Klamath River DPS Table 4, although impacts are evaluated generally as higher risk of potential adverse effects to bull trout due to the lack of strong populations within the DPS.

Table 4. Summary of existing fish status and distribution across management area categories, within Key and Priority Watersheds, and the Service's risk analysis of major activity classes for the portion of the Klamath River DPS within PACFISH and INFISH administered areas considering the June 19, 1998 letter modifying the proposed action (L=low; M=moderate; H=high).

Fish Status and Management Activity	General Management Area Category		
	Undeveloped Areas (1,2, & 3)	Developed Areas (4, 5, & 6)	Highly Developed Areas (7 & 8)
Percent Strong (Total)	0.00	0.00	0.00
Percent Depressed (Total)	49.48	50.17	0.00
Percent Strong (Key and Priority Watersheds)	0.00	0.00	0.00
Percent Depressed (Key and Priority Watersheds)	49.48	48.44	0.35
Timber	L	M	M
Roads	L	H	H
Grazing	M	H	H
Mining/Minerals	M	M	M
Recreation	M	M	L
Fire/Fuels	M	M	M
Lands	L	M	H
General Riparian Area Management	L	M	M
Watershed and Habitat Restoration	L	M	L
Fisheries and Wildlife Restoration	L	M	L

In summary, reductions in expected risk are based on reducing existing and future road related impacts, additional riparian protections afforded by identification of special emphasis watersheds, and evaluation of Key and Priority Watershed networks, increased emphasis on restoration activities, and joint development of long-term conservation and recovery strategies. Monitoring and watershed analysis is also emphasized and should assist with identification of potential problems, and development of long-term conservation and recovery strategies. The main issues with the adequacy of PACFISH and INFISH, were adequacy of the refugia network, road-related impacts and the lack of implementation of road management S&Gs intended to address these impacts, lack of restoration emphasis within the PACFISH and INFISH area, and adequacy of monitoring and watershed analysis efforts. The Service concludes that successful implementation of the additional commitments agreed to by the agencies will sufficiently modify the proposed action to a degree where it is not likely to jeopardize bull trout in the Columbia River and Klamath River DPSs.

VI. CUMULATIVE EFFECTS

Cumulative effects are defined in the implementing regulations of section 7 of the Act as those effects of future State or private activities, not involving Federal activities, that are reasonably

certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.2). The cumulative effects of future Federal actions will be considered during the section 7 consultations required for those actions and, therefore, are not considered cumulative to the proposed action. This analysis will only address the potential effects of future State and private actions. Cumulative effects analysis of foreseeable State and private actions provide the Service and the action agency greater insight toward understanding the current environmental baseline and likely trends. This insight is necessary to provide the action agencies and the Service with a broader context in which to fully evaluate the impact of the Federal action.

An extensive description of the types of non-Federal actions which are and will likely continue to occur in the project area are included in the *"Non-Federal actions in the Action Area"* portions of this document above. Based on this information, and because of the type, extent and distribution of those actions, the Service concludes they will continue to have a moderate to high risk of adverse effects to bull trout in the Columbia Basin and Klamath Basin DPSs.

VII. CONCLUSION

After reviewing the current status of bull trout in the Columbia and Klamath River DPSs, the environmental baseline for the action area, the effects of implementation of the ACSs by LRMPs that include activities which may affect bull trout, and their cumulative effects, it is the Service's biological opinion that the action as proposed, when considered cumulatively, is not likely to jeopardize the continued existence of bull trout in those DPSs. No critical habitat has been designated for this species, therefore, none will be affected.

This consultation addresses continued implementation of LRMPs as modified by interim strategies for PACFISH and INFISH, and where more stringent protection exists in existing plans, in the individual LRMPs. This consultation does not address the specific effects of individual future actions. The scope of analysis for evaluating the impacts of an activity on bull trout is the DPS as a whole. The Level 1 teams, through the streamlined consultation process, will evaluate effects of specific future actions on bull trout. As provided in the section 7 consultation streamlining guidance, and as noted in the June 19, 1998 letter from the USFS and BLM, Service anticipates conducting project level section 7 consultations on a watershed basis. Programs or projects brought forward at the larger landscape scale will facilitate the Service's ability to evaluate the individual and cumulative effects of such projects on bull trout. As a result, the Service will be able to more accurately evaluate the impacts to the bull trout within their respective DPSs.

VIII. INCIDENTAL TAKE STATEMENT

Under sections 4(d) and 9 of the ESA, any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species is prohibited unless exempted by the ESA or authorized by ESA permit or special regulation. Harm is further defined to include significant habitat modification or degradation that actually kills or injures a

listed species by significantly impairing essential behavioral patterns such as breeding, feeding, and sheltering. Harass is defined as actions that create the likelihood of injuring a 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, and sheltering. Incidental take is take of listed animal species that results from, but is not the purpose of, the Federal agency or the applicant carrying out 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 prohibited taking provided that such taking is in compliance with the terms and conditions of an incidental take statement.

In general, an incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions which must be complied with in order to implement the reasonable and prudent measures.

Amount and Impact of Anticipated Incidental Take

This incidental take statement addresses impacts to Columbia River and Klamath River DPSs of bull trout from continued implementation of LRMPs for the subject administrative units, as amended by PACFISH and INFISH and the additional seven commitments, as conducted using the current streamlining guidance, and the procedures for conducting watershed level consultations according to the January 27, 1998 letter of direction.

Implementation of LRMPs, as Amended by PACFISH and INFISH

Notwithstanding the Service's conclusion that continued implementation of management direction in the subject LRMPs is not expected to jeopardize the continued existence of the Columbia River and Klamath River bull trout DPSs, certain actions implementing the LRMPs may result in incidental take of bull trout. These actions will be subject to future site-specific consultation.

The Service is unable to anticipate all possible circumstances related to continued LRMP implementing actions, including programmatic actions or individual actions that might be developed in the future. Therefore, the Service is unable to issue a "blanket" incidental take statement or a comprehensive list of reasonable and prudent measures to cover all programs and actions subsequently implemented pursuant to LRMP management direction. Even though the Service anticipates some low level of incidental take may occur due to these actions, the best scientific and commercial data available are not sufficient to enable the Service to estimate a specific amount of incidental take to the species. In these instances, the Service designates the expected level of take as "unquantifiable." While the Service has determined that the level of anticipated take associated with continued implementation of the LRMPs, as amended by PACFISH and INFISH and the seven additional commitments, is not likely to jeopardize the Columbia and Klamath River bull trout DPSs, the Service is not authorizing through this

biological opinion the incidental take of bull trout for any specific action carried out under direction of the LRMPs.

The Service is able, however, to prescribe reasonable and prudent measures that will reduce the overall level of incidental take which may result from continued implementation of LRMP management direction by ensuring that planned actions are fully consistent with the PACFISH and INFISH ACS objectives. There are actions which are fully consistent with LRMPs as amended by PACFISH, INFISH, and the seven commitments which may result in incidental take of bull trout. These include actions undertaken to benefit the species (e.g., instream habitat enhancement and restoration projects, culvert replacement and upgrades, and road decommissioning projects), as well as other actions (e.g., timber harvest, site preparation, road construction, livestock grazing, and mining). Incidental take associated with these types of actions may occur from detrimental effects on aquatic habitat parameters including stream temperature, substrate quality, suspended sediment levels, and habitat complexity and connectivity, all of which may directly or indirectly affect the life history of bull trout.

The reasonable and prudent measures and terms and conditions provided here are based on a process for evaluating and screening proposed actions at both individual action and watershed levels. The evaluation and screening of proposed actions is accomplished through the ESA consultation process developed to implement the May 31, 1995, interagency streamlining agreement and the direction letters of January 27, 1998 and February 6, 1998 (Appendix 3). Interagency Level 1 teams evaluate the effects of proposed actions against the environmental baseline at individual action and section 7 watershed scales. They determine whether effects to listed, proposed, and candidate species have been minimized by fully applying the relevant LRMP management direction, as amended by PACFISH and INFISH and the seven commitments, and relevant terms and conditions from this BO in the design of proposed actions.

The first step in this process, in fact the ultimate goal of the section 7 streamlining consultation process, is to design actions that are not likely to adversely affect the bull trout, and thus avoid the likelihood of incidental take and the need for formal consultation. The second step in the process, for those cases where adverse effects are likely to occur, is for the action agency, based on Level 1 team input, to incorporate adequate measures into the proposed actions to minimize the incidental take, with the goal of avoiding the need for additional measures beyond those described as part of the proposed action. Finally, in those cases where proposed actions are "likely to adversely affect" bull trout and additional measures are needed to minimize incidental take, the Service will need to identify these measures, associated terms and conditions, and prepare a biological opinion to conclude formal consultation.

These reasonable and prudent measures and terms and conditions will become mandatory when and where found appropriate through formal consultation, and prescribed by the Service in a site-specific biological opinion. Incidental take, if any, will be authorized at the site specific action level. Site-specific biological opinions may tier to, and incorporate by reference, the analysis, reasonable and prudent measures, and terms and conditions set forth in this opinion.

Reasonable and Prudent Measures

As noted in the June 19, 1998 amendment to the BA, the USFS and BLM made additional commitments in implementing the PACFISH and INFISH ACSs to ensure their actions conserve the federally listed bull trout. These actions were evaluated by the Service in this BO as part of the proposed action. In short, the additional commitments address:

1. Restoration and improvement
2. Standards and guidelines
3. Key and priority watershed networks
4. Watershed analysis
5. Monitoring
6. Long-term conservation and recovery
7. Section 7 consultation at the watershed level

The following reasonable and prudent measures and implementing terms and conditions are provided to emphasize and further clarify those commitments, and other aspects of the LRMPs as amended by PACFISH and INFISH.

Continued LRMP Implementation

1. Apply the review criteria described on pages C-3 through C-9 of the PACFISH ROD (USDA and USDI 1995a), and A-1 through A-6 of the INFISH FONSI (USDA 1995) to ensure that proposed actions are fully consistent with applicable standards and guidelines and ACS objectives.

2. Utilize the Level 1 team consultation process and apply the "bull trout Matrix" or a similar approach as agreed to by the agencies (USFS, BLM, and the Service; Appendices 2, 3, and 6) to evaluate actions to determine the potential effects on bull trout, and to assure interagency coordination to complete the consultation process. In addition, update the environmental baseline at the section 7 watershed scale to include proposed actions once consultation is concluded.

3. In collaboration with the Service, develop a mechanism for improved monitoring accountability and oversight of management actions that affect bull trout or their habitats, designed to meet the applicable objectives, standards and guidelines of PACFISH and INFISH.

4. Together with the Service, collaborate in development of multi-year road restoration strategies for key, priority and special emphasis watersheds.

5. In collaboration with the Service, conduct a comprehensive review of existing unroaded and low density roaded areas throughout the Columbia River and Klamath River bull

trout DPSs and determine their importance for the long-term conservation of bull trout. The information will serve as the foundation of a conservation strategy based on the protection of existing high quality habitat with the necessary connectivity between these areas.

The following reasonable and prudent measures and terms and conditions become mandatory when and where found appropriate through formal consultation, and prescribed by the Service in a site-specific biological opinion.

Watershed and Habitat Restoration Actions

6. Apply the results of watershed analysis where required or applicable, and consider expected benefits to bull trout during the design and prioritization of instream habitat enhancement and restoration projects, culvert replacement upgrades, and road decommissioning actions. Assess proposed watershed and habitat restoration actions to ensure that potential short term adverse effects to bull trout are outweighed by long term benefits.

7. Ensure that the timing of any work within intermittent or perennial stream channels associated with these projects is designed to minimize/reduce short-term adverse effects to aquatic habitat and bull trout.

8. Apply relevant PACFISH and INFISH objectives, standards and guidelines, and relevant aspects of the June 19, 1998 additional commitments in design and implementation of watershed and habitat restoration actions.

Road Construction Actions

9. Avoid, reduce or minimize the adverse effects of road construction, reconstruction and maintenance on bull trout habitat components; particularly water quality, flow and hydrology, and channel condition and dynamics.

Livestock Grazing Actions

10. Review, modify, and implement annual operating instructions or term grazing permits for those allotments/leases which encompass streams known or expected to contain bull trout addressed in this BO to meet appropriate PACFISH or INFISH objectives.

11. Develop and implement grazing management plans and practices in areas of known or suspected bull trout spawning to minimize/reduce trampling of redds and other direct and indirect effects that may result in take of the species.

12. As allotment management plans are amended or revised, modify the AMPs to meet

appropriate PACFISH or INFISH objectives.

Mining Actions

13. Minimize/reduce the adverse effects of mining actions, including placer mining, recreational suction dredging, and gold panning, that result in take of the species by implementing all relevant standards and guidelines (e.g., MM-1, MM-2, etc.).

Timber Management Actions

14. Analyze, design, and implement timber harvest activities to address impacts from the action on water quality, habitat access, habitat elements, channel condition and dynamics, stream flow, hydrology, and watershed conditions.

Terms and Conditions

Continued LRMP Implementation

1. By December 1, 1998, the USFS and BLM will develop, in cooperation with the Service, time lines and a schedule for completion of aspects of the additional commitments contained in the June 19, 1998 amendment to the BA where they are not currently described.

2. To ensure that proposed actions designed in accordance with relevant standards and guidelines are in fact consistent with PACFISH and INFISH ACS objectives, USFS and BLM decision makers will apply the results of watershed analysis and other relevant information to conclude that actions either "meet" or "do not prevent attainment" of the ACS objectives. The conclusion must be documented and supporting rationale provided. Examples of tools for the documentation include, but are not limited to materials provided at interagency workshops on the bull trout conference process (e.g. the bull trout matrix and outline for watershed BAs) and Adequate Documentation for Changes to ACS.

3. To ensure that an interagency, interdisciplinary process is used to implement management direction in the LRMPs, utilize the Level 1 team streamlining consultation process; the bull trout watershed consultation approach as outlined in the January 27, 1998 letter of direction and as updated by any new, revised interagency direction; and apply the bull trout Checklist and Matrix of Pathways and Indicators (USFWS 1998), or a similar agreed upon approach, to evaluate all proposed actions that may affect the bull trout.

4. Through interagency coordination, develop stratified monitoring plans (e.g. at the watershed or subbasin scales) to evaluate impacts of management actions to bull trout. The management program areas to address and a schedule for their development will be

agreed to by the interagency team. The plans should address, at a minimum, both compliance and effectiveness monitoring.

a. Develop these plans by subbasin, through use of an interagency group, to maximize the utility of monitoring information through a coordinated effort and a defensible sampling design. The interagency groups should establish objectives for the monitoring plans in accordance with PACFISH and INFISH.

b. Goals for the monitoring plans should include maximizing the effectiveness of limited monitoring funds, identifying appropriate scales and levels of monitoring necessary to determine if management actions are meeting PACFISH and INFISH direction, allowing for flexibility as funding and activities change, and identifying how monitoring results should be used to make management adjustments.

c. Fully implement the monitoring plans by ensuring monitoring schedules are developed and implemented, with agreement between the USFS, BLM and the Service. If these mutually agreed upon schedules can not be followed, an alternative approach will be developed and agreed to by the interagency group.

5. In collaboration with the Service, the USFS and BLM will develop and implement guidance for use by administrative units for minimizing/reducing effects of road management programs on bull trout. Issues that should be addressed in this guidance document include, but are not limited to, road construction, reconstruction, removal, obliteration and decommissioning as well as an assessment of unroaded and low density roaded areas in relation to conservation of bull trout. The exact scope, format and detail of this guidance document should be decided through interagency discussions. Following are items for consideration in completing this task:

a. Convene an technical interagency team of experts and research scientists to guide an assessment of road construction and management, including unroaded and low density roaded areas in relation to conservation of bull trout.

b. Provide descriptions, locations, and maps of unroaded and low density roaded areas, and existing information on the relative habitat value of the areas for bull trout.

c. The technical/research team will summarize and review existing management direction and make recommendations to senior agency managers regarding at a minimum: need for additional habitat protection; risks to bull trout from developmental activities; priority for subbasin assessments and watershed analyses connectivity between areas; and restoration priorities.

d. Provide a mutually agreed upon strategy to accomplish any additional habitat protections recommended by the technical/research team.

6. For mining operations on BLM-administered lands that are not required to have an approved Plan of Operation (see 43 C.F.R. § 3809.1-4), respond to all mining notices within 10 calendar days by advising the operator that the mining activity shall not cause take of bull trout unless the operator has first obtained an incidental take permit under section 10 of the ESA. BLM will advise the operator of what actions are needed to prevent adverse impacts to bull trout and their habitat.

The following terms and conditions, will become mandatory when and where found appropriate through formal consultation, and prescribed, by the Service, in a site-specific biological opinion.

Watershed and Habitat Restoration Actions

7. Provide documentation of information and criteria used to design and prioritize actions to demonstrate that the timing of in-channel work associated with the subject projects will minimize short-term adverse effects to aquatic habitat, and to demonstrate compliance with applicable objectives and standards and guidelines of the ACSs.

8. To ensure that proposed actions are designed to provide for long term habitat benefits while avoiding, minimizing or reducing short term impacts, utilize information and recommendations from completed watershed analysis reports, the most current watershed scale environmental baseline and the determination of effects of proposed actions using the bull trout Matrix and Checklist, or an agreed upon approach.

Road Construction Actions

9. To avoid or minimize incidental take associated with the adverse effects of road construction, reconstruction and maintenance on water quality, flow and hydrology, and channel condition and dynamics, each administrative unit shall apply the pertinent standards and guidelines for road construction and decommissioning as described in the LRMPs, as amended by PACFISH and INFISH.

10. New roads (temporary, semi-permanent or permanent) in RHCAs shall be minimized to the greatest extent possible, and shall be constructed only where watershed analyses have been completed to document that the roads would not prevent attainment of ACS objectives.

Livestock Grazing Actions

11. When reviewing and modifying grazing actions to minimize/reduce incidental take, amend livestock grazing annual operating instructions, term grazing permits or leases to incorporate appropriate criteria for evaluating ecological conditions of affected areas to ensure attainment of ACS objectives. The evaluation criteria should be developed by USFS and/or BLM range and other interdisciplinary specialists, in coordination with the

Service through Level 1 teams.

12. Implement management actions, as appropriate, to minimize the impact of livestock grazing in known bull trout spawning areas. Some actions which may be considered include numbers of animals, timing and duration of grazing, herding, fencing of riparian areas, or upland water sites.

Mining Actions

13. For mining operations where the administrative unit has discretion to require a Plan of Operations, require such a plan if the mining operation has the potential to adversely affect bull trout. Ensure that the plan complies with applicable minerals management standards and guidelines for the ACS.

Timber Management Actions

14. Analyze, design, and implement timber harvest activities to meet the requirements of PACFISH and INFISH, and such additional measures as needed to minimize/reduce incidental take of bull trout, through incorporation of the following terms and conditions as appropriate for site specific conditions:

    a. Evaluate effects to bull trout and develop mitigation measures.

        i. Utilize the indicators for bull trout habitat needs contained in the bull trout matrix (Appendix 2), or a similar evaluation tool agreed upon by the agencies;

        ii. Utilize information from: the scientific literature; models, validated with local data wherever possible; and on-site studies to evaluate slope stability, and landslide hazard and risk;

    b. Develop and implement approaches that address and minimize potential incidental take of bull trout from fuel storage and transportation associated with timber harvest actions.

IX. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of ESA by carrying out conservation programs for the benefit of endangered and threatened species. The term "conservation recommendations" is defined as suggestions from the Service regarding discretionary measures (1) to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, (2) conduct studies and develop information, and (3) promote the recovery of listed species. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the agency's 7(a)(1)

responsibilities.

1. *Roads within key, priority, and special emphasis area watersheds*: Seek a net reduction of roads in bull trout watersheds. Overall, watershed road densities of less than 1.0 mile per square mile, especially where there are bull trout stronghold populations, may be necessary to assure future survival and recovery to self-sustaining populations. An interim target should be to reduce total road densities in all Key, Priority, and special emphasis watersheds containing bull trout and to prevent any increase in road densities in those. Rehabilitation of road-miles cannot be accomplished alone by gating, berming, or otherwise blocking the entrance to a road permanently or temporarily, or seasonally closing roads, but will require obliteration, recontouring, and revegetating.

2. *Fish Passage*: Reduce passage problems associated with culverts and water diversions. Also screen all water intakes appropriately to prevent the entrainment of bull trout of all age classes.

3. *Viability Analysis*: The viability of bull trout on Federal lands should be analyzed using the definition suggested in Chapter 3, Table 3.5 of the ICBEMP Draft EIS that states a viable population "has the estimated numbers and distribution of reproductive individuals (both current and projected) to provide for a self-sustaining population with a sufficiently high likelihood of continued existence at a high enough level that listing of the species under the ESA does not become warranted. A "recovered" species is considered to be viable when it is removed from the endangered species list. The Service offers support in completing this analysis.

4. *Connectivity*: When the USFS and BLM are developing a "watershed network to ensure the protection and recovery of bull trout metapopulations" (as committed to in the amendment to the BA addressed to the Service dated June 19, 1998), seek to restore or improve connectivity within and between isolated sub-populations of bull trout, except in cases where the risks of non-native species introductions override the risks to continued population isolation. This network should contain high quality habitat for bull trout, both currently occupied and historic, that would act as "refugia". Guidance should be developed and implemented that specifies what actions can and cannot occur in these areas to preserve their status as "refugia".

5. *Adaptive Management*: Those LRMPs that are now amended by the PACFISH and INFISH strategies indefinitely until a long-term, comprehensive management plan is developed should initiate an adaptive management approach when implementing their ACSs. The USFS and BLM should use all monitoring information available, map and information from the BA and BO, findings from watershed analysis, and other pertinent information to determine how RMOs, RHCAs, and S&Gs should be modified to better address the needs of bull trout.

6. *Prioritization and multi-scale planning*: Subbasin assessments should be conducted to provide a multi-scale context of habitat status and restoration needs within subbasins and watersheds. A subbasin assessment process, similar to the Nez Perce National Forest's South Fork Clearwater River Assessment, would provide a method to use a broad perspective to

characterize the contributions of individual watersheds to the survival and recovery of listed species. Other benefits of subbasin information would be gaining the perspective necessary to determine which watersheds should be prioritized for subsequent analysis, such as at the watershed scale.

7. *Collaboration*: The Service should have the opportunity to participate in all levels of analysis, project planning, and monitoring on USFS and BLM-administered lands within the area where PACFISH and INFISH amend LRMPs. Much, but not all, of this collaboration can be accomplished through early involvement of Service representatives on section 7 consultation streamlining Level I and II teams.

8. *Watershed Improvement Efforts*: Together with the Service, and NMFS where appropriate, the USFS and BLM will provide leadership in developing partnerships with other federal agencies, with state agencies, tribes and private entities to implement actions which will lead to the survival and recovery of bull trout populations.

9. *Future mine development*: To protect bull trout habitat, determine whether future development of mining claims, mineral leasing, or sale of mineral materials would adversely impact habitat conditions in watersheds currently occupied by bull trout and historically-occupied watersheds necessary for bull trout recovery, and use all available administrative authority, including withdrawals, to minimize such impacts.

a. Review the results of completed assessments of bull trout habitat within each administrative unit (e.g., field surveys, watershed analyses, basin assessments, etc.) and identify essential bull trout habitat areas.

b. In conjunction with USFS and BLM mineral specialists, review existing, proposed, and potential mining activities within each administrative unit and work with the Level 1 teams to assess the potential for adverse effects to the essential bull trout habitat areas identified in step a. above. Identify those stronghold habitat areas where mining effects cannot be fully mitigated pursuant to relevant LRMP and RMP management direction, mining regulations, or other administrative options.

c. For areas where mining effects cannot be fully mitigated, withdraw these areas from location of new mining claims and prohibit mineral leasing and sales of mineral materials. For existing mining claims and mineral leases in these areas, use all available administrative authority to minimize and mitigate the adverse effects on mining on bull trout.

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

X. CLOSING STATEMENT - REINITIATION

This biological opinion addresses the effects of continued implementation of activities authorized by LRMPs as amended by PACFISH and INFISH by the USFS and BLM, as it affects populations of the Columbia River and Klamath River bull trout DPSs.

This concludes formal consultation on the actions outlined in the June 15, 1998 request for consultation, and amended by the letter of June 19, 1998. As provided in 50 CFR section 402.16, reinitiation 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) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (2) 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 (3) a new species is listed or critical habitat designated that may be affected by the action.

If you have any questions regarding this opinion, please contact Ron Rhew (Oregon: 503-231-6179); Susan Martin (Idaho: 208-378-5243); Linda Hallock (Washington: 509-921-0160); or Kemper McMaster or Dale Harms (Montana: 406-449-5225).

XI. LITERATURE CITED

Adams, S.B. 1994. Bull trout distribution and habitat use in the Weiser River drainage, Idaho. M.S. Thesis. University of Idaho, Moscow, ID.

Adams, S.B. 1996. Factors affecting distribution and co-occurrence of eastern brook trout and other fishes in the Northern Rocky Mountains. Annual Progress Report for U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Boise, ID. Contract # 94953-RJVA.

Adams, S.B. and T.C. Bjornn. 1997. Bull trout distribution related to temperature regimes in four central Idaho streams. Pages 371-380 *in* Mackay, W.C., M.K. Brewin and M. Monita, Friends of the Bull Trout Conference Proceedings. May 1994. Calgary, CA.

Administrative rules of Montana. 1996. Water quality administrative rules.

Allan, J.H. 1980. Life history notes on the dolly varden char (*Salvelinus malma*) in the Upper Clearwater River, Alberta. Manuscript Report. Energy and Natural Resources, Fish and Wildlife Division. Red Deer, AB. 58 pp.

Armour, C.L., D.A. Duff, and W. Elmore. 1991. The effects of livestock grazing on riparian and stream ecosystems. Fisheries 16(1):7-11.

Batt, P.E. 1996. State of Idaho bull trout conservation plan. Office of the Governor, Boise, ID.

Baxter, C.V. and F.R. Hauer. In prep. Geomorphology, interaction of ground and surface waters, and the selection of spawning habitat by bull trout (*Salvelinus confluentus*): a multi-scale, hierarchical approach. Flathead Lake Biological Station. University of Montana. Polson, MT.

Baxter, J.S. and J.D. McPhail. 1996. Bull trout spawning and rearing habitat requirements: summary of the literature. Fisheries technical circular no. 98. Fisheries Branch, British Columbia Ministry of Environment, Lands and Parks, Vancouver.

Belt, J.H., J. O'Laughlin and T. Merrill. 1992. Design of forest riparian buffer strips for the protection of water quality: analysis of scientific literature. Idaho Forest, Wildlife and Range Policy Analysis Group.

Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby and T.D. Hofstra. 1987. Stream temperature and aquatic habitat: fisheries and forestry interactions. *In*: Salo, E.O. and T.W. Cundy, eds., Streamside management forestry and fisheries interactions. University of Washington, Institute of Forest Resources Contribution 57, Seattle, WA.

Bjornn, T.C. and J. Mallet. 1964. Movements of planted and wild trout in an Idaho river system. Transactions of the American Fisheries Society 93:70-76.

Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams: influences of forest and rangeland management on salmonid fishes and their habitats. W.R. Meehan, ed., American Fisheries Society Special Publication 19: 83-138.

Bond, C.E. 1992. Notes on the nomenclature and distribution of the bull trout and the effects of human activity on the species. Pages 1-4 *in* Howell, P.J. and D.V. Buchanan, eds., Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Bonneau, J.L. and D.L. Scarnecchia. 1996. Distribution of juvenile bull trout in a thermal gradient of a plunge pool in Granite Creek, Idaho. Transactions of the American Fisheries Society 125: 628-630.

Booth, D.B. 1991. Urbanization and the natural drainage systems - impacts, solutions and prognoses. The N.W. Environmental Journal 7: 93-118.

Bozek, M.A. and M.K. Young. 1994. Fish mortality resulting from delayed effects of fire in the greater Yellowstone ecosystem. Great Basin Naturalist 54:91-95.

Brazier, J.R. and G.W. Brown. 1973. Buffer strips for stream temperature control. Research paper 15. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Brown, L.G. 1992. Draft management guide for the bull trout on the Wenatchee National Forest. Prepared for the Wenatchee National Forest, Wenatchee, WA.

Buchanan, D. M. and S. V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. Pages 1-8 *in*: Mackay, W.C., M.K. Brewin and M. Monita, Friends of the Bull Trout Conference Proceedings. May 1994. Calgary, CA.

Buchanan, D., M. Hanson, and R. M. Hooten. 1997. Status of Oregon's bull trout, distribution, life history, limiting factors, management considerations and status. Oregon Department of Fish and Wildlife, Portland, OR.

Buckley, D.S., T.L. Sharik, and J.G. Isebrands. 1998. Regeneration of northern red oak: positive and negative effects of competitor removal. Ecology 79(1):65-78.

Buckman, R.C., W.E. Hosford and P.A. Dupee. 1992. Malheur river bull trout investigations. Pages 45-57 *in*: Howell, P.J. and D.V. Buchanan, eds., Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Buktenica, M. W. 1997. Bull trout restoration and brook trout eradication at Crater Lake National Park, Oregon. *In*: Mackay, W.C., M.K. Brewin and M. Monita, Friends of the Bull Trout Conference Proceedings. May 1994. Calgary, CA.

Burroughs, J.W. and J.G. King. 1985. Surface erosion control on roads in granitic soils. Pages 183-190 *in*: ASCE Committee on Watershed Management Proceedings. Denver, CO.

Burroughs, J.W. and J.G. King. 1989. Reduction of soil erosion on forest roads. Gen. Tech. Rep. INT-GTR-264. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. 21 pp.

Carlson , D.W. and A. Groot. 1997. Microclimate of clear-cut, forest interior, and small openings in trembling aspen forest. Agricultural and Forest Meteorology 87(4):313-329.

Cavender, T. M. 1978. Taxonomy and distribution of the bull trout, *Salvelinus confluentus* (Suckley), from the American northwest. California Department of Fish and Game 64: 139-174.

Chamberlin, T.W., R.D. Harr and F.H. Everest. 1991. Timer harvesting, silviculture and watershed processes. *In*: Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19: 181-205.

Chaney, E., W. Elmore and W.S. Platts. 1990. Livestock grazing on western riparian areas. Produced for the U.S. Environmental Protection Agency by the Northwest Resource Information Center, Inc. Eagle, ID.

Chapman, D., A. Giorgi, M. Hill, A. Maule, S. McCutcheon, D. Park, W. Platts, K. Pratt, J. Seeb, L. Seeb, and F, Utter. 1991. Status of Snake River chinook salmon. Don Chapman Consultants, Inc., Boise, ID.

Clancy, C.G. 1993. Statewide fisheries investigations: Bitterroot Forest inventory. Montana Fish, Wildlife, and Parks, Job Completion Report, Project F-46-R-4-Ij, Helena, MT.

Clancy, C.G. 1996. Statewide fisheries investigations: Bitterroot Forest inventory. Montana Fish, Wildlife, and Parks, Job Completion Report, Project F-46-R-4-I, Helena, MT.

Coeur d'Alene Tribe of Idaho, U.S. Department of Agriculture, and U.S. Department of the Interior. 1991. Preassessment screen of natural resource damages in the Coeur d'Alene watershed environment from mining and other related activities. Unpublished report. Coeur d'Alene Tribe.

Craig, S.D. and R.C. Wissmar. 1993. Habitat conditions influencing a remnant bull trout spawning population, Gold Creek, Washington. Draft report. Fisheries Research Institute, University of Washington, Seattle, WA.

Cross, D., and L. Everest. 1995. Fish habitat attributes and managed watersheds with special reference to the location of bullcharr spawning sites in the Upper Spokane river ecosystem. Fish Habitat Relations, Technical Bulletin No. 17.

Dambacher, J.M., M.W. Buktenica and G.L. Larson. 1992. Distribution, abundance, and habitat utilization of bull trout and brook trout in Sun Creek, Crater Lake National Park, OR.

Dambacher, J.M. and K.K. Jones. 1997. Stream habitat of juvenile bull trout populations in Oregon and benchmarks for habitat quality. *In*: Mackay, W.C., M.K. Brewin and M. Monita, Friends of the Bull Trout Conference Proceedings. May 1994. Calgary, CA.

Donald, D.B. and D.J. Alger. 1993. Geographic distribution, species displacement, and niche overlap for lake trout and bull trout in mountain lakes. Canadian Journal of Zoology 71: 238-247.

Dorratcaque, D. E. 1986. Lemhi River habitat improvement study. Final report to U.S. Department of Energy, Bonneville Power Administration. Proj. No. 84-28.

Ellis, M. 1940. Pollution of the Coeur d'Alene river and adjacent waters. U.S. Department of the Interior and Bureau of Fisheries Report.

Elmore, W. and R.L. Beschta. 1987. Riparian areas: perceptions in management. Rangelands 9(6):260-265.

Faler, M. P. and T.B. Bair. 1991. Migration and distribution of adfluvial bull trout in Swift Reservoir, North Fork Lewis River and tributaries. Draft report. U.S. Forest Service, Wind River Ranger District, Carson, WA.

Fleming , R.L., T.A. Black, R.S. Adams and R.J. Stathers. 1998. Silvicultural treatments, microclimatic conditions and seedling response in southern interior clear-cuts. Canadian Journal of Soil Science 78(1):115-126.

Fraley, J.J. and B.B. Shepard. 1989. Life history, ecology and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and river system, Montana. Northwest Science 63(4): 133-143.

Frissell, C.A. 1993. Topology of extinction and endangerment of native fishes in the Pacific Northwest and California. Conservation Biology 7(2): 342-354.

Frissell, C.A. 1997. A spatial approach to species viability: conservation of fishes in the Columbia River Basin. Draft report. Flathead Lake Biological Station, University of Montana, Polson, MT.

Furniss, M.J., T.D. Roelofs and C.S. Yee. 1991. Chapter 8: Road construction and maintenance. Pages 297-323 *in* Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19.

Gilbert, C.H. and B.W. Evermann. 1894. A report upon investigations in the Columbia River basin, with descriptions of four new species of fishes. Bulletin of the U.S. Fish Commission Vol. XIV, Washington, D.C.

Gloss, D, and N. Gerhardt. 1992. Nez Perce National Forest watershed analysis. Unpublished report. Nez Perce National Forest.

Goetz, F. 1989. Biology of the bull trout, *Salvelinus confluentus*, literature review. Willamette National Forest, Eugene, OR.

Goetz, F. 1994. Distribution and juvenile ecology of bull trout (*Salvelinus confluentus*) in the Cascade Mountains. Master's Thesis. Oregon State University, Corvallis, OR.

Graham, P.J., B.B. Shepard, and J.J. Fraley. 1981. Use of stream habitat classifications to identify bull trout spawning areas in streams. Pages 186-192 *in* N.B. Armantrout, ed., Acquisition and utilization of aquatic habitat inventory information. Montana Department of Fish, Wildlife, and Parks, Kalispell, MT.

Haas, G.R. and J.D. McPhail. 1991. Systematics and distributions of dolly varden (*Salvelinus malma*) and bull trout (*Salvelinus confluentus*) in North America. Can. J. Fish. Aquatic Sciences 48: 2191-2211.

Hansen, B. and J. DosSantos. 1997. Distribution and management of bull trout populations on the Flathead Indian Reservation, western Montana, USA. Pages 249-253 *in*: Mackay, W.C., M.K. Brewin and M. Monita, Friends of the Bull Trout Conference Proceedings. May 1994. Calgary, CA.

Harvey, B.C., T.E. Lisle, T. Vallier and D.C. Fredley. 1995. Effects of suction dredging on streams: a review and evaluation strategy. U.S. Department of Agriculture, Forest Service.

Haupt, H.F. 1959a. A method for controlling sediment from logging roads. Miscellaneous Publication Number 22. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 22 pp.

Haupt, H.F. 1959b. Road and slope characteristics affecting sediment movement from logging roads. Journal of Forestry 57(5):329-332.

Henjum, M.G., J.R. Karr, D.L. Bottom, D.A. Perry, J.C. Bednarz, S.G. Wright, S.A. Beckwitt, E. Beckwitt. 1994. Interim protection for late-successional forests, fisheries, and watersheds. National Forests east of the Cascade Crest, Oregon, and Washington. A Report to the Congress and President of the United States Eastside Forests Scientific Society Panel. American Fisheries Society, American Ornithologists Union Incorporated, The Ecological Society of America, Society for Conservation Biology, The Wildlife Society. The Wildlife Society Technical Review 94-2.

Howell, P.J. and D.V. Buchanan, eds. 1992. Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Idaho Department of Fish and Game. 1995. Assessment and conservation strategy for bull trout. Idaho Department of Fish and Game, Boise, ID.

Jakober, M. 1995. Autumn and winter movement and habitat use of resident bull trout and westslope cutthroat trout in Montana. M.S. Thesis, Montana State University, Bozeman, MT.

Jones, R. and A. Espinosa. 1992. Watershed and stream condition analysis for the Roaded Watershed. Final report. Clearwater National Forest.

Jones, J.A. and G.E. Grant. 1996. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. Water Resources Research 32(4):959-974.

Kauffman, J.B.and W.C. Krueger. 1984. Livestock impacts on riparian ecosystems and streamside management implications, a review. J. Range Manage. 37(5): 430-435.

Kelly, E., S. Jones, and S. Whalen. 1996. Anglers ability to identify bull trout and other salmonid species found in Northwest Montana. Montana Department of Fish, Wildlife, and Parks Report. 12 pp.

Ketcheson G. L. and W. F. Megahan. 1996. Sediment production and downslope sediment transport from forest roads in granitic watersheds. Research Paper INT-RP-486. 12 pp.

Kootenai National Forest. 1997. Kootenai National Forest Plan. U.S. Forest Service.

Leary, R.F., F.W. Allendorf and S.H. Forbes. 1993. Conservation genetics of bull trout in the Columbia and Klamath River drainages. Conservation Biology 7(4): 856-865.

Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow and J.E. Williams. 1997. Chapter 4: Broadscale assessment of aquatic species and habitats. *In* Quigley, T.M. and S.J. Arbelbide, tech. eds., An assessment of ecosystem components in the Interior Columbia Basin and portions of the Klamath and Great Basins: Volume III. General Technical Report PNW- GTR-405. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management.

Light, J., L. Herger and M. Robinson. 1996. Upper Klamath Basin bull trout conservation strategy, a conceptual framework for recovery. Part One. The Klamath Basin Bull Trout Working Group.

Long, M.H. 1994. Sociological implications of bull trout management in northwest Montana: illegal harvest and game warden efforts to deter poaching. Montana Department of Fish, Wildlife and Parks, Kalispell, MT.

Long, M. H. 1997. Sociological implications of bull trout management in northwest Montana: illegal harvest and game warden efforts to deter poaching. Pages 71-73 *in*: Mackay, W.C., M.K. Brewin and M. Monita, Friends of the Bull Trout Conference Proceedings. May 1994. Calgary, CA.

Markle, D.F. 1992. Evidence of bull trout x brook trout hybrids in Oregon. *In:* Howell, P.J. and D.V. Buchanan, eds., Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Martin, S.W., M.A. Schuck, K. Underwood and A.T. Scholz. 1992. Investigations of bull trout (*Salvelinus confluentus*), steelhead trout (*Oncorhynchus mykiss*) and spring chinook (*Oncorhynchus tshawytscha*) interaction in southeast Washington streams. Annual report. Washington Department of Wildlife and Eastern Washington University. Prepared for Bonneville Power Administration. Contract No. DE-BI79-91BP17758.

Mathieus, G. 1996. Montana forestry best management practices implementation monitoring. The 1996 Forestry BMP audits final report. Montana Department of Natural Resources and Conservation, Missoula, MT.

Maxell, B.A. 1996. Bull trout (*Salvelinus confluentus*) in the Rock Creek watershed of western Montana: a cursory population analysis. Unpublished report. University of Montana, Missoula, MT.

McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin and J. Van Sickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. Canadian Journal of Forest Sciences 20:326-330.

McGreer, D.J. 1994. Effectiveness of streamside protection regulations in western Montana - a comparison with the scientific literature. Unpublished Report. Western Watershed Analysts, Lewiston, ID.

McIntosh, B.A., J.R. Sedell, J.E. Smith, R.C. Wissmar, S.E. Clarke, J.H. Reeves and L.A. Brown. 1994. Management history of eastside ecosystems: changes in fish habitat over 50 years, 1935 to 1992. U.S. Forest Service. PNW-GTR-321.

McIntyre, M.J. 1993. Water Quality Status Report No. 108, Squaw Creek - Beneficial Use Assessment Gem County, Idaho 1991-1992. Division of Environmental Quality.

McPhail, J.D. and C.C. Lindsey. 1986. Zoogeography of the freshwater fishes of Cascadia (the Columbia system and rivers north to the Stikine). Pages 615-638 *in*: Hocutt, C.H., et al. eds., The Zoogeography of North American Freshwater Fishes. John Wiley and Sons, New York, NY.

McPhail, J.D. and C.B. Murray. 1979. The early life-history and ecology of dolly varden (*Salvelinus malma*) in the Upper Arrow Lakes. University of British Columbia, Department of Zoology and Institute of Animal Resources, Vancouver, BC.

Meehan, W.R. 1991. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19.

Meisner, J.D. 1990. Effect of climatic warming on the southern margins of the native range of brook trout, *Salvelinus fontinalis*. Canadian Journal of Fisheries and Aquatic Sciences 47:1065-1070.

Mongillo, P.E. 1993. The distribution and status of bull trout/dolly varden in Washington State-June 1992. Washington Department of Wildlife, Olympia, WA.

Montana Bull Trout Restoration Team. 1997. Bull trout restoration activities 1995-1996: report to the Governor. Unpublished report. Montana Fish, Wildlife and Parks, Helena, MT.

Montana Bull Trout Scientific Group. 1995a. Bitterroot River drainage bull trout status report. Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1995b. Blackfoot River drainage bull trout status report. Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1995c. Flathead River drainage bull trout status report (including Flathead Lake, the North and Middle forks of the Flathead River and the Stillwater and Whitefish rivers). Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1995d. Upper Clark Fork River drainage bull trout status report (including Rock Creek). Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1995e. South Fork Flathead River drainage bull trout status report (upstream of Hungry Horse Dam). Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1996a. Assessment of methods for removal or suppression of introduced fish to aid in bull trout recovery. Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1996b. Lower Clark Fork River drainage bull trout status report (Cabinet Gorge Dam to Thompson Falls). Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1996c. Middle Clark Fork River drainage bull trout status report (from Thompson Falls to Milltown, including the Lower Flathead River to Kerr Dam). Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1996d. Middle Kootenai River drainage bull trout status report (between Kootenai Falls and Libby Dam). Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1996e. The role of stocking in bull trout recovery. Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1996f. Swan River drainage bull trout status report (including Swan Lake). Montana Bull Trout Restoration Team, Helena, MT.

Montana Bull Trout Scientific Group. 1998. The relationship between land management activities and habitat requirements of bull trout. Report prepared for the Montana Bull Trout Restoration Team, Helena, MT.

Montana Department of Health and Environmental Sciences. 1994. Montana Water Quality 1994. The Montana 305(b) Report. Water Quality Division, Helena, MT.

Montana Department of State Lands. 1994. Guide to the streamside management zone law and rules. Missoula, MT.

Moore, J.N., S.N. Luoma and D. Peters. 1991. Downstream effects of mine effluent on an intermontane riparian system. Canadian Journal of Fisheries and Aquatic Sciences 48:222-232.

Morecroft, M.D., M.E. Taylor, and H.R. Oliver. 1998. Air and soil microclimates of deciduous woodlands compared to an open site. Agriculture and Forest Meteorology 90(1-2):141-156.

Mullan, J.W., K.R. Williams, G. Rhodus, T.W. Hillman and J.D. McIntrye. 1992. Production and habitat of salmonids in Mid-Columbia River tributary streams. U.S. Fish and Wildlife Service. Monograph I.

Naiman, R.J., T.J. Beechie, L.E. Benda, D.R. Berg, P.A. Bisson, L.H. MacDonald, M.D. O'Connor, P.L. Olsen and E.A. Steel. 1992. Fundamental elements of ecologically healthy watersheds in the Pacific Northwest coastal ecoregion. Pages 127-188 *in*: Naiman R.J. ed., Watershed management: balancing sustainability and environmental change. Springer-Verlag, New York, NY.

Nehlson, W., J.E. Williams and J.A Lichatowich. 1991. Pacific salmon at the crossroads: stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16(2): 4-21.

Nelson, M.L. 1996. Evaluation of the potential for resident bull trout to reestablish downstream populations in fragmented landscapes. Project #RJVA 95093.

Nesler, T.P. and E.P. Bergersen, eds. 1991. Mysids in fisheries: hard lessons from headlong introductions. American Fisheries Society Symposium 9.

Newton, J.A. and S. Pribyl. 1994. Bull trout population summary: Lower Deschutes River subbasin. Oregon Department of Fish and Wildlife, The Dalles, OR.

Odum, E.P. 1981. The effects of stress on the trajectory of ecological succession. in Barrett and Rosenberg eds. Stress effects on natural ecosystems. John Wiley and Sons Ltd., New York, New York. 305 p.

Oliver, C.G. 1979. Fisheries investigations in tributaries of the Canadian portion of the Libby Reservoir. Fish and Wildlife Branch, Kootenay Region.

Oregon Chapter of the American Fisheries Society. 1993. Status review request.

Oregon Department of Environmental Quality. 1996. DEQ's 1994/1996 303 (d) list of water quality limited water bodies and Oregon's criteria used for listing water bodies.

Oregon Department of Fish and Wildlife. 1993. Bull trout population summary, 1993.

Overton, C. K., M. A. Radko, and R. L. Nelson. 1993. Fish habitat conditions; using the Northern/Intermountain region's inventory procedures for detecting differences on two differently managed watersheds. IN-300. U.S. Forest Service, Intermountain Research Station, Boise, ID.

Packer, P.E. 1967. Criteria for designing and locating logging roads to control sediment. Forest Science 13(1):2-18.

Pierce R., D. Peters, and T. Swanberg. 1997. Blackfoot River restoration project progress report. Unpublished report. Montana Fish, Wildlife, and Parks, Missoula, MT.

Platts, W.S. 1981. Impairment, protection and rehabilitation of Pacific salmonid habitats on sheep and cattle ranges. *In*: Hassler, T.J., ed., Proceedings: propagation, enhancement, and rehabilitation of anadromous salmonid populations and habitat in the Pacific Northwest symposium. Arcata, CA.

Platts, W.S. 1989. Compatibility of livestock grazing strategies with fisheries. Pages 103-110 *in* Practical approaches to riparian resource management: an educational workshop. Billings, MT.

Platts, W.S. 1991. Livestock Grazing. American Fisheries Society Special Publication 19: 389-424.

Platts, W.S., M.T. Hill and I.A. Hopkins. 1995. Historical trends in bull trout abundance in Idaho, Montana, Oregon, and Washington (draft report). Unpublished report. Intermountain Forest Industry Association, Couer d'Alene, ID.

Pratt, K.L. 1984. Pend Oreille trout and char life history study. Idaho Department of Fish and Game, Boise, ID.

Pratt, K.L. 1992. A review of bull trout life history. Pages 5 - 9 *in:* Howell, P.J. and D.V. Buchanan, eds., Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Pratt, K.L. and J.E. Huston. 1993. Status of bull trout (*Salvelinus confluentus*) in Lake Pend Oreille and the lower Clark Fork River. Draft report. Prepared for the Washington Water and Power Company, Spokane, WA.

Quigley, T.M. and S.J. Arbelbide, tech. eds. 1997. An assessment of ecosystem components in the interior Columbia basin and potions of the Klamath and Great Basins: volume III. General Technical Report PNW- GTR-405. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management.

Quigley, T.M. and H.B. Cole. 1997. Highlighted scientific findings of the Interior Columbia Basin Ecosystem Management Project. General Technical Report PNW-GRT-404. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management. Portland, OR. 34 pp.

Ratliff, D.E. 1992. Bull trout investigations in the Metolious River-Lake Billy Chinook system. Pages 37-44 *in* Howell, P.J. and D.V. Buchanan, eds., Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Ratliff, D. E. and P. J. Howell. 1992. The status of bull trout populations in Oregon. Pages 10-17 *in* Howell, P.J. and D.V. Buchanan, eds., Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Ratliff, D. E., S.L. Thiesfeld, W.G. Weber, A.M. Stuart, M.D. Riehle and D.V. Buchanan. 1996. Distribution, life history, abundance, harvest, habitat, and limiting factors of bull trout in the Metolius River and Lake Billy Chinook, Oregon, 1983-94. Oregon Department of Fish and Wildlife Information Reports Number 96-7.

Rich, C.F., Jr. 1996. Influence of abiotic and biotic factors on occurrence of resident bull trout in fragmented habitats, western Montana. MS thesis. Montana State University, Bozeman, MT.

Riehle, M.D. 1993. Metolious Basin water resources monitoring: 1988-1992. Progress report. Deschutes National Forest, Sisters Ranger District.

Rieman, B.E. and J. Clayton. 1997. Wildfire and native fish: issues of forest health and conservation of sensitive species. Fisheries 22(11):6-15.

Rieman, B.E., D.C. Lee, and R.F. Thurow. 1997. Distribution, status, and likely future trends of bull trout within the Columbia River and Klamath River basins. North American Journal of Fisheries Management 17:1111-1125.

Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302. U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

Rieman, B.E. and J. D. McIntyre. 1995. Occurrence of bull trout in naturally fragmented habitat patches of varied size. Transactions of the American Fisheries Society 124(3): 285-296.

Rode, M. 1990. Bull trout, *Salvelinus confluentus* Suckley, in the McCloud River: status and recovery recommendations. Administrative Report Number 90-15. California Department of Fish and Game, Sacramento, CA.

Schill, D.J. 1992. River and stream investigations. Idaho Department of Fish and Game. Boise, ID.

Sedell, J.R. and R.L. Beshta. 1991. Bringing back the "bio" in bioengineering. Pages 160-175 *in* Colt, J. and S. Dendrall eds., Fisheries bioengineering: proceedings of the symposium. American Fisheries Society Special Publication Number 10.

Shepard, B.B., S.A. Leathe, T.M. Weaver, and M.D. Emk. 1984. Monitoring levels of fine sediment within tributaries of Flathead Lake and impacts of fine sediment on bull trout recruitment. Proceedings of the Wild Trout III Symposium, Yellowstone National Park, WY.

Simpson, J.C. and R.L. Wallace. 1982. Fishes of Idaho. University Press of Idaho. Moscow, ID.

Spence, B.C., G.A. Lomincky, R.M. Hughes and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. National Marine Fisheries Service, U.S. Fish and Wildlife Service, Environmental Protection Agency. .

Steinblums, I.J., H.A. Froehlich and J.K. Lyons. 1984. Designing stable buffer strips for stream protection. Journal of Forestry 82:49-52.

Sullivan, K.J., K. Doughty, J.E. Caldwell and P. Knudsen. 1990. Evaluation of prediction models and characterization of stream temperature regimes in Washington. Pages iii, vii, viii, ix, x *in* Timber/Fish/Wildlife Report No. TFW-WQ3-90-006. Washington Department of Natural Resources, Olympia, WA.

Swanberg, T. 1996. The movement and habitat use of fluvial bull trout in the Upper Clark Fork River drainage. MS thesis. University of Montana, Missoula, MT.

Swift, L.W. Jr. 1986. Filter strip widths for forest roads in the southern Appalachians. Southern Journal of Applied Forestry 10(1):27-34.

Thomas, G. 1992. Status of bull trout in Montana. Report prepared for Montana Department of Fish, Wildlife and Parks, Helena, MT.

Troendle, C.A. and W.K. Olsen. 1993. Potential effects of timber harvest and water management on streamflow dynamics and sediment transport. Pages 34-41 *in* Covington, W., L.F. DeBano, tech. eds., Sustainable ecological systems: implementing an ecological approach to land management (July 12-15, 1993, Flagstaff, AZ). Gen. Tech. Rep. RM-247. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experimental Station, Fort Collins, CO. 363 pp.

Thurow, R. 1985. Middle Fork Salmon River Fisheries Investigations. Proj. No. F-73-R-6. Idaho Department of Fish and Game.

Thurow, R.F. 1997. Habitat utilization and diel behaviour of juvenile bull trout (*Salvelinus confluentus*) at the onset of winter. Ecology of Freshwater Fish 6(1):1-7.

Titan Environmental Corporation. 1997. Milltown Reservoir sediments NPL site Clark Fork Operable Unit remedial investigation report. Unpublished report to ARCO. Anaconda, MT.

Trimble, G.R. and R.S. Sartz. 1957. How far from a stream should a logging road be located? Journal of Forestry 55:339-341.

U.S. Department of Agriculture. 1994. Biological evaluation of the effects of the Boise River Wildfire Recovery project on bull trout (*Salvelinus confluentus*). Boise National Forest. Boise, ID.

U.S. Department of Agriculture, U.S. Department of the Interior, U.S. Department of Commerce, and the Environmental Protection Agency. 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Report of the Forest Ecosystem Management Assessment Team. Forest Service, Fish and Wildlife Service, National Marine Fisheries Service, National Park Service, Bureau of Land Management, Environmental Protection Agency. Portland, OR.

U.S. Department of Agriculture, U.S. Department of the Interior, U.S. Department of Commerce, and the Environmental Protection Agency. 1995. Ecosystem analysis at the watershed scale: federal guide for watershed analysis (version 2.2). U.S. Dept. of Agriculture, Forest Service, U.S. Dept. of Interior, Fish and Wildlife Service, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, U.S. Dept. of Commerce, National Marine Fisheries Service, Environmental Protection Agency. Portland, OR.

U.S. Department of Agriculture and U.S. Department of the Interior. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl. Forest Service, Bureau of Land Management. Portland, OR.

U.S. Department of Agriculture and U.S. Department of the Interior. 1995a. Interim strategies for managing fish-producing watersheds in eastern Oregon and Washington, Idaho, western Montana and portions of Nevada (INFISH).

U.S. Department of Agriculture and U.S. Department of the Interior. 1995b. Decision Notice/Decision Record Finding of No Significant Impact, environmental assessment for the interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California (PACFISH).

U.S. Department of Agriculture and U.S. Department of the Interior. 1996. Status of the Interior Columbia Basin, Summary of Scientific Findings.

U.S. Department of Agriculture and U.S. Department of the Interior. 1997a. Upper Columbia River Basin draft environmental impact statement. U.S. Forest Service and Bureau of Land Management. Boise, ID.

U.S. Department of Agriculture and U.S. Department of the Interior. 1997b. Interior Columbia River Basin Ecosystem Management Project, Upper Columbia River Basin Draft Environmental Impact Statement. Vol I., Vol II, Vol III.

U.S. Department of Agriculture and U.S. Department of the Interior. 1998a. Biological assessment: effects to bull trout, shortnose sucker, Lost River sucker, and Warner sucker of Land and Resource Management Plans, and associated federal actions on National Forest and Bureau of Land Management Resource Areas in the Columbia River, Klamath River, and Jarbidge River basins. Forest Service and Bureau of Land Management.

U.S. Department of Agriculture and U.S. Department of the Interior. 1998b. Biological assessment amendment dated June 19, 1998 (reference number 2670 (FS)/6840 (BLM).

U.S. Department of Commerce. 1997. Biological opinion and conference opinion on the implementation of Land and Resource Management Plans (FS) and Resource Management Plans (BLM). National Marine Fisheries Service, Portland, OR.

U.S. Department of Commerce. 1998. Biological opinion on Land and Resource Management Plans for National Forests and Bureau of Land Management Resource Areas in the upper Columbia River basin and Snake River basin ecologically significant units (ESUs). National Marine Fisheries Service, Boise, ID.

U.S. Department of the Interior. 1992. Whitehorse Butte allotment biological assessment. Bureau of Land Management, Vale, OR. 25 pp.

U.S. Department of the Interior. 1997. Endangered and threatened wildlife and plants; proposal to list the Klamath river population segment of bull trout as an endangered species and Columbia river population segment of bull trout as a threatened species. *Federal Register* 62: 32268. June 13, 1997.

U.S. Department of the Interior. 1998a. Endangered and threatened wildlife and plants; determination of threatened status for the Klamath River and Columbia River distinct population segments of bull trout. *Federal Register* 63: 31647.

U.S. Department of the Interior. 1998b. Endangered and threatened wildlife and plants: proposal to list the coastal Puget Sound, Jarbidge river and St. Mary-Belly River population segments of bull trout as threatened species. *Federal Register* 63:31693.

U.S. Department of the Interior. 1998c. Klamath River and Columbia River bull trout population segments: status summary. Prepared by the Fish and Wildlife Service's bull trout listing team.

U.S. Department of the Interior, U.S. Department of Commerce, and Washington Department of Natural Resources. 1996. Draft Environmental Impact Statement, Habitat Conservation Plan. Issued March 22, 1996. Olympia, WA.

U.S. Environmental Protection Agency. 1994. The 1994 303(d) list for the State of Idaho.

U.S. Environmental Protection Agency. 1997. Water quality standards for Idaho. *Federal Register* 62: 41162 - 41188.

Washington Department of Ecology. 1992. 1992 statewide water quality assessment. 305(B) report.

Washington Department of Wildlife. 1992. Bull trout/dolly varden management and recovery plan. Washington Department Number 92-22, Fisheries Management Division, Olympia, WA.

Washington Department of Fish and Wildlife. 1997. Washington State salmonid stock inventory: bull trout/dolly varden. Washington Department of Fish and Wildlife, Fish Management. Olympia, WA. 437 pp.

Weaver, T.M. 1992. Coal Creek fisheries monitoring study no. X and forest-wide fisheries monitoring-1991. Special project. Montana Department of Fish, Wildlife and Parks. Kalispell, MT. 35 pp.

Weaver, T.M. and R.G. White. 1985. Coal Creek fisheries study no. III. Montana State Cooperative Fisheries Research Unit, Bozeman, MT. 94 pp.

Williams, J.E., J.E. Johnson, D.A. Hendrickson, S. Contreras-Balderas, J.D. Williams, M. Navarro-Mendoza, D.E. McAllister and J.D. Deacon. 1989. Fishes of North America: endangered, threatened, or of special concern: 1989. American Fisheries Society 14(6):2-20.

Williams, R.N., R.P. Evans and D.K. Shiozawa. 1997. Mitochondrial DNA diversity patterns of bull trout in the upper Columbia River Basin. *In*: Mackay, W.C., M.K. Brewin and M. Monita, eds., Proceedings - Alberta Friends of the Bull Trout, May 1994. Trout Unlimited, Bull trout Task Force. Calgary, Canada.

Wissmar, R.C., J.E. Smith, B.A. McIntosh, H.W. Li, J.H. Reeves and J.R. Sedell. 1994. A history of resource use and distribution in riverine basins of eastern Oregon and Washington (early 1800s-1900s). Northwest Science 68, Special Issue.

Zaroban, D. and 1996 Forest Practices Audit Team. 1997. Forest practices water quality audit. Idaho Department of Environmental Quality.

Ziller, J.S. 1992. Distribution and relative abundance of bull trout in the Sprague River subbasin, Oregon. Pages 18-29 *in* Howell, P.J. and D.V. Buchanan, eds., Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Personal Communications

Berg, R. 1997. Montana Department of Fish, Wildlife, and Parks.

Burton, T. 1997a. Bosie National Forest, Boise, ID.

Burton, T. 1997b. Boise National Forest, Boise, ID.

Cummings, T. 1997. U.S. Fish and Wildlife Service, Vancouver, WA.

Edwards, R. 1998. University of Washington, Seattle, WA.

Gearhard, N. 1997. Nez Perce National Forest.

Hallock, B. 1997. U.S. Fish and Wildlife Service, Spokane, WA.

Howard, R. 1997. U.S. Fish and Wildlife Service, Boise, ID.

Johnson, B. 1997. U.S. Timberlands.

---

in litt.

Achord, S. 1994. National Marine Fisheries Service, *in litt.*

Barker, R. 1997. Idaho Statesman, *in litt.*

Batt, P. 1997. Governor of Idaho, *in litt.*

Clinch, B. 1997. Montana Department of Natural Resources and Conservation, *in litt.*

Cody, S. 1997. U.S. Environmental Protection Agency, *in litt.*

Dunsmoor, L. and C. Bienz. 1997. Klamath Tribe, *in litt.*

Flowers, P. 1996. Montana Department of Natural Resources and Conservation, *in litt.*

Graham, P. and B. Clinch. Montana Department of Fish, Wildlife and Parks and Montana Department of Natural Resources and Conservation, *in litt.* 1997.

Huffman, M. 1997. Boise National Forest, *in litt.*

Idaho Department of Fish and Game. 1995. *in litt.*

Johnson, B. 1997. U.S. Timberlands, *in litt.*

Kappesser, G. 1993. Panhandle National Forest, *in litt.*

Kasun, B. 1993. U.S. Forest Service, Idaho Panhandle National Forests, *in litt.*

Long, M. and S.P. Whalen. 1997. Montana Department of Fish, Wildlife and Parks, *in litt.*

Malany, H. 1997. Idaho Forest Practice Act Advisory Committee Member, *in litt.*

McLaud, L. 1997. Idaho Conservation League, *in litt.*

McMaster, K. 1997. U.S. Fish and Wildlife Service, *in litt.*

Mealey, S. 1997. Idaho Department of Fish and Game, *in litt.*

Montana Department of Fish, Wildlife and Parks. 1991. *in litt.*

Northwest Forest Resources Council. 1997. *in litt.*

Oregon Department of Fish and Wildlife. 1993. *in litt.*

Oregon State Game Commission. 1950. *in litt.*

Oregon Water Resources Division. 1988. *in litt.*

Palmisano J.F. and V.W. Kaczynski. 1997. *in litt.*

Patten, R. 1997. Panhandle National Forest, *in litt.*

Payette National Forest. 1996. *in litt.*

Racicot, M. 1995. Governor of Montana, *in litt.*

Rexroat, P. 1997. The Nature Conservancy, *in litt.*

Rosen, R. 1995. Oregon Department of Fish and Wildlife, *in litt.*

Schroeder, K. and H. Weeks. 1997. Oregon Chapter of the American Fisheries Society, *in litt.*

Smith, B. 1997. Washington Department of Fish and Wildlife, *in litt.*

Stewart, R. 1995. U.S. Department of the Interior, *in litt.*

Uberuaga, R. 1993. Payette National Forest, *in litt.*

U.S. Bureau of Reclamation. 1997. *in litt.*

U.S. Department of the Interior and Idaho Department of Transportation. 1994. *in litt.*

U.S. Forest Service Map. 1994. *in litt.*

Visconty, G. 1996. Boise National Forest, *in litt.*

Washington Department of Fish and Wildlife. 1995. *in litt.*

Weaver, T. 1993. Montana Department of Fish, Wildlife and Parks, *in litt.*

West, S. 1997. Idaho Department of Environmental Quality, *in litt.*

XII. APPENDICES

Appendix 1.

List of Major Documents used as Sources of Best Available Information.

Appendix 1. List of Major Documents used as Sources of Best Available Information.

PACFISH and INFISH Decision Documents:

U.S. Department of Agriculture and U.S. Department of the Interior. 1995. Decision Notice/Decision Record Finding of No Significant Impact, environmental assessment for the interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California (PACFISH).

U.S. Department of Agriculture. 1995. Interim strategies for managing fish-producing watersheds in eastern Oregon and Washington, Idaho, western Montana and portions of Nevada (INFISH).

Scientific findings from the Interior Columbia Basin project:

Quigley, T.M. and S.J. Arbelbide, tech. eds. 1997. An assessment of ecosystem components in the interior Columbia basin and potions of the Klamath and Great Basins: volume III. General Technical Report PNW- GTR-405. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management.

The Final Rule for the Columbia River and Klamath River bull trout DPSs:

U.S. Department of the Interior. 1998. Endangered and threatened wildlife and plants; determination of threatened status for the Klamath River and Columbia River distinct population segments of bull trout. *Federal Register* 63: 31647.

The MANTECH Report:

Spence, B.C., G.A. Lomincky, R.M. Hughes and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. National Marine Fisheries Service, U.S. Fish and Wildlife Service, Environmental Protection Agency.

The American Fisheries Society Special Publication:

Meehan, W.R. 1991. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19.

Appendix 2.

A Framework to Assist in Making Endangered Species Act Determinations of Effect for individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale.
U.S. Fish and Wildlife Service. February 1998.

A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale

Prepared by
U.S. Fish and Wildlife Service
(adapted from the National Marine Fisheries Service)

February 1998

A Framework to Assist in Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale

Table of Contents

Overview . . . . . p. 3
Before You Begin 5
Description of the Matrix 7
Description of the Checklist 8
Description of the Dichotomous Key for Making ESA Determinations of Effect 9
How to use the Matrix, Checklist, and Dichotomous Key 10
Definitions of Effects Thresholds 11
Sample Species Narrative 14
Matrix of Diagnostics / Pathways and Indicators (Table 1) 19
Checklist for Documenting Environmental Baseline and Effects of Proposed Action(s) on Relevant Indicators (Table 2) 25
Dichotomous Key for Making ESA Determinations of Effects (Table 3) 27
Documentation of Expected Incidental Take 28
Appendix A - Examples of Some of the Influences of Human Activities On Aquatic Ecosystems 30
Appendix B - Relating the ACS Objectives and Aquatic/Riparian Strategy Objectives with the Diagnostics/Pathways and Indicators 43

OVERVIEW

The following framework was designed to facilitate and standardize determinations of effect for Endangered Species Act (ESA) conferences, consultations and permits focusing on bull trout (*Salvelinus confluentus*). We recommend that this framework be applied to individual actions or grouped similar activities at the 5th or 6th field Hydrologic Unit Code (HUC) watershed scale. Subsequent Conference Reports or Biological Opinions that you will receive from the U.S. Fish and Wildlife Service (USFWS) will address the effects of your actions at the bull trout subpopulation level. Maps of bull trout subpopulation watersheds will be provided to you for your area and generally are similar to the 4th field Hydologic Unit Code (HUC). It will be necessary for you to aggregate your 5th or 6th field HUC framework determinations to the subpopulation watershed level in any Biological Assessment that you submit.

When USFWS conducts an analysis of a proposed activity or grouped activities, it involves the following steps: (1) define the biological requirements of the listed species; (2) evaluate the relevance of the environmental baseline to the species' current status; (3) determine the effects of the proposed or continuing action(s) on listed and proposed species; and (4) determine whether all the life stages and forms of the species can be expected to survive, with an adequate potential for recovery, to be self-sustaining and self-regulating under the effects of the proposed or continuing action(s), the environmental baseline, and any cumulative effects. The last item (item 4) addresses considerations given during a jeopardy analysis. Please recognize, however, that this framework document does not address jeopardy or identify the level of take or adverse effects which would constitute jeopardy. Jeopardy is determined on a case by case basis involving the specific information on habitat conditions and the health and status of the fish population. USFWS is currently preparing a set of guidelines, to be used in conjunction with this document, to help in the determination of jeopardy.

This framework document provides a consistent, logical line of reasoning to aid in determining when and where adverse effects occur and why they occur. It is a framework or template to stimulate discussion among Level 1 and Interdisciplinary teams regarding the influence of important habitat variables or indicators on bull trout populations. It is not an aquatic conservation strategy. This framework does not replace watershed analysis nor attempt to define data standards. Using available data, results from watershed analyses, and team discussions, the framework will help the teams arrive at an ecologically defendable and trackable determination of the effects of proposed actions on the species and its habitat.

This framework document contains definitions of ESA effects and examples of effects determinations, a recommended reading list to help in understanding the importance of an indicator on bull trout, a matrix of diagnostics/pathways of effects and indicators of those effects, a checklist for documenting the environmental baseline and effects of the proposed action(s) on the relevant indicators, and a dichotomous key for making determinations of effect and documenting expected incidental take. None of the tools identified in this document are new inventions. The matrix, check list, and dichotomous key format have been adapted from the matrix, check list, and dichotomous key developed by the National Marine Fisheries Service (NMFS) to determine the effects of

actions on listed anadromous fish species. Although some identifying words and values in this framework have been changed from those in the NMFS document, the format is very similar. The matrix developed here reflects the information needed to evaluate effects of proposed and on-going land management actions of the U.S. Forest Service and U.S. Bureau of Land Management on the persistence and potential recovery of proposed/listed bull trout subpopulations. The similarity between the NMFS's document and this framework should facilitate a blending of the matrices by Level 1 teams during combined consultation/conference efforts with the two regulatory agencies, as well as formal integration of the matrices by the two agencies in the future.

Using these tools, the Federal agencies and Non-Federal Parties (both will be referred to as evaluators in the remainder of this document) can make determinations of effect for proposed projects (i.e. "no effect"/"may affect" and "may affect, not likely to adversely affect"/"may affect, likely to adversely affect") on listed and proposed species. As explained below, these determinations of effect will depend on whether a proposed action (or group of actions) hinders the attainment of relevant environmental conditions (identified in the matrix as pathways and indicators) and further impacts the status of a bull trout subpopulation (also identified in the matrix as diagnostics and indicators), and/or results in "take" of a proposed or listed species, as defined in the ESA.

Finally, this framework is a **draft** document designed to be applied to a wide range of environmental conditions. This means it must be flexible and will be refined. It also means that a certain degree of professional judgement will be required in its application. **There will be circumstances where the numeric values or descriptions in the matrix simply do not apply to a specific watershed, are unavailable, or exist in a different format. In each case, the evaluator will need to provide more ecologically appropriate values using local data when available, including data sources and techniques used, as well as provide adequate documentation and rationale (see amendment to Streamlining direction) that justify changes or deletions of a diagnostic/pathway indicator(s). All documentation must be presented in each associated biological assessment, habitat conservation plan, or other appropriate document. This documentation will be used by USFWS in preparation of a section 7 consultation, habitat conservation plan, or other appropriate biologically based document.**

Before You Begin

To facilitate effective use of the framework, it will be necessary to gather and familiarize yourself with several documents and reports ranging in scope from general bull trout life history information to specific stream reach survey information. It would be difficult to even begin to list all the important information sources that can help you better understand the biology of bull trout and its interrelationship with its environment. To begin your information search, any watershed analysis and previous biological assessments pertaining to the watershed under consideration, as well as all the maps, data findings and results, and historical accounts you can gather, will be essential information in assessing your integrated environmental and population baseline and arriving at a biologically sound effects determination.

Below are listed a few sources that may be helpful to you in your information search. Many of those recommended are referred to or cited in the framework.

Behnke, R.J. 1992. Native trout of western North America. Monograph No. 6, American Fishereis Society. 275 p.

Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.

Buchanan, D.V.; Gregory, S.V. . 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. *In* W.C. Mackay, M.K. Brewin, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings. P8.

Frissell, C.A.; Liss, W.J.; Bayles, D. 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. *In* Potts, D., ed. Proceedings from the Symposium on Changing Roles in Water Resources Management and Policy, June 27-30, 1993. Herndon, VA: American Water Resources Association: p. 449-456.

Interior Columbia Basin Ecosystem Management Project Draft Environmental Impact Statement and Appendices.

Lee, D.C.; Sedell, J.R.; Rieman, B.E.; Thurow, R.F.; Williams, J.E. and others. 1997. Chapter 4: Broadscale Assessment of Aquatic Species and Habitats. *In* T.M. Quigley and S. J. Arbelbide eds "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III". U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech Rep PNW-GTR-405.

Leopold, L.B.; Maddock, T., J. 1953. The hydraulic geometry of stream channels and some physiographic implications. Professional Paper 252. U.S. Department of the Interior, Geological Survey. 56p.

Leopold, L.B.; Wolman, M.G.; Miller, J.P. 1964. Fluvial processes in geomorphology. San Francisco: W.H. Freeman and Co. 522p.

Menning, K.M.; Erman, K.; Johnson, N.; Sessions, J. 1996. Modeling aquatic and riparian systems, assessing cumulative watershed effects, and limiting watershed disturbance. Davis, CA: University of California-Davis, Sierra Nevada Ecosystem Project.

Montgomery, D.R.; Buffington, J.M.; Smith, R.D.; Schmidt, K.M.; Press, G. 1995. Pool spacing in forest

channels. Water Resources Research Vol. 31, No. 4. April 1995: p. 1097-1105.

Montgomery, D.R.; Buffington, J.M. 1993. Channel classification, prediction of channel response and assessment of channel condition. Report TFW-SH10-93-002. June 24, 1993. 84p.

Northwest Forest Plan, 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.

Overton, C.K.; McIntyre, J.D.; Armstrong, R. ; Whitewell, S.L.; Duncan, K.A.. 1995. User's guide to fish habitat: descriptions that represent natural conditions in the Salmon River Basin, Idaho. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-322.

Overton, C.K.; Wollrab, S.P.; Roberts, B.C.; Radko, M.A.. 1997. R1/R4 (Northern/Intermoutain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-346.

Reid, L.M. 1993. Research and cumulative watershed effects. U.S. Department of Agriculture, forest Service, Pacific Southwest Research Station, Gen Tech. Rep. PSW-GTR-141.

Rieman, B.E.; McIntyre, J.D.. 1993. Demographic and habitat requirements for conservation of bull trout. U.S.D.A. Forest Service, Intermountain Research Station, Boise, ID.

Rieman, B.E.; Meyers, D.L. . 1997. Use of redd counts to detect trends in bull trout (*Salvelinus confluentus)* populations. Conservation Biology 11(4): 1015-1018.

Rosgen, D.L. 1994. A classification of natural rivers. Catena. Vol. 22, No. 3, June 1994: 169-199.

Shepard, B.B.; Pratt, K.L.; Graham, P.J. . 1984. Life histories of westslope cutthroat and bull trout in the Upper Flathead River Basin, MT. Environmental Protection Agency Rep. Contract No. R008224-01-5.

Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.

Winward, A.H., 1989 Ecological Status of Vegetation as a base for Multiple Product Management. Abstracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Management: p277.

Description of the Matrix:

The objective of the "Matrix of Diagnostics/Pathways and Indicators" (Table 1, Page 19) is to integrate the biological and habitat conditions to arrive at a determination of the potential affect of land management activities on a proposed or listed species. This matrix is divided into seven overall diagnostics/pathways (major rows in the matrix) and a summary integration diagnostic:

Species Diagnostics
-- Subpopulation Characteristics
Habitat Pathways
-- Water Quality
-- Habitat Access
-- Habitat Elements
-- Channel Condition and Dynamics
-- Flow/Hydrology
-- Watershed Conditions
Habitat and Species
-Integration of Species and Habitat Condition

The above were designed to simplify arriving at an effects determination with a firm understanding of the status of the bull trout subpopulation in the watershed being considered for management activities, the environmental baseline (current condition) of the habitat, and how that subpopulation might be affected (beneficially or not) by changes in its habitat as a result of the proposed action(s). It is essential that each diagnostic/pathway be addressed. The species diagnostic "Subpopulation Characteristics" is designed to help you evaluate the status of the bull trout subpopulation in the area of the proposed action(s) under current habitat conditions. Each of the above listed diagnostic tools relating to habitat represents a pathway by which actions can have potential effects on bull trout. It is essential to have an understanding of both the condition of the habitat and the status of the subpopulation when proposing activities that will change the environmental baseline and potential risk to the species. Integration of these diagnostics and pathways is needed to make an appropriate effects determination.

The diagnostics and pathways are further broken down into "indicators." Within the habitat pathways, indicators are generally arranged from a finer to a broader scale. For example, under the pathway "Habitat Elements", the indicators ask you to consider information from the reach level, (substrate embeddedness), to the grouped reach level (large woody debris, pool frequency and quality, large pools), to the entire stream length (off-channel habitat), and finally the complete subpopulation watershed (refugia). Indicators are generally of two types: (1) Metrics that have associated numeric values (e.g. "4 - 9 ° C"); and/or (2) descriptions (e.g. "adequate habitat refugia do not exist"). The purpose of having both types of indicators in the matrix is that numeric data are not always readily available for making determinations or there may be no reliable numeric indicator for a specific environmental or population attribute. In this case, a description of overall condition may be the only appropriate method available. When a numeric value and a description are combined in the same cell in the matrix, it is because

accurate assessment of the indicator requires attention to both. Values and descriptions are presented to stimulate discussion within Level 1 and interdisciplinary teams. They provide a diagnostic tool that should be evaluated for reliability in describing environmental functional relationships specific to the watershed you are considering for management activity. The numeric values are not presented as absolutes nor to define data standards. They are presented as diagnostic tools to promote discussion of differences between local data or findings and values suggested in the matrix. If local data relating to a specific indicator is not available for comparison and verification, then proposed management activities should be designed to minimize impacts to that indicator. If a numeric indicator suggested in the matrix is not functionally attainable given the inherent characteristics of the watershed being considered or if an equivalent value is available using a different field technique, Level 1 and Interdisciplinary teams should replace the numeric value with local data and professional judgement. When this occurs, changes must be accompanied by rigorous discussion within the team, which is integrated into adequate documentation complete with supportive local data and the technique used to compile the data, and/or scientifically supported reasoning, logic, or professional judgement for the change. Likewise, if a team decides not to use all indicators in a diagnostic or pathway, the team must provide defendable and trackable documentation on why an indicator was not considered.

Diagnostics, pathways, and indicators may overlap in their scope and data components. This is to provide a cross check that ensures potential effects are viewed from more than one perspective. Likewise, it provides an avenue for integration among habitat variables and between the condition of a bull trout subpopulation and its habitat.

The columns in the matrix correspond to levels of condition of the indicator. There are three condition levels: "functioning appropriately," "functioning at risk," and "functioning at unacceptable risk." These three categories of function are defined for each indicator in the "Matrix of Diagnostics/Pathways and Indicators". In concept, indicators in a watershed are "functioning appropriately" when they maintain strong and significant populations that are interconnected and promote recovery of a proposed or listed species or its critical habitat to a status that will provide self-sustaining and self-regulating populations. When the indicators are "functioning at risk", they provide for persistence of the species but in more isolated populations and may not promote recovery of a proposed or listed species or its habitat without active or passive restoration efforts. "Functioning at unacceptable risk" suggests the proposed or listed species continues to be absent from historical habitat, or is rare or being maintained at a low population level; although the habitat may maintain the species at this low persistence level, active restoration is needed to begin recovery of the species.

Description of the Checklist:

The "Checklist for Documenting Environmental Baseline and Effects of Proposed Action(s) on Relevant Indicators" (Table 2, page 25) is designed to be used in conjunction with the matrix. The checklist has six columns. The first three describe the condition of each indicator (which when taken together encompass the environmental

baseline and condition of the bull trout subpopulation), and the second three describe the effects of the proposed action(s) on each indicator. As with the matrix, rigorous discussion among Level 1 or Interdisciplinary teams should occur when making checklist selections. Likewise, documentation and rationale supporting each checklist selection must be made available.

Description of the Dichotomous Key for Making ESA Determinations of Effect and Documentation of Expected Incidental Take:

The "Dichotomous Key for Making ESA Determinations of Effect" (Table 3, page 27) is designed to aid in determinations of effect for proposed actions that require a section 7 consultation/conference or permit under Section 10 of the ESA. Once the matrix has been modified with watershed specific local data (if necessary) to meet the needs of the evaluators, and the checklist has been discussed and filled out, the evaluators should use the key to help make their ESA determinations of effect. If it is determined that the proposed actions will result in a "take", identify the expected "take" on the "Documentation of Expected Incidental Take" form that accompanies the Dichotomous Key.

How to Use the Matrix, Checklist, and Dichotomous Key

1) Group similar projects when possible that are proposed within a 5th or 6th field HUC watershed.

2) Using the Matrix provided (or a version modified and documented by the evaluator) **evaluate environmental and subpopulation baseline conditions** (mark on checklist), use all 7 pathways (identified in the matrix). Summarize the matrix in the "Habitat and Species: Integration of Habitat and Species Conditions" indicator.

Matrix of Diagnostics/Pathways and Indicators

Use to describe the Environmental and Subpopulation Baseline Conditions

Subpopulation Characteristics, Water Quality, Habitat Access, Habitat Elements, Channel Condition and Dynamics, Flow/Hydrology, Watershed Condition, Integration of Species and Habitat Conditions

and

Then use the same Diagnostics/ Pathways and Indicators to evaluate the Effects of Proposed Projects on Species and its Habitat.

3) **Evaluate effects of the proposed action** at both the 5th or 6th and watershed levels using the matrix. Do they restore, maintain or degrade existing baseline conditions? Mark on checklist, and provide written logic and rationale.

↓

Mark Results on Checklist

↓

Checklist

Environmental Baseline			Effects of the Action		
Funct. Appro-priately	Funct At Risk	Funct at Unaccept-able Risk	Maintain	Restore	Degrade

4) Take the checklist you marked and the dichotomous key and answer the questions in the key, substantiated by a written rationale and logic, **to reach a determination of effects.**

↓

Use Professional Judgement, Level 1 Team Discussions, written documentation and rationale, and the Checklist to Work through the Dichotomous Key

↓

Dichotomous Key

Yes/No

No Effect
May Effect
Not Likely to Adversely Affect
Likely to Adversely Affect

(Note: Actual Matrix is on page 19 through 24. Actual Checklist on page 25 and 26. Actual Dichotomous key on page 27).

DEFINITIONS OF ESA EFFECTS THRESHOLDS AND EXAMPLES

Following are definitions of ESA effects (sources in *italics*):

"No effect:"

This determination is only appropriate "if the proposed action will literally have no effect whatsoever on the species and/or critical habitat, not a small effect or an effect that is unlikely to occur." (From "*Common flaws in developing an effects determination*", Olympia Field Office, U.S. Fish and Wildlife Service). Furthermore, actions that result in a "beneficial effect" do not qualify as a no effect determination. If a "no effect" determination is derived, conference/consultation does not need to proceed, but it is recommended that these determinations be shared within the Level 1 team. Documentation to substantiate this determination must be filed in evaluator's records.

"May affect, not likely to adversely affect:"

"The appropriate conclusion when effects on the species or critical habitat are expected to be beneficial, discountable, or insignificant. Beneficial effects have contemporaneous positive effects without any adverse effects to the species or habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgement, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur." (From "*Draft Endangered Species Consultation Handbook; Procedures for Conducting Section 7 Consultations and Conferences*," USFWS/NMFS, 1994). The term "negligible" has been used in many ESA consultations involving anadromous fish in the Snake River basin. The definition of this term is the same as "insignificant." Consultation/conference is required for this effect determination, but can proceed as informal.

"May affect, likely to adversely affect"

Unfortunately, there is no definition of adverse effects in the ESA or its implementing regulations. The draft Endangered Species Consultation Handbook (NMFS/USFWS, November 1994) provides this definition for "Is likely to adversely affect" - the appropriate conclusion if any adverse effect to listed species or critical habitat may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions. In the event the overall effect of the proposed action is beneficial to the listed species or critical habitat, but is also likely to cause some adverse effects, then the proposed action 'is likely to adversely affect' the listed species or critical habitat. An "is likely to adversely affect" determination requires formal section 7 consultation.

The following is a definition specific to anadromous salmonids developed by NMFS, the FS, and the BLM during the PACFISH consultation and is given as

example: "Adverse effects include short or long-term, direct or indirect management-related, impacts of an individual or cumulative nature such as mortality, reduced growth or other adverse physiological changes, harassment of fish, physical disturbance of redds, reduced reproductive success, delayed or premature migration, or other adverse behavioral changes to listed anadromous salmonids at any life stage. Adverse effects to designated critical habitat include effects to any of the essential features of critical habitat that would diminish the value of the habitat for the survival and recovery of listed anadromous salmonids" (From *NMFS' Pacfish Biological Opinion, 1/23/95*). Interpretation of part of the preceding quotation has been problematic. The statement "...impacts of an individual or cumulative nature..." has often been applied only to actions and impacts, not organisms. NMFS' concern with this definition is that it does not clearly state that the described impacts include those to individual eggs or fish. However, this definition is useful if it is applied on the individual level as well as on the subpopulation and population levels.

For the purposes of Section 7, any action which has more than a negligible potential to result in "take" (see definition at bottom of Dichotomous Key, p. 27 of this document) is likely to adversely affect a proposed/listed species. It is not possible for NMFS or USFWS to concur on a "not likely to adversely affect" determination if the proposed action will cause take of the listed species. Take can be authorized in the Incidental Take Statement of a Biological Opinion after the anticipated extent and amount of take has been described, and the effects of the take are analyzed with respect to jeopardizing the species or adversely modifying critical habitat. Take, as defined in the ESA, clearly applies to the individual level, thus actions that have more than a negligible potential to cause take of individual eggs and/or fish are "likely to adversely affect."

"Likely to jeopardize the continued existence of"

The regulations define jeopardy as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (*50 CFR §402.02*).

"Take"

The ESA (Section 3) defines take as "to harass, harm, pursue, hunt, shoot, wound, trap, capture, collect or attempt to engage in any such conduct". The USFWS further defines "harm" to include "significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering", and "harass" as "actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering".

Examples of Effects Determinations

"No effect"

USFWS is encouraging evaluators to conference/consult at the subpopulation or watershed scale (i.e., on all proposed actions in a particular watershed or within the range of a bull trout subpopulation) rather than on individual projects. Due to the strict definition of "no effect" (above), the interrelated nature of in-stream conditions and watershed conditions, and the watershed scale of these conferences, consultations, and activities, "no effect" determinations for all actions in a watershed will be unusual when proposed/listed species are present in or downstream from a given watershed. This is reflected in the dichotomous key, however the evaluator may identify some legitimate exceptions to this general rule.

Example:

The proposed project is in a watershed where available monitoring information indicates that in-stream habitat is functioning appropriately and riparian vegetation is at or near potential. The proposed activity will take place on stable soils and will not result in increased sediment production. No activity will take place in the riparian zone and no listed/proposed species or designated critical habitat exist in the watershed or immediately downstream of the watershed where the activity will take place.

"May affect, not likely to adversely affect"

Example:

The proposed action is in a watershed where bull trout exists. Available monitoring information indicates that in-stream habitat is functioning appropriately and riparian vegetation is at or near potential. Past monitoring indicates that this type of action has led to the present condition (i.e., timely recovery has been achieved with the kind of management proposed in the action). No activity will take place in the riparian zone. Given available information, the potential for take to occur is negligible.

"May affect, likely to adversely affect"

Example:

The proposed action is in a watershed that has a remnant resident population of bull trout in very low numbers and the migratory form is no longer present. The watershed is in relatively good condition, however a few in-stream indicators show degradation, such as excess fine sediment, moderate cobble embeddedness, and poor pool frequency/quality. If the action will further degrade any of these indicators, the determination is clearly "likely to adversely affect".

A less obvious example would be a proposed action in the same watershed that is designed to improve baseline conditions, such as road obliteration or culvert repair. Even though the intent is to improve the degraded conditions over the long-term, if any short-term impacts (such as temporary sedimentation) will

cause take (adverse effects), then the determination is "likely to adversely affect."

Sample Species Narrative

(should be modified to address the specific bull trout population in the watershed where an action is proposed to occur)

Bull Trout (*Salvelinus confluentus)*

Endangered Species Act Status: Proposed threatened Columbia River population segment and endangered Klamath River population segment, June 10, 1997. All life forms are included in this proposal.

Description. For years, the bull trout and Dolly Varden (*Salvelinus malma* Girard) were combined under one name, the Dolly Varden (*Salvelinus malma* Walbaum). In 1991, with the support of the American Fisheries Society, they became two distinct species. A couple of the most useful characteristics in separating the two species are the shape and size of the head (Cavender 1978). The head of a bull trout is more broad and flat on top, being hard to the touch, unlike Dolly Varden. Bull trout have an elongated body, somewhat rounded and slightly compressed laterally, and covered with cycloid scales numbering 190-240 along the lateral line. The mouth is large with the maxilla extending beyond the eye and with well developed teeth on both jaws and head of the vomer (none on the shaft). Bull trout have 11 dorsal fin rays, 9 anal fins, and the caudal fin is slightly forked. Although they are often olive green to brown with paler sides, color is variable with locality and habitat. Their spotting pattern is easily recognizable showing pale yellow spots on the back, and pale yellow and orange or red spots on the sides. Bull trout fins are tinged with yellow or orange, while the pelvic, pectoral, and anal fins have white margins. There should be no black or dark markings on the fins.

Historical and Current Distribution. The historical range of bull trout was restricted to North America (Cavender 1978; Haas and McPhail 1991). Bull trout have been recorded from the McCloud River in northern California, the Klamath River basin in Oregon and throughout much of interior Oregon, Washington, Idaho, western Montana, and British Columbia, and extended into Hudson Bay and the St. Mary's River Saskatchiwan.

Bull trout are believed to be a glacial relict (McPhail and Lindsey 1986), and their broad distribution has probably contracted and expanded periodically with natural climate change (Williams and others, in press). Genetic variation suggests an extended and evolutionarily important isolation between populations in the Klamath and Malheur Basins and those in the Columbia River basin (Leary and others 1993). Populations within the Columbia River basin are more closely allied and are thought to have expanded from common glacial refugia or to have maintained higher levels of gene flow among populations in recent geologic time (Williams and others, in press).

It is unlikely that bull trout occupied all of the accessible streams at any one time. Distribution of existing populations is often patchy even where numbers are still strong and habitat is in good condition (Rieman and McIntyre 1993; Rieman and McIntyre 1995). Habitat preferences or selection is likely important (Dambacher and others, in press; Goetz 1994; Rieman and McIntyre 1995); but more stochastic extirpation and

colonization processes may influence distribution even within suitable habitats (Rieman and McIntyre 1995).

Even though bull trout may move throughout whole river basins seasonally, spawning and juvenile rearing appear to be limited to the coldest streams or stream reaches. The lower limits of habitat used by bull trout are strongly associated with gradients in elevation, longitude, and latitude, that likely approximate a gradient in climate across the Basin (Goetz 1994). The patterns indicate that spatial and temporal variation in climate may strongly influence habitat available to bull trout (see Meisner 1990 for an example with brook trout). While temperatures are probably suitable throughout much of the northern portion of the range, predicted spawning and rearing habitat are restricted to increasingly isolated high elevation or headwater "islands" toward the south (Goetz 1994; Rieman and McIntyre 1995).

Bull trout are now extinct in California and only remnant populations are found in much of Oregon (Ratliff and Howell 1992). A small population still exists in the headwaters of the Jarbidge River, Nevada which represents the present southern limit of the species range. Bull trout are known or predicted to occur in 45 percent of watersheds in the historical range and to be absent in 55 percent.

Migratory life histories have been lost or limited throughout the range (for example, Goetz 1994; Jakober 1995; Montana Bull Trout Scientific Committee, in preparation; Pratt and Huston 1993; Ratliff and Howell 1992; Rieman and McIntyre 1993, 1995). There is evidence of declining trends in some populations (Mauser and others 1988; Pratt and Huston 1993; Schill 1992; Weaver 1992) and extirpations of local populations are reportedly widespread.

Life History Characteristics. Bull trout spawn from August through November (McPhail and Murray 1979; Pratt 1992). Hatching may occur in winter or early spring, but alevins may stay in the gravel for an extended period after yolk absorption (McPhail and Murray 1979). Growth, maturation, and longevity vary with environment, first spawning is often noted after age four, with individuals living 10 or more years (Rieman and McIntyre 1993).

Two distinct life-history forms, migratory and resident, occur throughout the range of bull trout (Pratt 1992; Rieman and McIntyre 1993). Migratory forms rear in natal tributaries before moving to larger rivers (fluvial form) or lakes (adfluvial form) or the ocean (anadromous) to mature. Migratory bull trout may use a wide range of habitats ranging from 2nd to 6th order streams and varying by season and life stage. Seasonal movements may range up to 300 km as migratory fish move from spawning and rearing areas into overwinter habitat in downstream reaches of large basins (Bjornn and Mallet 1964; Elle and others 1994). The resident form may be restricted to headwater streams throughout life. Both forms are believed to exist together in some areas, but migratory fish may dominate populations where corridors and subadult rearing areas are in good condition (Rieman and McIntyre 1993).

Habitat Relationships. Bull trout appear to have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Habitat characteristics including

water temperature, stream size, substrate composition, cover and hydraulic complexity have been associated with the distribution and abundance (Dambacher and other, in press; Jakober 1995; Rieman and McIntyre 1993).

Stream temperatures and substrate composition may be particularly important characteristics of suitable habitats. Bull trout have repeatedly been associated with the coldest stream reaches within basins. Goetz (1994) did not find juvenile bull trout in water temperatures above 12.0°C. The best bull trout habitat in several other Oregon streams was where water temperature seldom exceeded 15°C (Buckman et al. 1992; Ratliff 1992; Ziller 1992). Temperature also appears to be a critical factor in the spawning and early life history of bull trout. Bull trout in Montana spawned when temperatures dropped below 9 to 10°C (Fraley and Shepard 1989). McPhail and Murray (1979) reported 9°C as the threshold temperature to initiate spawning for British Columbia bull trout. Temperatures fell below 9°C before spawning began in the Metolius River, Oregon (Riehle 1993). Survival of bull trout eggs varies with water temperature (McPhail and Murray 1979). They reported that 0-20%, 60-90%, and 80-95% of the bull trout eggs from British Columbia survived to hatching in water temperatures of 8-10°C, 6°C, and 2-4°C, respectively. Weaver and White (1985) found that 4-6°C was needed for egg development for Montana bull trout. Temperature may be strongly influenced by land management (Henjum and others 1994) and climate change; both effects may play an important role in the persistence of bull trout.

Bull trout are more strongly tied to the stream bottom and substrate than other salmonids (Pratt 1992). Substrate composition has repeatedly been correlated with the occurrence and abundance of juvenile bull trout (Dambacher and others in press; Rieman and McIntyre 1993) and spawning site selection by adults (Graham and others 1981; McPhail and Murray 1979). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985), but might also limit access to substrate interstices that are important cover during rearing and overwintering (Goetz 1994; Jakober 1995).

Key Factors. Angling is a factor influencing the current status of bull trout. Bull trout may be vulnerable to over-harvest (Ratliff and Howell 1992; Rieman and Lukens 1979). Poaching is viewed as an important cause of mortality, especially in accessible streams that support large migratory fish (N. Horner, Idaho Department of Fish and Game and J. Vasho, Montana Department of Fish, Wildlife and Parks, pers. comm.).

Watershed disruption is a second factor that has played a role in the decline of bull trout. Changes in or disruptions of watershed processes likely to influence characteristics of stream channels are also likely to influence the dynamics and persistence of bull trout populations. Bull trout have been more strongly associated with pristine of only lightly disturbed basins (Brown 1992; Clancy 1993; Cross and Everest 1995; Dambacher and others, in press; Huntington 1995; Ratliff and Howell 1992).

Patterns of stream flow and the frequency of extreme flow events that influence substrates are anticipated to be important factors in population dynamics (Rieman and McIntyre 1993). With 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 common in some parts of the range within the belt geography of northern Idaho and northwestern Montana (Rieman and McIntyre 1993). Channel dewatering tied to low flows and bed aggradation has also blocked access for spawning fish resulting in year class failures (Weaver 1992).

Changes in sediment delivery, aggradation and scour, wood loading, riparian canopy and shading or other factors influencing stream temperatures, and the hydrologic regime (winter flooding and summer low flow) are all likely to affect some, if not most, populations. Significant long-term changes in any of these characteristics or processes represent important risks for many remaining bull trout populations. Populations are likely to be most sensitive to changes that occur in headwater areas encompassing critical spawning and rearing habitat and remnant resident populations.

Introduced species are a third factor influencing bull trout. More than 30 introduced species occur within the present distribution of bull trout. Some introductions like kokanee may benefit bull trout by providing forage (Bowles and others 1991). Others such as brown, brook, and lake trout are thought to have depressed or replaced bull trout populations (Dambacher and others, in press; Donald and Alger 1992; Howell and Buchanan 1992; Kanda and others, in press; Leary and others 1993; Ratliff and Howell 1992). Brook trout are seen as an especially important problem (Kanda and others, in press; Leary and others 1993) and may progressively displace bull trout through hybridization and higher reproductive potential (Leary and others 1993). Brook trout now occur in the majority of the watersheds representing the current range of bull trout. Introduced species may pose greater risks to native species where habitat disturbance has occurred (Hobbs and Huenneke 1992).

Isolation and fragmentation are the fourth factor likely to influence the status of bull trout. Historically bull trout populations were well connected throughout the Basin. Habitat available to bull trout has been fragmented, and in may cases populations have been isolated entirely. Dams have isolated whole subbasins throughout the Basin (see for example, Brown 1992; Kanda and other, in press; Pratt and Huston 1993; Rieman and McIntyre 1995). Irrigation diversions, culverts, and degraded mainstem habitats have eliminated or seriously depressed migratory life histories effectively isolating resident populations in headwater tributaries (Brown 1992; Montana Bull Trout Scientific Committee, in preparation; Ratliff and Howell 1992; Rieman and McIntyre 1993). Introduced species like brook trout may displace bull trout in lower stream reaches further reducing the habitat available in many remaining headwater areas (Adams 1994; Leary and others 1993). Loss of suitable habitat through watershed disturbance may also increase the distance between good or refuge habitats and strong populations thus reducing the likelihood of effective dispersal (Frissell and others 1993).

References: Much of the narrative was taken from Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of Aquatic Species and Habitats. *In* T.M. Quigley and S. J. Arbelbide eds "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III". U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech Rep

PNW-GTR-405). For complete citations, refer to that document.

Other references used but not contained in Lee and others 1997:

Brown, C. J. D. 1971. Fishes of Montana. The Endowment and Research Foundation, Montana State University, Bozeman, MT.

Cavender, T.M. 1978. Taxonomy and Distribution of the Bull Trout, *Salvelinus confluentus* (Suckley), from the American Northwest. California Fish and Game 64(3): 139-174.

Simpson, J. C. and R. L White 1982. Fishes of Idaho. University Press of Idaho, Moscow, ID.

TABLE 1. MATRIX of DIAGNOSTICS / PATHWAYS AND INDICATORS

(Remember, the values of criteria presented here are NOT absolute, they may be adjusted for local watersheds given supportive documentation. See p. 7)

DIAGNOSTIC OR PATHWAY	INDICATORS	FUNCTIONING APPROPRIATELY	FUNCTIONING AT RISK	FUNCTIONING AT UNACCEPTABLE RISK
SPECIES:				
Subpopulation Characteristics within subpopulation watersheds	Subpopulation Size	Mean total subpopulation size or local habitat capacity more than several thousand individuals. All life stages evenly represented in the subpopulation.[1]	Adults in subpopulation are less than 500 but >50.[1]	Adults in subpopulation has less than 50.[1]
	Growth and Survival	Subpopulation has the resilience to recover from short term disturbances (e.g. catastrophic events, etc) or subpopulation declines within one to two generations (5 to 10 years).[1] The subpopulation is characterized as increasing or stable. At least 10+ years of data support this estimate.[2]	When disturbed, the subpopulation will not recover to predisturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The subpopulation is reduced in size, but the reduction does not represent a long-term trend.[1]. At least 10+ years of data support this characterization.[2] If less data is available and a trend can not be confirmed, a subpopulation will be considered at risk until enough data is available to accurately determine its trend.	The subpopulation is characterized as in rapid decline or is maintaining at alarmingly low numbers. Under current management, the subpopulation condition will not improve within two generations (5 to 10 years).[1] This is supported by a minimum of 5+ years of data.
	Life History Diversity and Isolation	The migratory form is present and the subpopulation exists in close proximity to other spawning and rearing groups. Migratory corridors and rearing habitat (lake or larger river) are in good to excellent condition for the species. Neighboring subpopulations are large with high likelihood of producing surplus individuals or straying adults that will mix with other subpopulation groups.[1]	The migratory form is present but the subpopulation is not close to other subpopulations or habitat disruption has produced a strong correlation among subpopulations that do exist in proximity to each other.[1]	The migratory form is absent and the subpopulation is isolated to the local stream or a small watershed not likely to support more than 2,000 fish.[1]

	Persistence and Genetic Integrity	Connectivity is high among multiple (5 or more) subpopulations with at least several thousand fish each. Each of the relevant subpopulations has a low risk of extinction.[1] The probability of hybridization or displacement by competitive species is low to nonexistent.	Connectivity among multiple subpopulations does occur, but habitats are more fragmented. Only one or two of the subpopulations represent most of the fish production.[1] The probability of hybridization or displacement by competitive species is imminent, although few documented cases have occurred.	Little or no connectivity remains for refounding subpopulations in low numbers, in decline, or nearing extinction. Only a single subpopulation or several local populations that are very small or that otherwise are at high risk remain.[1] Competitive species readily displace bull trout. The probability of hybridization is high and documented cases have occurred.
HABITAT:				
Water Quality:	Temperature	7 day average maximum temperature in a reach during the following life history stages:[1,3] incubation 2 - 5°C rearing 4 - 12 °C spawning 4 - 9°C also temperatures do not exceed 15°C in areas used by adults during migration (no thermal barriers)	7 day average maximum temperature in a reach during the following life history stages:[1,3] incubation <2°C or 6°C rearing <4°C or 13 - 15 °C spawning <4 °C or 10°C also temperatures in areas used by adults during migration sometimes exceeds 15°C	7 day average maximum temperature in a reach during the following life history stages:[1,3] incubation <1°C or >6°C rearing >15 °C spawning <4 °C or > 10°C also temperatures in areas used by adults during migration regularly exceed 15°C (thermal barriers present)
	Sediment (in areas of spawning and incubation; rearing areas will be addressed under "substrate embeddedness")	Similar to chinook salmon[1]: for example (e.g.): < 12% fines (<0.85mm) in gravel[4]; e.g. ≤20% surface fines of ≤6mm[5,6]	Similar to chinook salmon[1]; e.g. 12-17% fines (<0.85mm) in gravel[4]; e.g. 12-20% surface fines[7]	Similar to chinook salmon[1]: e.g. >17% fines (<0.85mm) in gravel[4]; e.g. >20% fines at surface or depth in spawning habitat[7]
	Chemical Contamination/ Nutrients	low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches[8]	moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one CWA 303d designated reach[8]	high levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one CWA 303d designated reach[8]
Habitat Access:	Physical Barriers (address subsurface flows impeding fish passage under the pathway "flow/hydrology")	man-made barriers present in watershed allow upstream and downstream fish passage at all flows	man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows

Habitat Elements:	Substrate Embeddedness in rearing areas (spawning and incubation areas were addressed under the indicator "sediment")	reach embeddedness <20%[9,10]	reach embeddedness 20-30%[9,10]	reach embeddedness >30%[4,10]
	Large Woody Debris	current values are being maintained at greater than 80 pieces/mile that are >24"diameter and >50 ft length on the Coast[9], or >20 pieces/ mile >12"diameter >35 ft length on the Eastside[11]; also adequate sources of woody debris are available for both long and short-term recruitment	current levels are being maintained at minimum levels desired for "functioning appropriately", but potential sources for long term woody debris recruitment are lacking to maintain these minimum values	current levels are not at those desired values for "functioning appropriately", and potential sources of woody debris for short and/or long term recruitment are lacking
	Pool Frequency and Quality	pool frequency in a reach closely approximates[5]: Welted width (ft) / #pools/mile 0-5 / 39 5-10 / 60 10-15 / 48 15-20 / 39 20-30 / 23 30-35 / 18 35-40 / 10 40-65 / 9 65-100 / 4 (can use formula: pools/mi = 5,280/welted channel width / #channel widths per pool); also, pools have good cover and cool water[4], and only minor reduction of pool volume by fine sediment	pool frequency is similar to values in "functioning appropriately", but pools have inadequate cover/temperature[4], and/or there has been a moderate reduction of pool volume by fine sediment	pool frequency is considerably lower than values desired for "functioning appropriately"; also cover/temperature is inadequate[4], and there has been a major reduction of pool volume by fine sediment
	Large Pools (in adult holding, juvenile rearing, and overwintering reaches where streams are >3m in wetted width at baseflow)	each reach has many large pools >1 meter deep[4]	reaches have few large pools (>1 meter) present[4]	reaches have no deep pools (>1 meter)[4]
	Off-channel Habitat (see reference 18 for identification of these characteristics)	watershed has many ponds, oxbows, backwaters, and other off-channel areas with cover; and side-channels are low energy areas[4]	watershed has some ponds, oxbows, backwaters, and other off-channel areas with cover; but side-channels are generally high energy areas[4]	watershed has few or no ponds, oxbows, backwaters, or other off-channel areas[4]

	Refugia (see Checklist footnotes for definition of this indicator)	habitats capable of supporting strong and significant populations are protected and are well distributed and connected for all life stages and forms of the species[12, 13]	habitats capable of supporting strong and significant populations are insufficient in size, number and connectivity to maintain all life stages and forms of the species[12, 13]	adequate habitat refugia do not exist[12]
Channel Condition & Dynamics:	Average Wetted Width/ Maximum Depth Ratio in scour pools in a reach	≤10[7, 5]	11 - 20[5]	>20[5]
	Streambank Condition	>80% of any stream reach has ≥90% stability[5]	50 - 80% of any stream reach has ≥90% stability[5]	<50% of any stream reach has ≥90% stability[5]
	Floodplain Connectivity	off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly
Flow/Hydrology:	Change in Peak/ Base Flows	watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography	some evidence of altered peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	pronounced changes in peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in Drainage Network	zero or minimum increases in active channel length correlated with human caused disturbance	low to moderate increase in active channel length correlated with human caused disturbance	greater than moderate increase in active channel length correlated with human caused disturbance
Watershed Conditions:	Road Density & Location	<1mi/mi² [13]; no valley bottom roads	1 - 2.4 mi/mi² [13]; some valley bottom roads	>2.4 mi/mi² [13]; many valley bottom roads
	Disturbance History	<15% ECA of entire watershed with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area there is an additional criteria of ≥15% LSOG in watersheds[14]	<15% ECA of entire watershed but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area there is an additional criteria of ≥15% LSOG in watersheds[14]	>15% ECA of entire watershed and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG

Riparian Conservation Areas (RHCA - PACFISH and INFISH) (Riparian Reserves - Northwest Forest Plan)	the riparian conservation areas provide adequate shade, large woody debris recruitment, and habitat protection and connectivity in subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact), and adequately buffer impacts on rangelands: percent similarity of riparian vegetation to the potential natural community/ composition >50%[15]	moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian conservation areas, or incomplete protection of habitats and refugia for sensitive aquatic species (≈70-80% intact), and adequately buffer impacts on rangelands : percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better[15]	riparian conservation areas are fragmented, poorly connected, or provides inadequate protection of habitats for sensitive aquatic species (<70% intact, refugia does not occur), and adequately buffer impacts on rangelands : percent similarity of riparian vegetation to the potential natural community/composition <25%[15]
Disturbance Regime	Environmental disturbance is short lived; predictable hydrograph, high quality habitat and watershed complexity providing refuge and rearing space for all life stages or multiple life-history forms. [1] Natural processes are stable.	Scour events, debris torrents, or catastrophic fire are localized events that occur in several minor parts of the watershed. Resiliency of habitat to recover from environmental disturbances is moderate.	Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents, or high probability of catastrophic fire exists throughout a major part of the watershed. The channel is simplified, providing little hydraulic complexity in the form of pools or side channels. [1] Natural processes are unstable.

SPECIES AND HABITAT:			
Integration of Species and Habitat Conditions	Habitat quality and connectivity among subpopulations is high. The migratory form is present. Disturbance has not altered channel equilibrium. Fine sediments and other habitat characteristics influencing survival or growth are consistent with pristine habitat. The subpopulation has the resilience to recover from short-term disturbance within one to two generations (5 to 10 years). The subpopulation is fluctuating around an equilibrium or is growing.[1]	Fine sediments, stream temperatures, or the availability of suitable habitats have been altered and will not recover to predisturbance conditions within one generation (5 years). Survival or growth rates have been reduced from those in the best habitats. The subpopulation is reduced in size, but the reduction does not represent a long-term trend. The subpopulation is stable or fluctuating in a downward trend. Connectivity among subpopulations occurs but habitats are more fragmented.[1]	Cumulative disruption of habitat has resulted in a clear declining trend in the subpopulation size. Under current management, habitat conditions will not improve within two generations (5 to 10 years). Little or no connectivity remains among subpopulations. The subpopulation survival and recruitment responds sharply to normal environmental events. [1]

[1] Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. U.S.D.A. Forest Service, Intermountain Research Station, Boise, ID.
[2] Rieman, B.E. and D.L. Meyers. 1997. Use of redd counts to detect trends in bull trout (*Salvelinus confluentus*) populations. Conservation Biology 11(4): 1015-1018.
[3] Buchanan, D.V. and S.V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. *In* W.C. Mackay, M.K. Brewin, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings. P8.
[4] Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.
[5] Overton, C.K., J.D. McIntyre, R. Armstrong, S.L. Whitewell, and K.A. Duncan. 1995. User's guide to fish habitat: descriptions that represent natural conditions in the Salmon River Basin, Idaho. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-322.
[6] Overton, C.K., S.P. Wollrab, B.C. Roberts, and M.A. Radko. 1997. R1/R4 (Northern/Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen Tech. Rep. INT-GTR-346.
[7] Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.
[8] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.
[9] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.
[10] Shepard, B.B., K.L. Pratt, and P.J. Graham. 1984. Life histories of westslope cutthroat and bull trout in the Upper Flathead River Basin, MT. Environmental Protection Agency Rep. Contract No. R008224-01-5.
[11] Interior Columbia Basin Ecosystem Management Project Draft Environmental Impact Statement and Appendices.
[12] Frissell, C.A., Liss, W.J., and David Bayles, 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on Changing Roles in Water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.
[13] Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of Aquatic Species and Habitats. *In* T.M. Quigley and S. J. Arbelbide eds "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III". U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech Rep PNW-GTR-405.
[14] Northwest Forest Plan, 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.
[16] Winward, A.H., 1989 Ecological Status of Vegetation as a base for Multiple Product Management. Abstracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Management: p277.

TABLE 2. CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

DIAGNOSTICS/ PATHWAYS: INDICATORS	POPULATION AND ENVIRONMENTAL BASELINE (list values or criterion and supporting documentation)			EFFECTS OF THE ACTION(S)			
	Functioning Appropriately	Functioning At Risk	Functioning at Unacceptable Risk	Restore[1]	Maintain[2]	Degrade[3]	Compliance with ACS
Subpopulation Characteristics: Subpopulation Size							
Growth and Survival							
Life History Diversity and Isolation							
Persistence and Genetic Integrity							
Water Quality: Temperature							
Sediment							
Chem. Contam./Nutrients							
Habitat Access: Physical Barriers							
Habitat Elements: Substrate Embeddedness							
Large Woody Debris							
Pool Frequency and Quality							
Large Pools							
Off-channel Habitat							
Refugia[4]							
Channel Cond. & Dynamics: Wetted Width/Max.Depth Ratio							
Streambank Condition							
Floodplain Connectivity							
Flow/Hydrology: Change in Peak/Base Flows							
Drainage Network Increase							
Watershed Conditions: Road Density & Location							
Disturbance History							
Riparian Conservation Areas							
Disturbance Regime							
Integration of Species and Habitat Conditions							

Watershed Name: _____ Location: _____

1 For the purposes of this checklist, "restore" means to change the function of a "functioning at risk" indicator to "functioning appropriately", or to change the function of a "functioning at unacceptable risk" indicator to "functioning at risk" or "functioning appropriately" (i.e., it does not apply to "functioning appropriately" indicators). Restoration from a worse to a better condition does not negate the need to consult/confer if take will occur.

2 For the purposes of this checklist, "maintain" means that the function of an indicator does not change (i.e., it applies to all indicators regardless of functional level).

3 For the purposes of this checklist, "degrade" means to change the function of an indicator for the worse (i.e., it applies to all indicators regardless of functional level). In some cases, a "functioning at unacceptable risk" indicator may be further worsened, and this should be noted.

4 Refugia = watersheds or large areas with minimal human disturbance having relatively high quality water and fish habitat, or having the potential of providing high quality water and fish habitat with the implementation of restoration efforts. These high quality water and fish habitats are well distributed and connected within the watershed or large area to provide for both biodiversity and stable populations.

(adapted from discussions on "Stronghold Watersheds and Unroaded Areas" in Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of Aquatic Species and Habitats. *In* T.M. Quigley and S. J. Arbelbide eds "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III". U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech Rep PNW-GTR-405).

TABLE 3. DICHOTOMOUS KEY FOR MAKING ESA DETERMINATION OF EFFECTS (Circle the conclusion at which you arrive)

1. Are there any proposed/listed fish species and/or proposed/designated critical habitat in the watershed or downstream from the watershed?

   NO ..... **No effect**

   YES (or unknown) ..... Go to 2

2. Will the proposed action(s) have any effect whatsoever[1] on the species and/or critical habitat:

   NO ..... **No effect**

   YES ..... Go to 3

3. Does the proposed action(s) have the potential to hinder attainment of relevant "functioning appropriately" indicators (from table 2)?

   A. NO ..... Go to 4

   B. YES ..... Go to 5

4. Does the proposed action(s) have the potential to result in "take"[1] of any proposed/listed fish species or destruction/adverse modification of proposed/designated critical habitat? [3]

   A. NO ..... **Not likely to adversely affect**

   B. YES ..... **Likely to adversely affect**

5. Does the proposed action(s) have the potential to result in "take"[1] of any proposed/listed fish species or destruction/adverse modification of proposed/designated critical habitat? [3]

   A. NO ..... **Not likely to adversely affect**

   B. YES ..... **Likely to adversely affect**

1 "Any effect whatsoever" includes small effects, effects that are unlikely to occur, and beneficial effects (all of which are recognized as "may effect" determinations). A "no effect" determination is only appropriate if the proposed action will literally have no effect whatsoever on the species and/or critical habitat, not a small effect, an effect that is unlikely to occur; or a beneficial effect.

2 "Take" - The ESA (Section 3) defines take as "to harass, harm, pursue, hunt, shoot, wound, trap, capture, collect or attempt to engage in any such conduct". The USFWS (USFWS, 1994) further defines "harm" as "significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering", and "harass" as "actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering".

3 Document expected incidental take on next page of this key.

DOCUMENTATION OF EXPECTED INCIDENTAL TAKE

Name and location of action(s):_____ Species:_____

1. The proposed action may result in incidental take through which of the following mechanisms (circle as appropriate)?

   Harm: Significant impairment of behavioral patterns such as breeding, feeding, sheltering, and others (identify).

   Harass: Significant disruption of normal behavior patterns which include, but are not limited to, breeding, feeding, sheltering, or others (identify).

   Pursue, Hunt, Shoot, Wound, Capture, Trap, Collect.

2. What is the approximate duration of the effects of the proposed action(s) resulting in incidental take?

3. Which of the following life stages will be subject to incidental take (circle as appropriate)?

   Fertilization to emergence (incubation)

   Juvenile rearing to adulthood

   Adult holding and overwintering

   Adults spawning

   Adults migrating

4. Which life form and subpopulation status are present in the watershed or downstream of the watershed where the activities will take place (circle as appropriate)?

Life Form:	Subpopulation status:
Resident	**Stronghold population**
Adfluvial	**Depressed population**
Fluvial	
Anadromous	

5. What is the location of the expected incidental take due to the proposed action(s)?

Basin and watershed:

Stream reach and habitat units:

6. Quantify your expected incidental take:

Length stream affected (miles):

Individuals (if known):

Examples of Some of the Influences of Human Activities on Aquatic Ecosystems

The following, except the section on water temperature, are excerpts generally from two sources: 1. "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins, Volume III, Chapter 4, 1997, (referred to as Lee and others 1997), and 2) Rieman and McIntyre 1993. These descriptions are generated to stimulate biologist's thought and Level 1 team discussion on evaluation of all the diagnostics/pathways through which habitat degradation could occur and aquatic populations can be altered. These examples are not all inclusive. We recommend that biologists review all the recommended reports and papers suggested on page **** and use them to gain a more complete insight into each indicator listed in the matrix. The Interior Columbia Basin Assessment can be acquired from the U.S. Forest Service, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331.

Channel Stability (excerpts from Rieman and McIntyre 1993)

"Young bull trout are closely associated with stream channel substrates. Incubation occurs over a prolonged period through the winter. Juvenile fish are found in close association with the bottom of the channel, often using substrate for cover (Fraley and Shepard 1989; Oliver 1979; Pratt 1984; Shepard and others 1984b). The association with substrate appears more important for bull trout than for other species (Nakano and others 1992; Pratt 1984).

The extended tie to substrate and the presence of embryos and alevins in substrate during winter and spring suggests that highly variable stream flows, bed load movements, and channel instability will influence the survival of young bull trout (Goetz 1989; Weaver 1985). The embryos and young of fish that spawn in the fall are particularly vulnerable to flooding and scouring during winter and early spring (Elwood and Waters 1969; Seegrist and Gard 1972; Wickett 1958) and to low winter flows or freezing within the substrate." "Low habitat complexity, the frequency of bed load scour and the frequency of low flows may be aggravated by watershed disruption and problems of channel instability in many bull trout streams."

Channel Substrate (excerpts from Rieman and McIntyre 1993)

"Increased sediments reduce pool depth, alter substrate composition, reduce interstitial space, and cause channels to braid (Beschta and Platts 1986; Clifton 1989; Everest and others 1987; Lisle 1982; Megahan and others 1980). Initial work on the influence of fine sediments (Shepard and others 1984a; Weaver and White 1985) suggested that incubating bull trout embryos tolerated fine sediments (less than 6.35 millimeters) better than cutthroat trout, steelhead trout, and brook trout. Their tolerance appeared similar to that of chinook salmon (Hausle and Coble 1976; Irving and Bjornn 1984; Tappel and Bjornn 1983). More recent work (Weaver and Fraley 1991), however, indicated that any increase in fine sediments reduces survival. Others have found that when the percent of fine sediments in the substrate was higher, rearing bull trout were also less abundant (Leathe and Enk 1985; McPhail and Murray 1979; Shepard and others 1984a; Weaver and Fraley 1991)." "Spawners may also "select" sites where substrate is not highly compacted (Graham and others 1981; McPhail and Murray 1979).

It is difficult to predict how much a particular change in substrate composition will affect

survival for any salmonid (Chapman 1988; Everest and others 1987; Weaver and Fraley 1991). Some substrates are more likely to accumulate fines than others, and some populations probably are more sensitive than others. In the absence of detailed local information on population habitat dynamics, any increase in the proportion of fines in substrates should be considered a risk to productivity of an environment and to the persistence of associated bull trout populations."

Cover (excerpts from Rieman and McIntyre 1993)

"Bull trout usually associate with complex forms of cover and with pools. Juveniles live close to in-channel wood, substrate, or undercut banks (Goetz 1991; Pratt 1984, 1992). Young-of-the-year bull trout use side channels, stream margins, and other areas of low velocity. Older fish use pools (Hoelscher and Bjornn 1989; Pratt 1984) and areas with large or complex woody debris and undercut banks (Graham and others 1981; Oliver 1979; Pratt 1985; Shepard and others 1984b). Woody debris correlated significantly with densities of bull trout sampled in streams in the Bitterroot National Fores (Clancy 1992)." "Cover is important in winter and is thought to limit many fish populations (Chapman 1966; Cunjak and Power 1986). Cover clearly influences population density and overwinter survival of brook trout (Boussu 1954; Hunt 1976; Saunders and Smith 1962)."

Water Temperature

Researchers recognize temperature more consistently than any other factor influencing bull trout distribution, based mostly on correlative evidence (Reiman and McIntyre 1993). Water temperatures in excess of about 15°C are thought to limit bull trout distribution (Rieman and McIntyre 1993). McPhail and Murray (1979) reported that the survival of bull trout eggs to hatching varied with water temperature: 0-20% survival in 8-10°C, 60-90% in 6°C, and 80-95% in 2-4°C. Temperatures between 4-6°C were needed for egg development in Montana streams (Weaver and White 1985). Water temperature also appears to be a critical factor in the spawning and early life history of bull trout. Spawning has been observed to occur in British Columbia, Oregon, and Montana at or below 9°C (Fraley and Shepard 1989, McPhail and Murray 1979, Riehle 1993).

Water Quality (excerpts from Lee et al. 1997)

"The extent and intensity of land development and land-use activities have increased during the past century." "Aquatic ecosystem perturbations related to these activities include: 1) thermal pollution; 2) toxicity due to the presence of organic compounds (synthetic and natural) and heavy metal ions; 3) introduction of pathogenic organisms; 4) organic wastes that result in potentially catastrophic changes in dissolved oxygen levels; 5) acidification; 6) elevated sedimentation rates; and 7) increased eutrophication (Ellis 1989).

Eutrophication is indicative of deteriorating water quality associated with a buildup of nutrients, especially nitrogen and phosphorus. Increased rates of nutrient loading can be related to changes an/or disturbances within a watershed (Brugam and Vallarino 1989; Dojlido and Best 1993; Stauffer 1991). Development activities that contribute to increased nutrient levels include point sources such as industrial effluents and water-borne sewage systems and nonpoint sources such as agricultural operations, residential development and septic systems, road construction, and forest practices (Dojlido and Best 1993; Spencer 1991; Thralls 1991).

Nonpoint source pollution may be the most problematic cause of water quality deterioration because the origin of perturbation is often difficult to identify and control." "Development can result in increases of nitrogen and phosphorus in surface waters resulting from: septic system effluents (Scott 1991; Sorrie 1994; Stauffer 1991), runoff from fertilized lawns and agricultural lands (Lewis and others 1984; Power and Schepers 1989), and runoff from highways and road (Ehrenfeld and Schneider 1991; Lewis and others 1984)."

Some Major Activities and their Effects

(All of the following are excerpts from Lee and others 1997)

Water diversions and dams

"Trends in the number of dams constructed over time and impounded water volumes indicate that many streams and rivers have experienced a rapid and massive change in their hydrology. Even though the rate of increase in storage volume has leveled since the mid-1970s, the total number of dams continues to increase, suggesting that new construction is focused on smaller dams (National Research Council 1995)."

"Reservoir operation has resulted in long-term changes in downstream water temperatures and the annual discharge of water and sediments. The pattern and timing of the annual hydrograph have been altered in most basins on scales ranging from hours to months and even years. In many instances dams have changed large river systems to isolated fluvial fragments between lakes. In arid areas of the Basin, stream diversions have reduced flows to a trickle."

"Water withdrawals for off-stream uses include rural domestic use, stock watering, irrigation, public water supply, commercial and industrial supply, and thermoelectric cooling." "Agricultural irrigation is by far the dominant off-stream use in the Basin."

"Most irrigation diversions on Forest Service and BLM-administered lands are operated by private individuals, but a few water rights are held by federal agencies."

" Irrigation has contributed to the extirpation of salmon and steelhead from many small streams in the Salmon National Forest (Keifenhiem 1992). Many streams in the Sawtooth National Recreation Area have inadequate instream flow as a result of irrigation." " The cumulative loss of spawning and rearing habitat in these tributaries is significant."

Grazing and Farming

"The proportion of land in the Pacific Northwest dedicated to agriculture is relatively small (approximately 16%). However, agricultural practices can have considerable effects on aquatic resources because the lands are often located on historic flood plains and valley bottoms. The effects of farming on aquatic systems include loss of native vegetation, bank instability, loss of floodplain function, removal of large woody debris sources, changes in sediment supply, changes in hydrology, increases in water temperature, changes in nutrient supply, chemical pollution, channel modification, and habitat simplification (Spence and others 1995)."

"The effects of livestock grazing on aquatic systems are related, in part, to the

biophysical attributes of the site (Archer and Smeins 1991)." "Unstable stream conditions often exist as part of the natural conditions of streams; however, grazing can amplify these unstable conditions. In some cases, livestock use may initiate additional instability *within* a stream system.

Over*grazing* by livestock can lead to a reduction of soil structure, soil compaction, and damage or loss of vegetative cover. All of these processes contribute to an increase in the rate and erosive force of surface runoff (Meehan and Platts 1978; Thurow 1991). Resulting increases in soil erosion lead to a loss of stored nutrients in the soil and a decrease in the level of vegetative productivity (Thurow 1991). The degree of soil erosion associated with livestock grazing is related to slope gradient and aspect of the site being grazed, the condition of the soil, type and density of vegetation, and the accessibility of the site to livestock (Meehan and Platts 1978).

Riparian areas maintain stream structure and function through processes such as water filtration, bank stabilization, water storage, groundwater recharge, nutrient retention, regulation of light and temperature, channel shape and pattern (morphology and micro-topography), and dispersal of plants and animals (Cummins and others 1984; Gregory and others 1991; Minshall 1967, 1994; Sullivan and others 1987)." "Livestock grazing can alter the species composition of stream-side vegetation (Archer and Smeins 1991; Platts 1978; Stebbins 1981; Thurow 1991; Vollmer and Kozel 1993) and diminish vegetative productivity (Archer and Smeins 1991; Horning 1994; Meehan and Platts 1978; Platts 1978; Thurow 1991; Vollmer and Kozel 1993). Grazing alters riparian vegetation by removing deep rooting plant species and decreasing canopy cover and riparian vegetation height (Platts 1991). Grazing has been implicated in the alteration of species composition of vegetative communities and associated fire regimes (Agee 1993; Leopold 1924).

Grazing is a major nonpoint source of channel sedimentation (Dunne and Leopold 1978; MacDonald and others 1991; Meehan 1991; Platts 1991). Grazed watersheds typically have higher stream sediment levels than ungrazed watersheds (Lusby 1970; Platts 1991; Rich and others 1992; Scully and Petrosky 1991). Increased sedimentation is the result of grazing effects on soils (compaction), vegetation (elimination), hydrology (channel incision, overland flow), and bank erosion (sloughing) (Kauffman and others 1983; MacDonald and others 1991; Parsons 1965; Platts 1981a, 1981b; Rhodes and others 1994). Sediment loads that exceed natural background levels can fill pools, silt spawning gravels, decrease channel stability, modify channel morphology, and reduce survival of emerging salmon fry (Burton and others 1993; Everest and others 1987; MacDonald and others 1991; Meehan 1991; Rhodes and others 1994). In addition, runoff contaminated by livestock wastes can cause an increase in potentially harmful bacteria (for example, *Pseudomonas aeruginosa* and *Aeromonas hydrophila*) (Taylor and others 1989; Hall and Amy 1990; Thurow 1991). Compared to ungrazed sites, aquatic insect communities in stream reaches associated with grazing activities often are composed of organisms more tolerant of increased silt levels, increased levels of total alkalinity and mean conductivity, and elevated water temperatures (Rinne 1988)."

Timber harvest

"Anderson (1988), citing a 1986 report of the Montana State Water Quality Bureau,

suggested that the single greatest threat to watersheds and aquatic life is timber harvest and associated road building within forests. This threat is due, in part, to the increased level of harvesting timber from steeper, more environmentally sensitive terrain (Anderson 1998; Platts and Megahan 1975). Accelerated surface erosion and increased levels of sedimentation can decrease after initial disturbance but may remain above natural levels for many years (Platts and Megahan 1975; Spencer 1991; Swanson 1981)." "Vulnerable watersheds generally have high slope gradients, high levels of potential soil erodibility, soils having moderate to very poor drainage, or soil moisture contents in excess of field capacity for long periods of the year (van Kesteren 1986).

Soil and site disturbance that inevitably occur during timber harvest activities are often responsible for increased rates of erosion and sedimentation (Chamberlain and others 1991; FEMAT 1993; MacDonald and others 1991; Meehan 1991; Reid 1993; Rhodes and others 1994); modification and destruction of terrestrial and aquatic habitats (FEMAT 1993; van Kesteren 1986); changes in water quality and quantity (Bjornn and Reiser 1991; Brooks and others 1992; Chamberlain and others 1991; Rhodes and others 1994); and perturbation of nutrient cycles within aquatic ecosystems (Rowe and others 1992). Physical changes affect runoff events, bank stability, sediment supply, large woody debris retention, and energy relationships involving temperature (Li and Gregory 1995). All of these changes can eventually culminate in the loss of biodiversity within a watershed (FEMAT 1993; Rowe and others 1992).

Increased delivery of sediments, especially fine sediments, is usually associated with timber harvesting and road construction (Eaglin and Hubert 1993; Frissell and Liss 1986; Havis and others 1993; Platts and Megahan 1975). As the deposition of fine sediments in salmonid spawning habitat increase, mortality of embryos, alevins, and fry rises. Erosion potential is greatly increased by reduction in vegetation, compaction of soils and desruption of natural surface and subsurface drainage patterns (Chamberlain and others 1991; Rhodes and others 1994). Generally, logged slopes contribute sediment to streams based on the amount of bare compacted soils that are exposed to rainfall and runoff. Slope steepness and proximity to channels determine the rate of sediment delivery.

Water quality (for example, water temperature, dissolved oxygen, and nutrients) can be altered by timber harvest activities (Chamberlain and others 1991). Stream temperature is affected by eliminating stream-side shading, disrupted subsurface flows, reduced stream flows, elevated sediments, and morphological shifts toward wider and shallower channels with fewer deep pools (Beschta and others 1987; Chamberlain and others 1991; Reid 1993; Rhodes and others 1994). Dissolved oxygen can be reduced by low stream flows, elevated temperatures, increased fine inorganic and organic materials that have infiltrated into stream gravels retarding intergravel flows (Bustard 1986; Chamberlain and others 1991). Nutrient concentrations may increase following logging but generally return quickly to normal levels (Chamberlain and others 1991).

Because the supply of large woody debris to stream channels is typically a function of the size and number of trees in riparian areas, it can be profoundly altered by timber harvest (Bisson and others 1987; Sedell and others 1988; Robison and Beschta 1990). Shifts in the composition and size of trees within the riparian area affect the recruitment potential and longevity of large woody debris within the stream channel. Large woody

debris influences channel morphology, especially in forming pools and instream cover, retention of nutrients, and storage and buffering of sediment. Any reduction in the amount of large woody debris within streams, or within the distance equal to one site-potential tree height from the stream, can reduce instream complexity (Rainville and others 1985; Robison and Beschta 1990). Large woody debris increases the quality of pools, provides hiding cover, slow water refuges, shade, and deep water areas (Rhodes and others 1994). Ralph and others (1994) found instream wood to be significantly smaller and pool depths significantly shallower in intensively logged watersheds. The size of woody debris in a logged watershed in Idaho was smaller than that found in a relatively undisturbed watershed (Overton and others 1993).

Because water is often delivered to lakes via stream channels, we can infer that effects to streams related to timber harvest and road construction may eventually be manifested within lakes." "Birch and others (1980) reported that timber harvest activities caused increases in lake sedimentation rate and lake productivity in three of four lakes studied in western Washington, accelerating the rate of change in the trophic status of each lake. Timber harvest activities and road construction, including railroad construction, increased sedimentation rates above natural levels in three lades of the Flathead Basin (Spencer 1991). Road construction appeared to be the greatest cause of disturbance resulting n enhanced fine sediment deposition in lakes downstream from the construction areas."

Roads

"Roads contribute more sediment to streams than any other land management activity (Gibbons and Salo 1973; Meehan 1991), but most of the land management activities, such as mining, timber harvest, grazing, recreation, and water diversions are dependent on roads. The majority of sediment from timber harvest activities are related to roads and road construction (Chamberlain and others 1991; Dunne and Leopold 1978; Furniss and others 1991; Megahan and others 1978; MacDonald and Ritland 1989) and associated increased erosion rates (Beschta 1978; Gardner 1979; Meehan 1991; Reid 1993; Reid and Dunne 1984; Rhodes and others 1994; Swanson and Dyrness 1975; Swanston and Swanson 1976)." "Roads can also affect water quality through applied road chemicals and toxic spills (Furniss and others 1991; Rhodes and others 1994)."

"Roads directly affect natural sediment and hydrologic regimes by altering streamflow, sediment loading, sediment transport and deposition, channel morphology, channel stability, substrate composition, stream temperatures, water quality, riparian conditions within a watershed. For example, interruption of hill-slope drainage patterns alters the timing and magnitude of peak flows and changes base stream discharge (Furniss and others 1991; Harr and others 1975) and sub-surface flows (Furniss and others 1991; Megahan 1972). Road-related mass soil movements can continue for decades after the roads have been constructed (Furniss and others 1991). Such habitat alterations can adversely affect all life-stages of fishes, including migration, spawning, incubation, emergence, and rearing (Furniss and others 1991; Henjum and others 1994; MacDonald and others 1991; Rhodes and others 1994)."

"Road/stream crossings can also be a major source of sediment to streams resulting from channel fill around culverts and subsequent road crossing failures (Furniss and others 1991). Plugged culverts and fill slope failures are frequent and often lead to

catastrophic increases in stream channel sediment, especially on old abandoned or unmaintained roads (Weaver and others 1987). Unnatural channel widths, slope, and stream bed form occur upstream and downstream of stream crossings (Heede 1980), and these alterations in channel morphology may persist for long periods of time. Channelized stream sections resulting from riprapping of roads adjacent to stream channels are directly affected by sediment from side casting, snow removal, and road grading; such activities can trigger fill slope erosion and failures. Because improper culverts can reduce or eliminate fish passage (Belfore and Gould 1989), road crossings are a common migration barrier to fishes (Evans and Johnston 1980; Furniss and others 1991; Clancy and Reichmuth 1990)."

Mining

"Although any mining activity may have negative effects on aquatic ecosystems (according to the Pacific States Marine Fisheries Commission 1994, 14,400 kilometers of rivers and streams in the western United States have been polluted by mining), the largest impacts are generally associated with surface mining."

"Mining activities can affect aquatic systems in a number of ways: through the addition of large quantities of sediments, the addition of solutions contaminated with metals or acids, the acceleration of erosion, increased bank and streambed instability, and changes in channel formation and stability. Sediments enter streams through erosion of mine tailings (Besser and Rabeni 1987), by direct discharge of mining wastes to aquatic systems, and through movement of groundwater (Davies-Colley and others 1992). Coarse particles that enter watersheds are likely to settle relatively rapidly (Davies-Colley and others 1992), and therefore, effects on aquatic systems are greatest near mining activities. Fine inorganic particles (like clays) settle slowly and may travel great distances from the point of their introduction and therefore may have a greater effect on water bodies such as lakes further from mining activities. Fine suspended material reduces the amount of light available for benthic algae and plants, and thereby, biomass and primary production are diminished. Fine suspended materials may also reduce the quantity and quality of epilithon (substrate surface biofilm) that serves as food for benthic invertebrates. If suspended sediments damage respiratory structures of benthic invertebrates, their abundance may decline (Davies-Colley and others 1992)."

"Acidification of surface waters, a process associated with surface mining, mobilizes toxic metals naturally embedded in soils and streambeds." "Acidification of surface waters can affect organisms directly, such as salmonids which experience reduced egg viability, fry survival, growth rate, and other ills, or indirectly from toxic metals or substances which can affect growth, reproduction, behavior, and migration of salmonids and production of benthic algae (Spence and others 1995). Ecosystem responses to contaminants are dependant on the chemical, physical, biological, and geological processes at each site (Pascoe and others 1993). Depending on concentration, trace metal toxicity may reduce growth and reproduction or cause death of aquatic organisms (Leland and Kuwabara 1985). Adult stages of mollusks and fish can generally withstand higher concentrations of metals than other organisms (Leland and Kuwabara 1985), but embryonic and larval stages are quite sensitive to heavy metals (Leland and Kuwabara 1985). The combination of some metals may inhibit primary production more than any single metal alone (Wong and others 1978); therefore, when several metals

are present, water quality criteria for single metals are insufficient for protecting aquatic life (Borgmann 1980)."

"Surface mining practices of dredging and placer mining have altered aquatic habitats by destroying riparian vegetation and reworking channels."

Common practice for extracting gold today involves heap leach mining, a form of open-pit mining used for low-grade ore deposits. Piles of crushed ore are sprayed with a solution of sodium-cyanide (NaCN) that bonds with gold particles and is deposited in pools from which the gold is recovered. Numerous, small help leach fields are located in the Basin, primarily in floodplains of rivers or streams which are susceptible to large floods, creating the potential for flood inundation of the toxic leach pools and consequent contamination of river or stream habitats."

Non-native Fish Species

"Most introductions have been made with the intent of creating or expanding fishing opportunities and were initiated in earnest as early as the late 1800's (Evermann 1893; Simpson and Wallace 1978). Stocking of mountain lakes with cultured stocks of cutthroat, brook, and rainbow trout has been extensive (Bahls 1992; Liss and others 1995; Reiman and Apperson 1989)." "A variety of species such as kokanee salmon, chinook salmon, lake trout, brown trout, Atlantic salmon, coho salmon, black bass and other centrarchids, and ictalurids were introduced in these systems to diversify angling opportunities, create trophy fisheries, and to provide forage for potential trophy species."

"Although introductions have provided increased fishing opportunities and socioeconomic benefits, they have also led to catastrophic failures in some fisheries and expanded costs to management of declining stocks (Bowles and others 1991; Gresswell 1991; Gresswell and Varley 1988; Wydoski and Bennett 1981)."

"Non-native fishes also threaten native species through hybridization and subsequent loss of the native genome through introgression." "Hybridization between brook trout and bull trout appears to be common where the species overlap (Adams 1994; Leary and others 1993; Reiman and McIntyre 1993), and elimination or displacement of bull trout can be a common outcome (Leary and others 1993).

Predation by non-native species may have an important influence on some native cyprinids and catostomids (Williams and others 1990), resident trout populations (Griffith 1988; Reiman and Apperson 1989), and on the survival of juvenile anadromous salmonids (Reiman and others 1991)." "Predation by introduced fishes is also commonly identified as a major factor in the isolation and decline of native amphibians (Bahls 1992; Bradford and others 1993; Liss and others 1995) and has important effects on local invertebrate faunas as well (Bahls 1992; Liss and others 1995)."

"Consequences of introducing non-native species are not limited to a few interacting species. Effects frequently cascade through entire ecosystems (Winter and Hughes 1995) and compromise structure and ecological function in ways that rarely can be anticipated (Li and Moyle 1981; Magnuson 1976; Moyle and others 1986)."

"There is growing recognition that biological integrity and not just species diversity (Angermeier 1994; Angermeier and Karr 1994) is an important characteristic of aquatic ecosystem health. The loss or restriction of native species and the dramatic expansion of non-native species leave few systems that are not compromised."

Hatcheries

"Although the cultured stocks of salmonids have been frequently used to mitigate the effects of over-harvest and habitat degradation, there is substantial evidence that this practice has detrimental effects on native populations (Hindar and others 1991; Krueger and May 1991; Marnell 1986; Miller 1954). Offspring of hatchery fish spawning in the wild do not survive as will as the offspring of wild fish (Chilcote and others 1986; Leider and others 1990; Nickelson and others 1986), even if the hatchery stock was developed from wild adults (Reisenbichler and McIntyre 1977). There is unavoidable selection for traits favoring survival in the artificial conditions of egg trays, tanks, raceways, and holding ponds. Hatchery fish thus become genetically distinct from wild fish. If they stray and subsequently spawn with wild fish in natural areas, survival of the offspring is compromised (Chilcote and others 1986).

Despite lower survival, hatchery fish occupy habitat that would otherwise be used by wild fish (Miller 1954). In addition, artificially high densities of fish returning to hatcheries attract intensive fisheries that can over-harvest wild fish (Reisenbichler, in press; Wright 1981, 1993)."

"Many hatcheries located on tributaries of the Columbia River have water intakes upstream of structures designed to divert migrating fish into hatchery ponds. In order to reduce the risk of transmitting diseases to the hatchery via its water intake, adult fish are not passed upstream of the intake barrier at many sites. Protection of hatchery water supplies often prevents natural populations from accessing large tracts of historic spawning and nursery area."

Commercial and Recreational Harvest

"Angler harvest directly increases mortality and thereby influences total population abundance, size- and age-structure, and reproductive potential (Ricker 1975). Fishing may lead to substantial declines in abundance, especially in populations that are extremely vulnerable to certain types of gear." "Although high catchability may be desirable in sport fisheries, it may lead to substantial declines in abundance and changes in population structure without restrictions (Gresswell 1990; Gresswell and others 1994; Gresswell and Liss 1995).

Although management agencies have attempted to reduce or eliminate fishing as a source of mortality, incidental harvest of many sensitive native fish stocks is a problem in the Basin." "Anglers may also affect fish stocks by altering fish habitat through redd trampling and increased bank erosion. Roberts and White (1992) demonstrated that wading on trout redds can cause mortality to eggs and fry. For many years, stream reaches in some states have been closed to angling during salmon spawning season to reduce harassment of spawning fish."

"Within the past decade, many agencies have adopted new philosophies of

management that prioritize restoration and management of native fish stocks and their habitats (Idaho Department of Fish and Game (IDFG) 1991) and recognize the non-consumptive values of fish (Botsford 1994; Gresswell 1994). Where habitat for native species remains suitable, fish populations have increased substantially following implementation of restrictive harvest regulations (Gresswell 1990; Varley and Gresswell 1988)." "Bull trout numbers and redds also increased in response to decreased harvest (Ratliff 1992). These examples suggest that where populations retain resilience, restoration efforts can be successful."

Habitat Fragmentation and Simplification

"Aquatic habitat fragmentation (impassable obstructions, temperature increases, and water diversion) and simplification (channelization, removal of woody debris, channel bed sedimentation, removal of riparian vegetation, and water flow regulation) have resulted in a loss of diversity within and among native fish populations."

"Theories from population and conservation biology predict that smaller or more isolated populations have an increased risk of extirpation, and that smaller patches of habitat are likely to support less diverse communities (Boyce 1992; Gilpin and Soule 1986; MacArthur and Wilson 1967; Simberloff 1988). There is empirical evidence that these are important issues for many aquatic communities and species (Gilpin and Diamond 1981; Hanks 1991; Sjogren 1991) including fishes (Reiman and McIntyre 1995; Schlosser 1991; Sheldon 1988). At the same time species and communities that are spatially diverse face lower risks of regional extirpation in highly variable environments (den Boer 1968; Simberloff 1988). Core or source populations that are resistant to disturbance may support populations in other marginal or ephemeral habitats through dispersal (Bowers 1992; Simberloff 1988). The quality and distribution of even a few such key areas may ultimately dominate the dynamics of whole systems (Bowers 1992).

The heterogeneity of habitats for aquatic organisms, and particularly fishes, has been clearly recognized at multiple scales from microhabitat units to entire basins (Sedell and others 1990; Schlosser 1991). This spatial complexity is seen as an important factor influencing species diversity and ecosystem stability (Bowers 1992; Gresswell and others 1994; Schlosser 1991) and results in discontinuous distribution of life stages, populations, metapopulations, or subspecies and species as well. Important habitat types, such as pools or off-channel rearing areas, are discontinuous within stream reaches and influence the distributions and relative abundances of a species or life stages at that scale (Schlosser 1991). At larger watershed scales the distribution among reaches and among streams may be influenced by such things as local climate, stream temperature, stream gradients, the distribution of suitable spawning sites and gravels, and stream size (Fausch and others 1994; McIntyre and Rieman 1995; Rieman and McIntyre 1995). Spawning and rearing of bull trout and westslope and Yellowstone cutthroat trout, for example, may be restricted to smaller, headwater streams both by temperature and stream size even though subadults and adults may move widely throughout entire river basins (Gresswell 1995; McIntyre and Reiman 1995; Reiman and McIntyre 1995)."

"Fringe environments that do not support a large abundance of fishes may actually contribute much of the genetic variability to the population and may contribute in a

critical way to the persistence of much larger systems (Northcote 1992; Scudder 1989). The connection among spatially diverse and temporally dynamic habitats and populations is likely to be a critical factor to persistence and integrity of aquatic communities.

Fishes, particularly salmonids, exhibit remarkable diversity of life-history strategies (Lichatowich and Mobrand 1995; Reiman and McIntyre 1993; Thorpe 1994) and important dispersal mechanisms for dealing with naturally fragmented and variable environments (Milner and Bailey 1989; Quinn 1993; Thorpe 1994). Migratory life-history forms may be a particularly important mechanism of dispersal and risk aversion in highly variable environments for species like bull and Yellowstone cutthroat trout (Gresswell and others 1994; Reiman and McIntyre 1993).

The loss or degradation of habitats resulting form anthropogenic activities has not occurred in a random or uniformly dispersed fashion. Often lower elevation lands are more accessible, have wider floodplain valleys, and are more easily developed, hence habitat degradation has been greater in lower watersheds or in the lower reaches of larger systems. Dams and water diversions often result in fragmented streams and rivers. As a result, watershed retaining the best remaining habitats are not well dispersed throughout the individual basins; they are often restricted to less productive headwater areas. Small streams in the headwater basins actually represent more extreme or sensitive environments with limited resilience to disturbance, increased synchrony among the populations, and relatively poor potential for dispersal throughout the entire Basin.

Because life-history stages and forms are also distributed in non-uniform or non-random patterns (Lichatowich and Mobrand 1994; Reiman and Apperson 1989; Schlosser 1991), some have been more likely to disappear than others. Within heavily managed areas, disturbance has often been dispersed among watersheds in an effort to minimize damage in any single area. If most watersheds are compromised, there are few local populations with the resilience to persist in the face of major storm or other catastrophic events that eventually test those populations. When high quality habitats are isolated in a system, the loss of migratory life histories, elimination of connecting corridors, or the poor quality of interspersed habitats that may act as "stepping stones" (Gilpin 1987) for dispersal may seriously limit the connectivity among populations. Eventually the ability of populations to rebound or support those that are lost is diminished."

"The loss of life history expression influences the connectivity and stability among populations, but it also has restricted the full potential for fish production (Lichatowich and Mobrand 1995). The challenge for aquatic ecosystem management will be the maintenance and restoration of spatially diverse, high quality habitats that minimize the risks of extinction (Frissell and others 1993; Reeves and Sedell 1992) and that provide for the full expression of potential life histories (Healey 1994; Lichatowich and Mobrand 1995)."

General Recreational Activities

"Mountain lakes, especially those in national parks and scenic forested areas, may be the most susceptible aquatic systems to the negative effects of recreation. The

inherent sensitivity of a lake to pollutants influences its susceptibility to water-quality degradation (Gilliom and others 1980)." "Likelihood of pollutant-loading increases if soil, geologic, or hydrologic characteristics of a watershed favor the transport of pollutants to a lake (Gilliom and others 1980)."

"Where visitor use is high, trampling associated with foot traffic can affect vegetation along lakes and streams through direct mechanical action and indirectly through changes in soil (Liddle 1975). Resistance to trampling depends on plant life form; large and broad-leaved plants are most susceptible, and grasses generally are most resistant (Burden and Randerson 1972). Loss of vegetation from shorelines, wetlands, or steep slopes can cause erosion and pollution problems (Burden and Randerson 1972; Gilliom and others 1980)."

"Power boats can have numerous negative effects on lake environments. Resuspension of bed sediments can occur with passage of a single boat (Garrad and Hey 1987)." "Concomitant high levels of turbidity and reduced light penetration may be a major factor in declining populations of submerged macrophytes." "Power boats are also associated with the spread of the exotic Eurasion watermilfoil (*Myriophyllum spicatum*). Because it reproduces from seeds, rhizomes, and fragmented stems, this non-native plan is easily transported between water bodies when plant matter becomes entangled on boat propellers or trailers (Reed 1977)."

"Outboard engines introduce hydrocarbon emissions to the aquatic environment, and emissions have a high phenol content that is quite toxic to aquatic organisms (Wachs and others 1992). Increased lead levels in reservoirs may be attributed to recreational boating and gasoline spills (Cairns and Palmer 1993)."

"Effects of off-road recreational vehicle use on aquatic resources are documented only for a few types of natural systems. On sand dunes and shorelines, off-road vehicles can result in significant reductions of vegetation (Anders and Leatherman 1987; Wisheu and Keddy 1991)." "Disturbance associated with off-road vehicle use can alter plant community composition or create openings in cover vegetation on shorelines (Wisheu and Keddy 1991). Partial loss of vegetation from shorelines can result in increased erosion that continues until those shorelines are devoid of vegetation (Wisheu and Keddy 1991). Because seeds tend not to be deeply buried in shoreline wetlands, they may be particularly sensitive to intense disturbance (Wisheu and Keddy 1991), and recovery of disturbed shorelines may be very slow. Use of off-road vehicles may be particularly detrimental in fragile soils or in areas where habitat for sensitive species is limited (Williams 1995). Additionally, off-road vehicle use in streams can result in destruction of redds, eggs, and young."

References

Fraley, J. J. and B. B. Shepard. 1989. Life History, Ecology, and Population Status of Migratory Bull Trout (*Salvelinus confluentus*) in the Flathead Lake River System, Montana. Northwest Science 63(4);133-143.

Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of Aquatic Species and Habitats. *In* T.M. Quigley and S. J. Arbelbide eds "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III". U.S. Department of Agriculture, Forest Service, and

U.S. Department of Interior, Bureau of Land Management, Gen Tech Rep PNW-GTR-405).

McPhail, J. D. and C. B. Murray. 1979. The Early Life-history and Ecology of Dolly Varden (*Salvelinus malma*) in the upper Arrow Lakes. University of British Columbia, Department of Zoology and Institute of Animal Resources, Vancouver, B.C.

Reiman, B. E. and J. D. McIntyre. 1993. Demographic and Habitat Requirements for Conservation of Bull Trout. Gen. Tech. Rep. INT-302. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Boise, ID. 38p

Riehle, M. D. 1993. Metolius Basin Water Resources Monitoring, Progress Report 1988-1992. U.S. Department of Agriculture, Forest Service, Deschutes National Forest, Bend, OR.

Weaver, T. M. and R. G. White. 1985. Coal Creek Fisheries Monitoring Study No. III. Quarterly Progress Report. Montana State Cooperative Fisheries Research Unit, Bozeman, MT.

Appendix B
Relating the ACS Objectives and Aquatic/Riparian Strategy Objectives with the Diagnostics/Pathways and Indicator

ACS Objectives of the Northwest Forest Plan

Forest Service and BLM-administered lands within the range of the northern spotted owl will be managed to:

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

4. Maintain and restore water quality necessary to support healthy riparian, aquatic, wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and enter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

Aquatic/Riparian Strategy Objectives in PACFISH and INFISH

The ACS for PACFISH and INFISH is written as "Riparian Goals" that describe expectations in establishing the characteristics of healthy, functioning watersheds, riparian areas, and associated fish habitats. These are interim directions. Until a long-term direction is finalized, these goals/objectives amend LRMPs and RMP in areas within the proposed bull trout listing areas but outside of that land covered by the Northwest Forest Plan.

Maintain or restore:

1. water quality, to a degree that provides for stable and productive riparian and aquatic ecosystems;

2. stream channel integrity, channel processes, and the sediment regime (including the elements of timing, volume, and character of sediment input and transport) under which the riparian and aquatic ecosystems developed;

3. instream flows to support healthy riparian and aquatic habitats, the stability and effective function of stream channels, and the ability to route flood discharges;

4. natural timing and variability of the water table elevation in meadows and wetlands;

5. diversity and productivity of native and desired non-native plant communities in riparian zones;

6. riparian vegetation, to:
    1. provide an amount and distribution of large woody debris characteristic of natural aquatic and riparian ecosystems;
    2. provide adequate summer and winter thermal regulation within the riparian and aquatic zones; and
    3. help achieve rates of surface erosion, bank erosion, and channel migration characteristics of those under which the communities developed.

7. riparian and aquatic habitats necessary to foster the unique genetic fish stocks that evolved within the specific geo-climatic region; and

8. habitat to support populations of well-distributed native and desired non-native plant, vertebrate, and invertebrate populations that contribute to the viability of riparian-dependent communities.

A comparison between ACS Objectives of the Northwest Forest Plan and the diagnostics/ pathways and indicators used in the effects matrix.

Relation of Indicators to ACS and Aquatic/Riparian Strategy Objectives

Aquatic Conservation Strategy Objectives - Northwest Forest Plan	Aquatic/Riparian Strategy Objectives - PACFISH/INFISH.	Indicators
1,8,9	7,8	Subpop Char / Subpop Size
3,4,5,9	1,2,7,8	Subpop Char / Grow & Survi
1,2,4,6,7,9	1,2,3,6,7	Subpop Char / Life History Diversity & Isolation
2,6,9	3,6,7,8	Subpop Char / Persistence & Genetic Integrity
2,4,8,9	1,5,6,7	Water Quality / Temperature
4,5,6,8,9	1,2,3,4,5,6,7	Water Quality / Sediment
2,4,8,9	1,5,7,8	Water Quality / Chemical Concentration/Nutrients
2,6,9	3,7,8	Hab Access / Phys Barriers
3,5,8,9	2,6,7,8	Hab Elem / Substrate Embed
3,6,8,9	2,3,6,7	Hab Elem / L W D
3,8,9	2,6,7	Hab Elem / Pool Freq & Qual
3,5,6,9	2,3,7	Hab Elem / Large Pools
1,2,3,6,8,9	2,3,4,6,7	Hab Elem / Off-Channel Hab
1,2,9	7,8	Hab Elem / Refugia
3,8,9	3,7,8	Chan Cond & Dynamics / Wet Width/Max Depth Ratio
3,8,9	1,2,5,6,7	Chan Cond & Dynamics / Streambank Condition
1,2,3,6,7,8,9	3,4,5,6,7	Chan Cond & Dynamics / Floodplain Connectivity
5,6,7	2,3,6	Flow/Hydrology / Change in Peak/Base Flow
2,5,6,7	2,3	Flow/Hydrology / Increase in Drainage Network
1,3,5	2,4,8	Watershed Conditions / Road Density & Location
1,5	2,6,8	Watershed Conditions / Disturbance History
1,2,3,4,5,8,9	1,2,4,5,6,7,8	Watershed Conditions / RCA, RHCA, Riparian Reserves
1,2,4,5,6,7,8,9	1,2,4,5,6,7,8	Watershed Condition / Disturbance Regime

Appendix 3.

Interagency letters of direction (dated January 27, 1998 and February 6, 1998) regarding the conference/consultation process for bull trout.

United States Department of Agriculture Forest Service	United States Department of Interior Bureau of Land Management	United States Department of Interior Fish & Wildlife Service

File Code: 2670 (FS)/6840 (BLM) (OR-931)P
Route To: BLM-Instruction Memorandum No. OR-98-28

Date: January 27, 1998

Subject: Section 7 Coordination--Conference for Bull Trout

To: USDA Forest Service, Forest Supervisors, Regions 1, 4, and 6; Klamath and Columbia River Basins

USDI Fish and Wildlife Service Project Leaders, WA, OR, ID, and MT; Klamath and Columbia River Basins

USDI Bureau of Land Management, District Managers, WA/OR, ID, and MT; Klamath and Columbia River Basins

THIS LETTER REPLACES THE PREVIOUS DIRECTION OF OCTOBER 20, 1997.

I. INTRODUCTION

In the June 13, 1997 Federal Register (Vol. 62, No. 114) the bull trout was proposed for listing; no critical habitat was proposed at this time. It is important the USDA Forest Service (FS), the USDI Bureau of Land Management (BLM) and USDI Fish and Wildlife Service (FWS) meet their section 7 responsibilities under the Endangered Species Act (ESA) for this proposed species. For proposed species, each Federal agency is required to confer with the FWS on any actions which are "likely to jeopardize the continued existence of any species proposed to be listed ... or result in the destruction or adverse modification of critical habitat proposed to be designated for such species." (50 CFR 402.10.) Once a species is listed, consultation is required for actions that may affect listed species or critical habitat (50 CFR 402.14).

This memorandum sets forth interagency coordination agreements to ensure that the agencies' responsibilities are met for proposed species. A further goal is to efficiently prepare for potential listing of the bull trout and the agencies' responsibilities to consult on actions that may affect listed species or designated critical habitat. Both programmatic actions and project level actions of the FS and BLM will be considered. The programmatic actions are the FS Land and Resource Management Plans (LRMPs), and the BLM Resource Management Plans (RMPs), hereinafter referred to collectively as the LRMPs. Project level actions are site-specific actions undertaken by the agencies. This approach applies to those FS and BLM lands in the Klamath and Columbia River Basins.

II. CONFERENCE PROCESS

The FWS Regions 1 and 6, FS Regions 1, 4 and 6 and BLM in Idaho, Montana, Washington and Oregon will approach the conference at two scales. The first is the large scale, analogous to the area of the distinct population segments (DPS) of bull trout designated in the proposed rule. This would include evaluating the LRMPs as amended by the Interim Strategies for Managing - Anadromous Fish-Producing Watersheds in Eastern Oregon, Washington, Idaho, and Portions of California (PACFISH), and as amended by the Inland Native Fish Strategy (INFISH). In addition, in Oregon the LRMP level evaluation will consider Warner, Lost River and short nose sucker and their critical habitat.

The second scale is more local, analogous to the sub-populations described in the proposed rule to list bull trout. It involves conference at the action and watershed level. This process builds on the existing consultation direction outlined in the "Streamlining Consultation Procedures under Section 7 of the ESA" (2/26/97), where applicable (also referred to as the streamlining guidance). In addition, should critical habitat for bull trout be proposed, a conference process may also need to be developed to address that issue; it is not addressed in this memorandum.

To most efficiently prepare for potential listing of bull trout, the agencies have agreed to begin conference on LRMPs and site specific actions, existing or planned in a watershed, that may affect bull trout. Conference at this level of effect is not required by the ESA, but is being undertaken to facilitate ESA compliance if listing of the bull trout occurs. The strategy outlined here will be implemented to meet this goal. The process for conference at the two levels is described below.

A. LRMP CONFERENCE

The FS and BLM will prepare a programmatic Biological Assessment (BA) addressing current LRMPs as amended by PACFISH or INFISH and the eastside screens. The BA will also include the best scientific information available to conserve bull trout habitat in the Klamath and Columbia River Basins. Conference at this level allows an opportunity to evaluate program impacts to bull trout, as well as trends toward recovery of the species. A BA Team (Team) has been established to develop the BA, including FS and BLM representatives. This Team will coordinate with the FWS in developing the BA, through development of an initial, agreed-upon outline for the BA, and through regular meetings or conference calls to discuss the progress of the document. The FWS will also provide information for the BA regarding the status of bull trout. In addition, the FS, BLM and FWS will work together in developing the analysis and determination of effects for the programmatic BA. The tentative due date for the final joint agency BA is February, 1998, and for the formal conference opinion is March, 1998.

Components of the LRMPs which will be addressed in terms of the protection provided for bull trout will include: land allocation; standards and guidelines; goals and objectives; production levels of goods and services; key and priority watersheds; and plan implementation.

Some of the programmatic issues which will be addressed in the conference include: 1) evaluating the level of protection for bull trout provided by the key/priority watershed designations; 2) evaluating the level of protection for bull trout provided by the standards and guidelines/goals and objectives in PACFISH and INFISH, especially in terms of removing jeopardy to, preventing adverse effects to and promoting recovery of bull trout; 3) evaluating the level of protection for bull trout provided by implementation of PACFISH, based on implementation reviews already conducted; and 4) determining what constitutes adequate documentation for modification of standards and guidelines or riparian management objectives in PACFISH and INFISH.

The Team will strive for a BA and conference opinion that improves the efficiency of future conference and consultation, should the bull trout be listed. Due to the broad scale of this programmatic conference, incidental take will not be addressed at this level, but rather at the action or watershed level conference.

The LRMP conference at the "may affect" level will be undertaken as described above. As such, the level of analysis of the programmatic LRMP conference will consider not only whether the action is likely to jeopardize bull trout, but will also evaluate whether it may adversely affect the species.

B. CONFERENCE ON ACTIONS AT THE WATERSHED LEVEL

The goal of this strategy is to complete conferences for all actions by the final effective date of any potential bull trout listing. As noted above, this includes conference not only on those actions likely to jeopardize bull trout, but also those actions that may affect the DPS as described in the proposed rule to list the species. In this approach, all Federal actions underway or proposed after June 13, 1997, and that may affect bull trout will be addressed in conference, regardless of when the National Environmental Policy Act decision document was signed. Training on how to confer using the streamlining process will be provided to relevant staff from the three agencies, including Level 1 and 2 Streamlining Teams, where applicable[1].

As an initial step, actions will be evaluated to determine if they have the potential to jeopardize the continued existence of bull trout. Examples of where to begin would be a list of actions which are inconsistent with, or pre-date existing strategies such as PACFISH, INFISH and the Northwest Forest Plan. Also, actions that individually or collectively may have the potential for

---

[1]Due to staff limitations, the FWS in Montana was not able to implement the consultation direction outlined in the streamlining guidance. This issue was explained in a letter dated April 15, 1997, from Paul Gertler, Assistant Regional Director, Region 6, FWS to Hal Salwasser, Regional Forester, Region 1. As a result, the Forests and BLM Districts in Montana will confer with the FWS in accordance with 50 CFR 402.10 only for actions determined likely to jeopardize the continued existence of the Columbia River bull trout DPS. The FWS in Montana cannot undertake conference with the Federal action agencies where it has been determined that actions "may affect" bull trout until such time as the staff limitations are resolved, or the species is listed.

widespread adverse effects to bull trout populations will be considered. Those actions determined to potentially jeopardize the continued existence of bull trout must undergo conference immediately.

For "non-jeopardy" actions, the agencies agree conferences will evaluate the effects of all actions on bull trout at the watershed scale. A list of bull trout watersheds will be provided at the training on the conference approach, and also in the LRMP conference opinion. Each watershed BA will analyze the effects of actions already underway and actions proposed to take place against the watershed baseline conditions. The baseline conditions for the watershed will include the effects of actions completed prior to the effective date of bull trout listing (tentatively July 13, 1998). The effects of actions that take place after July 13, 1998, including actions with signed decisions but which may extend beyond that date, and actions proposed in the watershed, will be considered in the analysis and determination of effects portions of the watershed BA.

Conference on single actions is not encouraged in the watershed conference approach. However, the Forest or BLM District may determine there are certain high priority actions in a watershed over which they have little or no discretion on the timing of implementation. In those limited cases where such projects may occur before or close to the final listing of bull trout, the Level 1 and 2 teams can agree to separate an action from the watershed BAs for conference. The analyses of effects of that action would then need to be considered in the final watershed BA where the action occurs.

The agencies agree on the following direction for conducting bull trout conference under the streamlining guidance. Each FS National Forest (Forest) and BLM District should:

i. Initiate conferences following the streamlining guidance. The focus of discussions will be the Level 1 Team. In those areas where the streamlining process is not in place (e.g. Montana), use of the streamlining guidance is recommended as an information tool.

ii. Use the best scientific information available, including existing biological evaluations (BEs), BAs, NEPA documents, the proposed rule to list bull trout, guidance regarding determination of effects to bull trout, and any new information available to guide determinations of effect for individual actions and to develop watershed BAs evaluating the effects of all actions in the watershed.

iii. Review all actions to determine consistency with the LRMP conference opinion for bull trout and other ESA listed salmonids, and with INFISH/PACFISH, and LRMP, and Northwest Forest Plan standards and guidelines.

iv. Group and analyze the effects of all actions in each bull trout subpopulation watershed. Lists of these watersheds will be provided in training on the conference approach, and in the LRMP conference opinion. Where other listed fish species under FWS or National Marine Fisheries Service jurisdiction are present in the watershed, Level

1 teams have the discretion to alter geographic boundaries so that a single watershed BA can be prepared for both agencies and all fish species, rather than a separate watershed BA for each fish species.

v. Analyze collective effects of all actions in the subpopulation watershed. Make the appropriate determination of the effect of all actions in the watershed on bull trout (the baseline condition) as one of the following: (1) no effect; (2) may affect, and is not likely to adversely affect; (3) may affect, but is likely to adversely affect; and (4) likely to jeopardize. As noted below (Part C), these analyses should be updated when new actions are proposed in the watershed, or on a regular basis, as agreed to by the Level 1 Team.

vi. When the results of the analyses determine the actions in the watershed will have no effect on bull trout, no further conference is required, the actions can proceed as analyzed, and the determination should be documented in project files.

vii. Except as noted for Montana, when the results of the analyses determine the actions in the watershed are not likely to adversely affect bull trout, the FWS will provide a letter of concurrence within 30 days of receiving the BA which was agreed upon by the Level 1 Team.

viii. Except as noted for Montana, formal conference for actions determined likely to jeopardize or likely to adversely affect bull trout of a DPS will be conducted under the procedures and time frames for formal consultation in CFR 402.14, as modified by the streamlining guidance. A conference opinion will be developed which follows the contents and format of a biological opinion. However, the incidental take statement in a conference opinion will not take effect until the FWS adopts the conference opinion as a biological opinion, once the species is listed (see Section III below). Conference opinions or reports will be provided to the FS or BLM on all activities which have gone through this process in bull trout subpopulation watersheds.

C. CONFERENCE/CONSULTATION FOLLOWING COMPLETION OF WATERSHED BAs

The agencies agree to use the streamlining guidance to conduct conference/consultation on actions proposed in a watershed after the initial watershed BA has been developed and gone through the conference process. Similar to the conference strategy, all new actions will be analyzed in watershed BAs which update the previous watershed document. In this way, Level 1 Teams should review all proposed FS and BLM actions in watershed BAs, and single action consultations will be avoided as much as possible.

For future consultation, Level 1 Teams should analyze the effects of proposed actions on bull trout based on the following: (1) the information contained in the bull trout programmatic LRMP conference opinion; (2) the information contained in the watershed BA where the project is proposed to occur; (3) PACFISH, INFISH or Northwest Forest Plan standards and guidelines;

(4) LRMP direction for conserving bull trout or other salmonids (this includes the east side screens for R-6 National Forests); and (5) any other available scientific data or information relative to bull trout on a site-specific basis.

III. CONFIRMATION AS CONSULTATION

It is the intent of this agreement to conference such that if the bull trout becomes listed, the conference opinion on the LRMP and any completed informal or formal conferences on actions can be confirmed as meeting the requirements of section 7 consultation.

At the request of the FS or BLM, the FWS can adopt a conference opinion as a biological opinion issued through formal consultation. In order to do this, there must be no significant changes in the proposed action or the information used in the conference which reveal effects of the action that may affect bull trout that were not already previously considered. If such new information exists, the FS and BLM should present it to the FWS, together with an updated analysis of how the new information changes the determination of effect for bull trout. In those cases where there is no new information, the FWS can adopt a conference opinion or informal conference as a "consultation," either a formal or an informal, as appropriate, within 30 days of receipt of the request from the action agency. Where new information is involved, the time frame may extend to 60 days.

If you have any questions about this process please feel free to contact your agency's Regional Technical Specialist Team member, listed in the streamlining guidance.

Kathleen A. McAllister
for DALE BOSWORTH
Regional Forester
Region 1

for JACK BLACKWELL
Regional Forester
Region 4

ROBERT W. WILLIAMS
Regional Forester
Region 6

MICHAEL J. SPEAR
Regional Director
FWS, Region 1

RALPH MORGENWECK
Regional Director
FWS, Region 6

MARTHA HAHN
BLM State Director, Idaho

ELAINE ZIELINSKI
BLM State Director, Oregon/Washington

LARRY HAMILTON
BLM State Director, Montana

File Code: 2670(FS)/6840 (BLM) Date: Febuary 6, 1998

Route To:

Subject: Bull Trout Conference/Consultation Process

To: USDA Forest Service Supervisors, Regions 1, 4, and 6: Klamath and Columbia River Basins

USDI Bureau of Land Management, District Managers, WA/OR, ID, and MT, Klamath and Columbia River Basin

USDI Fish and Wildlife Service Project Leaders, WA, OR, ID, and MT

This letter is to introduce new direction for the Section 7 Coordination/Conference process for bull trout under the Endangered Species Act. The original letter of direction dated October 20, 1997, was not sent to all units because of needed clarification and is now replaced by the attached letter dated January 27, 1998. Those administrative units that did receive copies of the earlier letter are asked to please replace it with this new direction. This is also a good opportunity to let all units where bull trout occur know what is being done to help prepare for the final decision regarding listing of the bull trout.

An Interagency Team (Team) has been established to work on the Biological Assessment (BA) and associated conference opinion for the Land and Resource Management Plans (LRMP) as modified by the Northwest Forest Plan, PACFISH, and INFISH; guidelines for the completion of watershed level BAs; schedules for watershed BA training; and provide any oversight needed for the consultation/conference process. This team consists of:

F S - Rick Stowell (R-1), Scott Woltering (R-6), and Randy Hickenbottom (R-4)
BLM - Lew Brown (ID/MT), Dorothy Mason (OR/WA)
FWS - Susan Martin (ID), Ron Rhew (OR), Larry Lockard (MT), Sandy Noble (WA),and Bob Hallock (WA)

The time lines under which the Team is currently working are:

1/27	-Distribute letter regarding conference approach and schedules for training
2/13	-Draft LRMP BA completed for team review.
2/6	-Draft watershed BA guidance distributed to forests.
2/19-3/6	-Training workshops on the conference process
4/1	-Final LRMP BA completed (tentative)
4/6	-Final watershed BA guidance completed. Will incorporate comments and ideas received during the workshops
5/1	-LRMP Conference Report/Biological Opinion
5/12	-Last date for final watershed BAs to be through Level 1 process
6/13	-Final Rule regarding bull trout listing published (tentative)
7/12	-Conference/Consultation completed on watersheds/projects (30 days after final rule)

Product time lines are designed to complete the consultation/conference process before the anticipated listing of the species. By February 6, 1998, a draft guidance document designed to assist the units in the development of the watershed level BAs will also be distributed to Level 1 and 2 teams.

In order to accomplish the consultation process by the tentative listing date of June 13, 1998, it will be extremely important that units be trained in the application of the watershed BA guidelines. A series of training sessions are planned for the month of February. Dates, locations, and units for these meetings are as follows:

Meeting Location	Meeting Date	BLM/FS Unit Attending
Bend Bend Armory 875 SW Simson Ave.	March 5-6	Klamath, John Day, Fremont, Winema, Mt. Hood, Malheur, Willamette, Umatilla, Ochoco and Winema NF, Col. Gorge NRA, and Central Oregon, Deschutes, Malheur, Jordon, Klamath Falls, McKenzie, 3 Rivers RAs and Salem District
Spokane Ramada Inn Airport	March 2-3	Idaho Panhandle, Colville, Clearwater, Nez Perce, Wenatchee, Gifford Pinchot, Okanogan NFs, and Border, Cottonwood, Wenatchee, and Emerald Empire RAs
Missoula Ruby's Reserve Street Inn	February 19-20	Kootenai, Flathead, Lolo, Bitterroot, Beaverhead/Deerlodge, Helena NFs, and Garnet RA
Boise Natural Resources Center 1387 Vinnell Way	February 23-24	Payette, Salmon/Challis, Sawtooth, Boise, Wallowa-Whitman, and Humbolt/Toiyabe, NFs and Upper Snake River, Baker, Lemhi, Jarbridge, Cascade, and Challis RAs

Due to the large size of these meetings, we are limiting attendance to Level 1 and 2 team members and hydrologists only not to exceed five participants per unit. The agenda and full meeting information will be sent under separate cover by the meeting coordinators by the end of February 9th. In the mean time plan from 10am to 5pm the first day and 8am to 3pm the second day.

Since the time to complete the watershed-level BAs is short and the draft guidance and training will not be available until February 1998, it would be advisable for each unit to start compiling the data necessary to complete the Assessments now. The Team recommends that the units start this work by following the direction contained in the NMFS Matrix for steelhead. It is anticipated that the final direction for bull trout will be similar enough to NMFS Matrix to avoid major changes in final watershed BAs. By doing this the units will be prepared to meet the short time frames for completing conference by the tentative listing date. The NMFS matrix is available through your State Biologist (BLM) or Regional Fisheries Program Leader (FS).

If you have additional questions, please contact your appropriate Team Member: Rick Stowell (406)329-3287, Scott Woltering (503)808-2669, Randy Hickenbottom (801)625-5664, Lew Brown (208)769-5040, Dorothy Mason (541)523-1256, Sandy Noble (509)548-7573, Bob Hallock (509)921-0160, Susan Martin (208)378-5348, Ron Rhew (503)231-6179, or Larry Lockard (406)758-6868.

Kathleen A. McAllister

KATHLEEN A. MCALLISTER
Deputy Regional Forester

Enclosures

concur: N.Steward 1/6/98
Iconcur:M.Prather 1/6/98

Appendix 4.

October 28, 1997 letter to Russ Strach (NMFS) from Jack Williams (BLM).

Appendix 4 - Memorandum on Consistency with LRMP Guidelines(October 28, 1997, Memorandum from Jack Williams, BLM, to Russell Strach, NMFS)

October 28, 1997

MEMORANDUM

To: Russ Strach, NMFS, Boise

From: Jack Williams, BLM, Boise

Subject: LRMP Expected Outcomes

This responds to expectations are described the National Marine Fisheries Service in the LRMP Biological Opinion and the PACFISH extension letter. These responses are primarily the same as provided by FAX to National Marine Fisheries Service on October 9 with only minor editing by myself.

These responses include comments from Steve Kozel on broad-scale questions, and from Dave Burns, Paul Boehne and I on project and watershed-scale questions. Dave Burns sent a draft of his comments to Lee Jacobson of the Boise NF and Scott Russell of the Nez Perce NF for review. He tried to incorporate their thoughts as well. Paul Boehne surveyed staff of the Wallowa-Whitman and Umatilla National Forests for implementation of the LRMP Opinion for site specific projects. These responses are based on incomplete surveys but are intended to be representative of the project specific and watershed specific projects. I also report on relevant observations from the PACFISH Implementation Team.

I. Relative to long-term strategy development.

The DEISs were released to the public in June, 1997. The public comment period will end February 6, 1998. The Final EIS is expected in late summer or early fall 1998. The NMFS has been a partner in development of the DEISs and provided input on the selection of the preferred alternative.

I.1. Relative to long-term conservation.

The Forest Service and BLM propose to develop and implement a coordinated, scientifically sound, ecosystem based management strategies to achieve the following: 1) restore and maintain habitats of plant and animal species, especially those of threatened, endangered, and candidate species (this would be

done primarily by moving toward desired ranges of landscape conditions at a sub-regional and regional ecosystem basis); 2) provide long-term management direction to replace interim strategies such as PACFISH; 3) provide consistent direction to assist federal managers in making decisions at a landscape level within the context of broader ecological considerations; and 4) emphasize adaptive management over the long term.

I.2. Relative to guidance in development of EISs.

Ecological goals, objectives, and guidelines identified in the LRMP Biological Opinion and the preliminary draft Snake River Salmon Recovery Plan were considered in development of the alternative management strategies. These elements or modifications of these elements can specifically be found in the seven alternatives under Desired Ranges of Future Condition, Objectives, Standards, RMOs, and Riparian Conservation Areas (RCAs).

I.3. Relative to geographic application of objectives.

Currently, aquatic and riparian management objectives found in Alternatives 3 through 7 apply to all Forest Service and BLM administered lands.

I.A. Relative to overall goal of strategy.

One of the five goals for Alternatives 3 through 7 is to contribute to recovery and delisting of threatened and endangered species. To accomplish this goal, each alternative emphasizes maintenance and restoration of aquatic and riparian functions and processes that create or sustain habitat for aquatic species. Each alternative differs in strategy and risk to aquatic species and habitat.

I.B.1. Relative to objectives being same as in PACFISH.

Each alternative contains aquatic and riparian management standards that are intended to prevent further degradation to aquatic habitat. These standards apply to all Forest Service and BLM administered lands regardless of aquatic species. Management activities must comply with these standards. Some alternatives vary in the level of management flexibility embedded within standards.

I.B.3. Relative to providing priority to high-quality watershed network.

The aquatic scientific assessment identified and ranked subbasins (4th field hydrologic units) according to the integrity of species and habitats. Typically these subbasins of highest integrity contained a high abundance of aquatic species strongholds where connectivity was unimpeded. They also identified subbasins where aquatic strongholds were numerous but conditions could be improved through restoration to allow fuller expression of life histories. The EIS team used this information in developing management objectives for each of these subbasin types for Alternatives 3 through 7 that emphasize conservation and restoration.

I.B.4. Relative to need to provide high-quality over time.

The scientific assessment of the project area described historic and current conditions for natural disturbance regimes, changes in current conditions due to anthropogenic forces and project future ecosystem trends. Based on this information and issues developed through public scoping, the EIS developed alternatives using different management strategies to maintain and restore long-term forest, rangeland, aquatic, and riparian ecosystem health.

I.B.5. Relative to short-term strategies.

The PACFISH strategy has been implemented by BLM and Forest Service to prevent further declines and maintain long-term options. PACFISH implementation has not precluded options.

I.B.6. Relative to items for comprehensive strategy.

The long-term strategies within the DEIS alternatives contain elements identified on page 68 and 69. The alternatives vary these elements based on the theme of the alternative. In addition some items identified as complete have been modified in some alternatives based on scientific information and issues.

I.C. Relative to consistency of ecological goals.

Ecological goals or modifications are found under the Desired Range of Future Condition for the various alternatives. The Desired Range of Future Condition is a projection of long-term condition of the land expected to result in 50 to 100 years if management objectives are achieved.

I.D.1.Relative to implementation of RMOs.

Proper implementation of PACFISH RMOs is a primary question during all PACFISH field reviews and implementation reports. The PACFISH Implementation Team has prepared a questionnaire that is to be completed if RMOs are modified. The Questionnaire asks about the quality of data available to make the change, rationale for the change, etc. In general, most units used default RMOs during the first year of PACFISH and we have seen a greater tendency to modify RMOs during subsequent years based on results of watershed analysis and site specific analysis. Nonetheless, default objectives are widely used.

RMOs have been known to be implemented where sufficient data have been collected to know habitat condition and trend. However, sufficient data have not been available for some ongoing projects, especially small scale activities like special use permits. Some floods and fires have required short term emergency response that precluded timely inventory of changed conditions. For example, road repairs to provide reasonable access to private property after the January 1997 storms did not allow time for data acquisition so that data supported reconstruction of some road segments; an example of the latter is for the Payette National Forest road up Lake Creek, a Salmon River tributary near Riggins, Idaho. The expectation that data would be available, especially for an 18 month PACFISH implementation is probably not realistic.

The Nez Perce National Forest continues to use Forest Plan desired future condition values similar to RMOs. They have not changed to use the RMO values based on their assumption that the locally generated numbers are more accurate. No analysis of this assumption has been conducted.

For the Wallowa-Whitman and Umatilla forests, RMO's have been implemented on a project specific and watershed specific basis. RMO's have been adjusted using site specific data on a few projects and have been reviewed and agreed to by the Level 1 streamlining teams.

I.D.2. Relative to degradation of RMOs.

In general, areas where existing conditions exceed default RMOs are managed as roadless, wilderness or other special management category. With the exception of some roadless areas affected by salvage timber harvest, RMOs have not been degraded even where they exceed PACFISH standards.

limitations cited above, it is not always possible to conduct watershed analysis. Exceptions occur due to mines, emergency actions related to fire and floods, access to private property, and exceptions occur for other similar reasons.

Most ICBEMP alternatives vary on the process for modification of Riparian Conservation Area widths. For example in Alternative 4 widths can only be modified after completion of ecosystem analysis at the watershed scale while in Alternative 6 site specific analysis can be used to modify widths in some areas.

PACFISH allows for modification to RHCA using watershed analysis or site-specific information. In general, information at both the watershed and site scales are needed. Watershed analysis places the broader context on RHCAs and defines whether changes are appropriate and in which direction (reducing or expanding RHCAs). Site-specific information is needed to define precisely where the new RHCA boundaries should be.

On the Wallowa-Whitman and Umatilla forests, RHCA widths have not been reduced without a watershed analysis and a site specific analysis.

I.F.1. Relative to size of priority areas.

For broadscale response see item I.B.3.

I.F.2. Relative to identification of priority areas.

For broadscale response see item I.B.3. These criteria were not explicitly used in the development of subbasin categories. Instead, aquatic species presence, population strength, and native species assemblages information and general knowledge about subbasin condition was used in developing the categories. Habitat condition information was not available for all areas within the project area.

I.F.3.A. Relative to RMOs risk should be minimized.

True risk minimization seldom occurs. In practice the minimization of risk has been limited by jurisdiction and timing of administrative actions as cited above. For example, mitigation measures were provided for fuel haul to the Stibnite mine area as part of reasonable and prudent alternatives resulting from consultation; these measures have apparently been successful at avoiding a large scale fuel spill, but enabled other land disturbing actions. An example of the latter are

Conditions were degraded by some actions. For example, at the Stibnite mine area on the Payette National Forest, the Garnet Creek pit was mined within 50 feet of a perennial stream. This resulted in a landslide entering the RHCA. Similarly, sheep grazing on the Payette National Forest in the Lake Creek, Secesh River, watershed occurred in the immediate vicinity of the stream and some sediment was visibly added. On the Nez Perce National Forest predicted or modeled habitat degradation was shown for the Cove/Mallard timber sales and Hurley Creek road access. Other examples exist and will be cited later. So long as the verbiage is a "should" rather than a "will", relatively more exceptions can be expected. Exceptions have occurred due to permit violations, administrative error and limited discretion on the part of the Forest Service.

For the Wallowa-Whitman and Umatilla forests, RMO's have not been degraded. Where changes have been made to RMOs the changes are based on site specific data that represents the best known conditions (near potential) for that stream type in that specific subwatershed. The data from stream surveys were assessed using the techniques of McKinney et al. (1996).

I.D.3. Relative to insuring that actions do not retard RMOs.

So long as the verbiage is a "should" rather than a "will", relatively more exceptions can be expected. Exceptions have occurred due to permit violations, administrative error and limited discretion on the part of the Forest Service.

For Wallowa-Whitman and Umatilla forests, all proposed actions were designed to ensure actions did not degrade or prevent attainment of RMOs.

I.E.1. Relative to RHCA management.

Alternatives 2, 3, and 7 of EISs have similar Riparian Conservation Areas as PACFISH. Riparian Conservation Areas in Alternatives 4, 5, and 6 differ from PACFISH. Each alternative contains management objectives and standards for conservation and restoration of Riparian Conservation Areas.

I.E.2. Relative to reducing RHCA widths based on site specific analysis poses a risk.

There is broad agreement that risk increases without watershed analysis unless actions are very limited in scope and excellent local knowledge is available. However, because of the time-frames needed for data acquisition combined with administrative

those actions that resulted in "show cause" letters from the Forest to the mine in September 1997, and an alleged violation of water quality regulations affecting critical habitat in 1997.

Another mechanism that does not result in literal minimization of risk are those decisions to take risk in spite of existing guidance. The clearest examples occurred due to salvage logging under the Recision Bill in the South Fork Salmon River watershed. Forests decided to log and support that logging with fuel haul. True risk minimization would have precluded these actions under Forest Plan direction. The result was a decision and project implementation contrary to absolute risk minimization. At least two accidents occurred; one accident resulted in a truck going into a perennial tributary of Warren Creek and fuel spill; another accident resulted in a truck directly entering the South Fork Salmon River south of Goat Creek. In neither case lethal effects were observed, but sub-lethal effects were not monitored. Fuel haul enabled salvage logging within areas of subsequent channelized erosion or debris torrents in the lower South Fork Salmon River; this removed large durable tree boles from those areas decreasing long term stabilizing effects. In addition, the road mileage scheduled to receive sediment reduction as mitigation has not been completely treated due to timber sale purchasers claiming the "prudent operator concept." Some reduction in risk to salmon and steelhead was provided by mitigation measures including Jersey barrier installation, and road graveling, but all increased risks due to project implementation could not be avoided. Data limitations, administrative uncertainty and uncertainty of RHCA definition contributed to increased discretionary risk taking.

For the Wallowa-Whitman and Umatilla, risks have been minimized and good habitat maximized through mitigation and avoidance measures in project proposals, Level 1 streamlining consultation, and implementation of those proposals.

For the broadscale, the management objective for Category 1 subbasins under Alternatives 3 through 7 is conservation while in Category 2 subbasins it is conservation and restoration. Management standards apply to all subbasin categories and are intended to minimize adverse affects to aquatic and riparian resources. In addition, ecosystem analysis is required in Category 1 subbasins prior to management actions that require an Environmental Assessment or Environmental Impact Statement.

I.F.3.B. Relative to reducing risk from aggregated land use.

The DEISs in ICBEMP do not contain a quantitative cumulative effects process or direction for its development.

I.F.3.C. RMOs actions known...should be avoided.

For the Payette, Nez Perce and Boise forests, management actions known to cause direct negative affects to listed salmon have been minimized. Most management actions are reviewed and modified as needed so that a "not likely to adversely affect" determination is made. Only 17 site-specific formal opinions have been conducted and very few of these have resulted in jeopardy determinations.

For the Wallowa-Whitman and Umatilla, actions known to cause direct or indirect affects have been avoided. This has been carried out through site specific project planning mitigation and avoidance and implementation of those projects.

Also, see prior discussion for F.3.A.

I.F.4.A. Relative to changing RMOs only if watershed capabilities cannot support initial values.

Few watershed analyses have been conducted in Idaho. Data limitations described above have not resulted in reduced RMO values.

For the Wallowa-Whitman and Umatilla forests, RMO values were only changed after a WA was completed and the site specific streams in subwatersheds were assessed using the technique as described by McKinney et al. (1996) and reviewed by the Level 1 streamlining team.

I.F.4.B. a through d. Relative to additional RMOs in priority watersheds.

Data limitations described above have not resulted in reduced RMO values in Idaho.

For the Wallowa-Whitman forest, a fine sediment standard of 20% was adopted. Site specific projects identified reduction of sediment delivery as a major issue and mitigation and avoidance measures identified to reduce sediment delivery. The Umatilla National Forest does not use a fine sediment standard.

For the Wallowa-Whitman and Umatilla forests, cobble embeddedness has been adopted at 30% in rearing habitat. Monitoring has taken place which measures the embeddedness each year to assess this RMO using both ocular estimate through the Level 2 stream surveys and direct measurement. Width/depth ratios have been stratified by Rosgen channel types and adopted. This has been done for project specific streams and through some watershed analyses. Streambank stability has been adopted at 90% stable stream banks.

The additional RMOs identified in the LRMP BiOp were included in Alternative 7 of ICBEMP except for the width/depth ratio recommendation and the existing lower bank angle measure. Some of these recommendations were also included in other alternatives. The project also developed RMOs from science assessment data and displayed these values as an option for Alternatives 4 and 6. Work is in progress to better define scale specific RMOs, processes for modification, and use criteria. As currently defined in the DEISs, RMOs would apply to all lands administered by the Forest Service or BLM.

I.F.5.A. Relative to priority watersheds should have "de minimus" risk.

The Biological Assessment points out that this has not occurred. At least half of the Biological Opinions for federal actions that were likely to adversely effect listed salmon occurred in priority watersheds. "De minimus" risk refers to those actions that are not likely to have adverse effects and to which NMFS concurs.

For the Wallowa-Whitman and Umatilla forests, actions have been planned and implemented to pose no more than a de minimis risk of adverse effects to listed salmon. Actions submitted to Level 1 teams have a determination of NLAA with mitigation or avoidance measure planned into projects to avoid adverse effects.

Each ICBEMP alternative contains aquatic and riparian resource objectives and standards that are intended to conserve and restore watershed and aquatic habitats and minimize short term adverse effects. These management requirements apply to all Forest Service and BLM administered lands. In addition, in all action alternatives (3-7) ecosystem analysis at the watershed scale is required prior to project implementation in Category 1 subbasins. Ecosystem analysis is also triggered for other aquatic issues in the action alternatives. The extent of ecosystem analysis varies by alternative.

I.F.5.B. Relative to aggregated actions should have a high probability ...

On the Wallowa-Whitman and Umatilla forests, where watershed analyses have been completed and the cumulative effects analysis for projects have been completed, the assessment has been made

that demonstrates a high probability that high quality habitat will be maintained, expanded and reconnected.

Also see above.

I.F.5.C. a through d. Relative to guidelines that should be followed.

On the Wallowa-Whitman and Umatilla forests, guidelines for mining, timber and roads have been implemented.

Also see above.

I.F.5.C.d.ii. Project staff provided NMFS with a map of potentially unroaded areas greater than 1,000 acres. This map was based on projections of road densities from mid-scale sub-sampling information. No items were included on the map. This map should be used with caution since it is based on estimates of road density. Proposed road construction in the next two years was not evaluated because the project had no information to base any projections. (I believe Jeff Lockwood was given a copy of the map. This needs to be confirmed. This item is also a broadscale and project issue.)

For the Wallowa-Whitman and Umatilla forests, roadless areas have been evaluated through Watershed Analysis. Watershed Analysis has not been completed for all areas and as such not all roadless areas have been evaluated.

I.F.5.C e. Relative to restoration.

Restoration has been conducted as budgets allow and emphasis has been placed on priority watersheds. However, as noted in the Biological Assessment, restoration lags behind Forest Plan direction in some critical areas.

For the Wallowa-Whitman and Umatilla forests, restoration has been focused primarily in Priority Watersheds. Restoration has proceeded on schedule.

I.G.1. Relative to eliminate or restrict access during spawning...

Certain access has been limited, but administrative limitations have resulted in incomplete effectiveness. For example on the Sawtooth National Forest in the upper Salmon River recreational and commercial floating has been restricted. Closure of dispersed camping and campgrounds has occurred in some areas. This has not eliminated take. For example, a person was recently prosecuted for spearing salmon on the Poverty spawning area in the South Fork Salmon River. Some measures identified in prior consultation have not been implemented. For example, the ford in the upper Big Creek spawning area (Middle Fork Salmon River) is not yet eliminated. So long as the verbiage is a "should" rather than a "will", relatively more exceptions can be expected.

Actions have been taken to eliminate or adequately restrict access to spawning habitats and redds. Actions include closures to recreational activities and restrictions to livestock use in timing and location.

On the Wallowa-Whitman and Umatilla forests, access to spawning habitat and redds has been limited for recreational users through campground closures and removal, fencing of streams to prevent livestock trampling and road closures or obliteration to prevent off-road vehicle use in these areas.

For ICBEMP broadscale issues, see response to I.F.5.

I.G.2. Relative to minimizing risk from fuel haul.

For the Wallowa-Whitman and Umatilla forests, transport of toxic chemicals has not been restricted through RHCAs as most routes are parallel or cross RHCAs. Most precautions have been taken and documented in BAs and reviewed through Level 1 streamlining teams.

See also previous discussion regarding risk.

I.G.3. Relative to water convevance.

Not all authorizations have been brought into compliance with this guidance. The Forest Service has limited discretion regarding some actions such as Ditch Act easements. Some actions could not be brought to a condition so as to be not likely to adversely effect listed salmon or critical habitat. For example, consultations regarding Yantis Ditch and the Delbaere-Campbell ditch are based on adverse effects.

On the Wallowa-Whitman and Umatilla forests, screens on intakes have been assessed and screened to meet NMFS requirements. Permits issued after assessment of instream water needs have been assessed for downstream needs of listed salmon.

I.G.4. Relative to mining management.

The Wallowa-Whitman and Umatilla forests report that mining operating plans have been reviewed with conditions generally adhered to by the miner to protect existing fish habitat.

See also prior discussion.

I.G.5. Relative to fire suppression.

For the Idaho forests, emergency consultation on fires has been initiated in most situations. Reviews have been conducted and

are reported to the NMFS as part of consultation records for prescribed fire in many cases. However, reports on all actions have not been received by NMFS.

For the Wallowa-Whitman and Umatilla forests, an outline of salmon protection responsibilities for Overhead Teams has been submitted to NMFS each year before June 1. This has taken place at the Regional or Tri-Regional level. The review of suppression and rehabilitation activities has taken place following each large fire. Reports have been submitted to NMFS which describe the fire, suppression activities and rehabilitation and their success.

I.H. Relative to procedural guidelines for watershed BAs.

On the Boise, Payette and Nez Perce forests, project screening was completed by approximately April 1995. Most units reported medium to high success in successfully completing the screening process. Often the documentation for decisions was poor, however, upon review by the PACFISH Implementation Team a large portion of the decisions made appeared to be appropriate.

For the Wallowa-Whitman and Umatilla forests, PACFISH screening took place and was completed by March, 1995. Priority watersheds were identified.

See also discussion in the Biological Assessment.

I.I. Relative to monitoring and reporting.

An interagency PACFISH Implementation Team was formed to monitor PACFISH implementation and to assist field units in compliance. The NMFS, FWS, BLM, and Forest Service have been active participants in the Team. Each year, the Team has compiled written implementation reports from each unit and conducted field reviews of selected units in the fall. Written reports have been submitted to NMFS annually.

The DEISs for ICBEMP do not contain a specific monitoring plan however requirements found in all action alternatives direct the Forest Service and BLM to develop an integrated intergovernmental monitoring and evaluation protocol. At a minimum key ecosystem health indicators that transcend multiple planning scales should be assessed and reported to determine progress in meeting objectives. State and Regional offices would be responsible for oversight and development and implementation of annual monitoring programs. The monitoring direction contains a feedback loop that would require administrative units to modify actions if objectives are not be met due to agency actions. Since a

monitoring plan has not be developed, the monitoring guidelines in the LRMP BiOp cannot be compared or evaluated.

I.J. Relative to watershed analysis.

Most Forests and Districts have been actively completing watershed analyses. Few watershed analyzes are completed for Idaho. Exceptions on the Boise, Nez Perce, and Payette National Forests include the upper South Fork Salmon River, Johnson Creek, the East Fork South Fork Salmon River, Elk Creek, and Slate Creek. Most Forests have completed between 30 to 70% of their watersheds. Completion of watershed analysis has been slower on BLM lands, in part because of lack of models to follow in rangeland habitats. Recently completion of the Herd Creek WA now provides this model.

I.K. Relative to additional guidelines for fall chinook.

A cumulative effects analysis for the Clearwater River will not be conducted by the ICBEMP project.

I.M. Relative to long-term approaches for management.

Item 1. See response to I.B.1., I.B.2., I.B.3., I.B.4., I.B.5, and I.B.6.

Item 2. The scientific assessment includes information on historic conditions and disturbance regimes. Comparisons of historic to current aquatic habitat condition were made if information was available. Conclusions were then made as to why changes may have occurred and the role of human induced disturbance in these changes.

Item 3. The current desired range of future conditions for each alternative are a qualitative description of the expected condition if objectives are achieved. The RMO value options for Alternatives 4 and 6 do contain ranges that reflect near natural conditions.

The aquatic science team used some landscape features to predict of salmonid presence if it was unknown.

I.M. Item 4. See response I. B. 3.

I.M. Item 5. Currently, the DEISs would not revise current allocations due to the broadscale nature of information. Allocations would be made during forest plan revision.

I.M. Item 6. This element has not be included in the current DEIS direction. However, it may be incorporated during the development of the monitoring plan.

I.M. Item 7. See response I. I.

I.M. Item 8. The DEISs' current direction place a strong emphasis on collaboration with states, counties, federal agencies, tribes, and other stakeholders in accomplishing conservation and restoration objectives.

I.M. Item 9. See response I. 1.

I.M. Item 10. This recommendation has been included in Alternative 7.

PACFISH Extension Letter.

1. See response I. F. 5. C. d. ii.

2. This was completed for the Wallowa-Whitman and Umatilla.

3. The Umatilla National Forest responded to PACFISH deficiencies by report dated August 12, 1996 to the Regional Forester. They outlined procedures to insure that PACFISH is properly implemented. Progress has been noted in field implementation during 1996 and 1997. The PACFISH Implementation Team is preparing field review for Umatilla National Forest on November 4-6, 1997 to field check progress.

4. PACFISH implementation reports have been submitted for 1995 and 1996 field seasons and are in preparation for 1997

5. Interagency Level 1 teams are in place and functioning as designed

To the best of our knowledge, any departures from guidelines have been documented as appropriate.

6. Although inconsistencies remain among administrative units relative to their proper implementation of PACFISH, overall performance has improved for BLM and Forest Service. Director and Chief have sent follow up memoranda to Regional Executives on the importance of proper implementation of PACFISH. Importance of proper implementation of PACFISH is stressed during performance appraisals of Regional Executives and during field visits.

7. PACFISH remains in place until such time as long-term management strategies are developed by ICBEMP. PACFISH will remain in place at least through 1998 field season. PACFISH is being followed and implemented with deficiencies being corrected and will be until the amendments or modifications by ICBEMP EISs.

Appendix 5.

Habitat Characteristics Important to Bull Trout (Temperature, Habitat Complexity, Connectivity, Substrate Composition and Stability), and Management Issues (Roads, Floodplain and Riparian Protection) That Affect These Habitat Characteristics.

Appendix 5. Habitat Characteristics Important to Bull Trout (Temperature, Habitat Complexity, Connectivity, Substrate Composition and Stability), and Management Issues (Roads, Floodplain and Riparian Protection) That Affect These Habitat Characteristics

---

The organization of each Habitat and Management issue is as follows:

- **Problem Assessment**--Habitat and Management condition relative to bull trout.
- **Biological Needs**--bull trout biological requirements relative to the issue.
- **Objectives**--specific to issue type.
- **Caution Zone**--areas where land management activities have the greatest potential to adversely affect bull trout. We have adopted the "caution zone" from the Montana Bull Trout Scientific Group's report "The Relationship between Land Management Activities and Habitat Requirements of Bull Trout" (MBTSG 1998). We have identified caution zones for each issue, often using the 100-year floodplain plus one site-potential tree height distance on either side of the stream. For some issues, such as roads, the entire watershed is identified as the caution zone. One site-potential tree is approximately 150' on the west side of the Cascade Mountains; 90' to 150' on the east side dependent on forest Potential Vegetation Type (PVG = cold, moist, or dry).

  The 100-year floodplain was chosen based on the need to fully incorporate the channel migration zone (CMZ) on low gradient alluvial streams. These stream channels provide critical spawning and rearing habitat for bull trout. An additional 150 feet on either side of the 100-year floodplain is required for the following reasons: 1) it encompasses one site-potential tree height at most locations; 2) provides sufficient width to filter most sediment from non-channeled surface runoff from most slope classes; 3) provides some microclimate and shallow groundwater thermal buffering to protect aquatic habitats inside the channel and the channel migration zone; and 4) provides an appropriate margin error for unanticipated channel movement, hillslope and soil stability, blowdown, wildfire, operator error, disease, and certain other events that may be difficult or impossible to foresee on a site specific basis (MBTSG 1998).

  The caution zone may include non-fish bearing tributaries, seeps, springs, and wetlands in order to capture the linkages in a watershed critical to aquatic system function: stream, riparian, and sub-surface networks (Stanford and Ward 1992). In the caution zone the site-potential tree distance is measured horizontally from the edge of the floodplain.

TEMPERATURE

Problem Assessment

Bull trout distribution is strongly influenced by water temperature (Ratliff 1992; Rieman and McIntyre 1993, 1995; Bonneau and Scarnechia 1996; Lee et al. 1996; Buchanan and Gregory 1997), and they are found to be associated with the coldest stream reaches in basins (Lee et al. 1997). Researchers recognize temperature more consistently than any other factor influencing bull trout distribution (Rieman and McIntyre 1993). Thermal barriers have contributed to the disruption and fragmentation of bull trout habitat (WDFW 1997; Buchanan et al. 1997; MBTSG 1998; EPA 1997). Increases in stream temperatures can cause direct mortality, displacement by avoidance (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 62 FR114 Proposed Rule; MBTSG 1998). Brook trout, which interbreed with bull trout, may be more competitive than bull trout and displace bull trout in drainages containing more fine sediment and higher temperatures (Leary et al. 1991; Clancy 1993).

Many areas within the species range have temperature regimes that exceed levels identified as necessary to support various life stages of bull trout (Montana Dept. of Health and Environmental Sciences 1994; Oregon Dept. of Environmental Quality 1996; EPA 1997; Washington Dept. of Ecology 1998). For example, in Washington, the current State temperature criteria are inadequate to protect bull trout (WDOE 1998); in 1996, EPA disapproved Idaho's standards after concluding they were inconsistent with the Clean Water Act (EPA 1997); and in Oregon, as recently as 1995 bull trout and other cold water species were not protected by Oregon's threshold temperature standards (Buchanan and Gregory 1997).

Biological Needs

Bull trout and other char often thrive in waters too cold for other salmonid species (Balon 1980). Although preferred water temperatures vary by life history stage, consistently cold water is required at all critical life history stages (spawning, incubation, rearing, overwintering).

- Spawning is initiated in the fall as temperatures drop to 9-10°C (McPhail and Murray 1979; Fraley and Shepard 1989; Riehle 1993), although the threshold for char spawning in north Puget Sound is believed to be 8°C (Kraemer 1991).

- Survival of incubating eggs has been found to be optimal at constant exposure to 2-4°C water, with mortality increasing markedly above 8°C (McPhail and Murray 1979; Weaver and White 1985). From egg deposition to emergence, juvenile bull trout may reside 220 or more days in the gravel.

- Optimal juvenile rearing temperatures range between 4-10°C (Buchanan and Gregory 1997).

- For migratory corridors, bull trout require water temperatures ranging between 10-12 °C (Buchanan and Gregory 1997; McPhail and Murray 1979).

Temperature criteria are based on the consecutive 7-day average daily maximum temperature standards consistent with EPA water quality standards for Idaho (EPA 1997).

Objectives

- Maintain or restore temperature regimes that are optimal to support bull trout at all life history stages, including historic migratory corridors that will be necessary for reconnecting fragmented subpopulations.

- Maintain and restore the cold water temperature contribution of intermittent and non-fish bearing streams to bull trout streams.

- Decrease the risk of invasion and displacement by introduced species, by preventing increases in water temperature.

- Provide or maintain sufficient thermal refugia (deep pools, tributary confluences, groundwater influences) to support residence throughout summer months.

- Protect all ground water sources (seeps, springs, wetlands, hyporheic zone) that may influence stream temperatures.

- Maintain and restore water quality within a range that maintains the biological, physical, and chemical integrity of the bull trout watershed.

Caution Zone

100-year floodplain plus one site potential tree distance, including tributaries that provide or have potential to provide thermal refugia, wetlands, and groundwater (seeps and springs) sources that provide cool water (USDA et al. 1993). USDA et al. (1993) indicated that stream buffers may need to be wider for maintaining microclimate than for other riparian functions. The contribution of microclimate to stream temperature is an area needing further research.

HABITAT COMPLEXITY

Problem Assessment

Land management activities can alter processes that create and maintain riparian and aquatic habitats, often resulting in reductions of habitat complexity and the diversity of aquatic species (USDA et al. 1993; Elmore and Beschta 1987). In watersheds containing bull trout, changes in habitat features associated with reductions in habitat complexity include decreases in: large woody debris, pool quality, channel stability, substrate quality, groundwater inflows, and suitable habitat serving as corridors between habitat patches (e.g. resulting from increases in water temperature [MBTSG 1998]).

Large pools, consisting of a wide range of water depths, velocities, substrates, and cover, are characteristic of high quality aquatic habitat and an important component of channel complexity. Moreover, bull trout are associated with large, deep pools (Watson and Hillman 1997). Large pools have been lost in many tributaries of the Columbia River in the past 50 years (Sedell and Everest 1991; USFS 1996; McIntosh et al. 1994). Overall, there has been a 58 percent reduction in the number of large, deep pools in resurveyed streams in National Forests within the range of the Northern Spotted Owl in western and eastern Washington (USDA et al. 1993). A similar trend is apparent on private lands in coastal Oregon where large, deep pools decreased by 80 percent (USDA et al. 1993). In western Washington, Bisson and Sedell (1984), reported a similar loss of pools in basins with moderate to intensive levels of timber harvest has been reported. Historical grazing practices in eastern Oregon have contributed to degraded riparian zones with reduced summer flows, unstable and eroding stream banks, and reduced productivity for fish and wildlife (Elmore and Beschta 1987). Reduction of wood in stream channels, either from present or past activities, generally reduces pool frequency, quality, and channel complexity (House and Boehne 1987; Bisson et al. 1987; Spence et al. 1996). Road construction and timber harvest on unstable slopes can result in the loss of pools due to mass wasting and sedimentation (Morrison 1975; Swanson and Dyrness 1975; Betcha 1978; Swanson et al.1981; Ziemer and Swanston 1977; Ketcheson and Froehlich 1978, Marion 1981; Grant and Wolff 1991; Coats 1987; Janda et al. 1975; Kelsey et al. 1981; Madej 1984; Nolan and Marron 1985).

Large woody debris (LWD) in streams enhances the quality of habitat for salmonids and contributes to channel stability (Bisson et al. 1987). LWD creates pools and undercut banks, deflects streamflow, retains sediment, stabilizes the stream channel, increases hydraulic complexity, and improves feeding opportunities (Murphy 1995). By forming pools and retaining sediment, LWD also helps maintain water levels in small streams during periods of low stream flow (Lisle 1986 cited in Murphy 1995).

Cover is another important component of habitat complexity that is utilized by bull trout at all life-history stages. Cover can include woody debris, overhanging vegetation, undercut banks, cobble and boulder substrate, water depth and turbulence, and aquatic vegetation (Murphy 1995; Goetz 1991; Pratt 1984; Pratt 1992; Hoelscher and Bjornn 1989; Graham et al. 1981). Past land management activities have reduced cover through reductions in riparian vegetation and associated decreases in woody debris recruitment, declines in pool size and frequency, stream

clean-up activities that removed woody debris, splash dams, and declines in shrub lands (Narver 1971; Bisson and Sedell 1984; Sedell and Luchessa 1982; Sedell et al. 1991; Lee et al. 1997; NMFS 1991).

Biological Needs

Complex aquatic habitats are necessary to accommodate the diverse needs of various salmonid species (Murphy 1995; Spence et al. 1996). Complex habitats not only provide salmonids with critical habitat for all life-history stages in freshwater, but provide refuges from environmental variability (e.g. extreme flows) and stochastic events (e.g., catastrophic fires), buffering populations from the effects of environmental perturbations (Seddell et al. 1990; Rieman and McIntyre 1993). Because most bull trout spend their entire life in freshwater, they are more sensitive to habitat disturbance than anadromous salmonids (Balon 1980; Rieman and McIntyre 1993). Bull trout are strongly associated with various components of habitat complexity, including cover, large woody debris, side channels, undercut banks, boulders, pools, and interstitial spaces in coarse substrate (Jakober 1995; Rieman and McIntyre 1993; MBTSG 1998).

Several life history features of bull trout make them particularly sensitive to activities directly or indirectly affecting stream channel integrity and natural flow patterns (MBTSG 1998). Examples of these life history features and their association with habitat complexity are:

- An extremely long period from egg incubation to fry emergence from the gravel (220 days or more during winter and early spring);
- Strong association of juvenile bull trout with streambed cobble and substrates low in fine sediments;
- Extensive spawning and overwintering migrations of adult bull trout, which require a large network of suitable freshwater habitat with migratory corridors;
- Use of deep pools by both adults and juveniles for cover and thermal refuge;
- Selection of redd sites by adults in low gradient reaches and in areas of ground water influences (Baxter, University of Montana, pers. comm. 1998).
- Use by both adults and juveniles of areas with reduced water velocity, such as side channels, stream margins, and pools (Watson and Hillman 1997; MBTSG 1998).

Objective

- Maintain and restore floodplain, riparian, and channel processes, including hydrologic regime, sediment inputs and transport, channel configurations, and bank characteristics, to resemble watershed-specific historic or expected conditions to the greatest extent.

Caution Zone

In streams, channel morphology is largely influenced by geomorphic setting and riparian vegetation (Sullivan et al. 1987 cited in Murphy 1995), and by climate (Leopold 1994) such as the frequency of rain and snow. Other factors influencing channel morphology are discharge, sediment load, bank characteristics, and solid structures, such as LWD (large woody debris),

bedrock, and boulders (Murphy 1995). The upstream head of steep channels and other steep hill slope areas are common initiation sites of debris slides and debris flows (Dietrich and Dunne 1978). Headwater riparian areas need to be protected so that adequate materials contributing to complex habitat downstream would be available when debris slides and flows occur (USDA et al. 1993).

Because the natural processes (erosion, fire, flood, mass wasting, wind, avalanches) in a watershed produce the components that maintain complex aquatic habitat, the whole watershed may be the caution zone. At the very least, the caution zone is 100-year floodplain, plus 150 feet, plus all unstable or potentially unstable slopes. This applies to all streams, fish bearing, non-fish bearing, and intermittent in bull trout watersheds.

CONNECTIVITY

Problem Assessment

The Service's bull trout listing team identified 141 isolated bull trout subpopulations in the Columbia River distinct population segment (DPS) and 7 subpopulations in the Klamath River DPS (Service 1998). Overall, there is a lack of connectivity among subpopulations. Isolating mechanisms that have resulted in the loss of migratory (anadromous, adfluvial, and fluvial) bull trout (Rieman and McIntyre 1993) include, physical passage blockages at mainstem impoundments that have isolated whole subbasins (Brown 1992; Rieman and McIntyre 1995; Pratt and Huston 1993), water diversions removing spawners access to formerly suitable habitat, and thermal passage barriers at both tributary and mainstem scales.

Currently, fish passage research, management, and facility modification efforts at mainstem projects are focused on salmon and steelhead. Most projects provide upstream adult passage facilities (designed to pass steelhead and salmon), but the development of downstream passage of migrating steelhead kelts (or adult bull trout) have not been developed, and efficiency of passing these individuals through juvenile passage facilities or via spill has not been thoroughly examined (NMFS 1998). Other natural and artificial barriers may prevent upstream or downstream movement of juveniles or adults at some locations or at certain times of the year. Intervening areas of poor habitat quality may also limit dispersal of resident forms. Conversely, some man-made barriers may have unintentionally benefitted bull trout by preventing invasion of non-native species such as introduced brook trout or lake trout. Habitat fragmentation and the subsequent isolation of bull trout subpopulations is a key factor in the current threatened status of bull trout in the Klamath River and Columbia River basins (Lee et al. 1997; Rieman et al. 1997). Historically current bull trout subpopulations were well connected throughout the basins (Lee et al. 1997). Many bull trout subpopulations are currently confined to smaller headwater streams that have been minimally affected by human caused habitat alterations. First and second-order streams in steep headwaters tend to be hydrologically and geomorphologically more unstable than larger, low gradient streams (Spence et al. 1996).

Small, isolated subpopulations are more likely than larger subpopulations to go extinct over long time scales due to stochastic events (e.g. landslides, catastrophic fires, and floods). Further isolation of subpopulations in shrinking habitat will probably lead to increasing rates of extirpation not proportional to the simple loss of habitat area (Lee et al. 1997). Even with no further habitat loss, extirpation may be likely for many remaining isolated subpopulations (Lee et al. 1997; Rieman et al. 1997). As subpopulations become fragmented and isolated, local extinctions become permanent, making the extirpation of other subpopulations more likely (Rieman and McIntyre 1993). Meffe et al. (1994) caution against managing for unnaturally small populations, and urge that gene flow among historically connected populations should continue at historical rates.

Irrigation diversions, culverts, and degraded mainstem habitats have eliminated or seriously depressed migratory bull trout, effectively isolating resident subpopulations in headwater tributaries (Brown 1992; Ratliff and Howell 1992; Rieman and McIntyre 1993; Thurow et al.

1997). Loss of suitable habitat through watershed disturbance may also increase the distance between suitable or refuge habitats and strong subpopulations, thus reducing the likelihood of effective dispersal (Frissell et al. 1993).

Biological Needs

Bull trout are a wide-ranging species with different habitat requirements at specific life history stages (MBTSG 1998). Migratory corridors provide the necessary connection between bull trout spawning, juvenile rearing, sub-adult rearing, adult over-wintering and foraging areas (Rieman and McIntyre 1993). Disruption of migratory corridors can increase stress, reduce growth and survival, and potentially lead to the loss of the migratory life-history types (Rieman and McIntyre 1993). In general, it is necessary to provide bull trout access to a large, connected, high quality, freshwater habitat that includes cool temperature, deep pools, large wood, low substrate embeddedness, unimpaired flow regime and channel floodplain interactions).

Movement is also believed to be important to the persistence and interaction of local populations within the larger subpopulations (Rieman and McIntyre 1993). Furthermore, within the Columbia River basin, bull trout persistence will require improved connectivity among the 141 subpopulations that are not historically isolated by natural barriers or that are not currently at risk of invasion by non-native species. Enhanced connectivity for migratory life forms within bull trout subpopulations is needed to encourage population refounding and to allow gene transfer at historical rates.

Objectives

- Protect current bull trout refugia. Avoid activities or their negative effects that would further fragment habitat, reduce habitat patch size, or further isolate remaining bull trout subpopulations.

- Maintain or improve connectivity among occupied habitats and refugia by removing human-caused physical, thermal, and chemical barriers within and among isolated subpopulations in areas not at risk of invasion by non-native species (e.g., introduced brook trout, lake trout).

- Improve connectivity among occupied habitatsand refugia by providing for passage of both upstream and downstream bull trout migrants at mainstem hydroelectric and flood control projects.

- Restore occupiable habitat, particularly in low gradient unconstrained channels that often serve as migratory corridors or seasonal habitats for specific life-history stages of bull trout. Historically, alluvial floodplain reaches were highly productive for salmonids, and bull trout occur significantly more often in streams of alluviated lowlands and valleys than in other areas.

Caution Zone

The area of concern for improved connectivity is the watershed, basin, or largest hydrologic unit that matches bull trout distribution within a distinct population segment (DPS) or historical subpopulation. Further research into interactions among bull trout subpopulations may help refine the appropriate scale for understanding connectivity issues.

SUBSTRATE COMPOSITION AND STABILITY

Problem Assessment

Bull trout show strong affinity for stream bottoms and a preference for deep pools of cold water streams, lakes and reservoirs (Goetz 1989). Because of this strong association with the stream bottom throughout their life history, they can be adversely affected by human activities that directly or indirectly change substrate composition and stability.

Sedimentation reduces pool depth, alters substrate composition, reduces interstitial space, and causes channels to braid (Rieman and McIntyre 1993 citing others). For example, in National Forests within the range of the northern spotted owl in western and eastern Washington, there has been a 58 percent reduction in large, deep pools as a result of sedimentation and loss of pool-forming structures such as boulders and large wood (USDA et al. 1993). In the Oregon and Washington portions of the Columbia Basin outside the range of the northern spotted owl, preliminary results indicate that the frequency of large pools within managed watersheds have decreased by 28 percent over the past 50 years (McIntosh et al. 1994). Sedimentation from extensive and intensive land use activities (timber harvest, road building, livestock grazing, agriculture, and urbanization) is recognized as a primary cause of habitat degradation in the range of west coast steelhead and west coast chinook salmon (NMFS proposed rules: 62 FR 43937, 63 FR 11798, and 63 FR 11482). Impoundments and diversions have altered natural sediment transport processes, causing deposition of fine sediments in slackwater areas, reducing flushing of sediments through moderation of extreme flows, and decreasing recruitment of coarse material (including spawning gravels) downstream of the obstruction (Spence et al. 1996).

According to Rieman and McIntyre (1993) "some substrates are more likely to accumulate fine sediments than others, and some bull trout populations probably are more sensitive than others. In the absence of detailed local information on population and habitat dynamics, any increase in the proportion of fines in substrates should be considered a risk to productivity of an environment and to the persistence of associated bull trout populations."

Biological Needs

For spawning, bull trout prefer loose, clean, gravel (McPhail and Murrey 1979; Fraley and Shepard 1989). Spawning occurs primarily in gravels and cobbles (Baxter and McPhail 1996). Due to bull trout's extended residency in the gravel (220+ days from egg deposition to emergence), eggs, alevins, and fry are highly vulnerable to bedload movements and deposition of fine sediments. Because juvenile bull trout are closely associated with the stream substrate, they are also sensitive to bedload movements. Unembedded substrate is an important cover element for juvenile bull trout, especially in areas lacking other forms of cover (Goetz 1989; Pratt 1992; Baxter and McPhail 1996; Thurow 1997). Juvenile bull trout densities decrease with increasing embeddedness of substrate (Enk 1985; Shepard et al. 1984; Pratt 1992).

Objectives

- Maintain and restore the sediment regime under which aquatic ecosystems evolved.
- No increase of sediment delivery from management activities to stream channels in sensitive reaches (spawning and rearing areas, less than 3% gradient) including no measurable increase in percent inter-gravel fine sediment in spawning areas.
- Where land management induced sediment delivery is occurring, achieve a net decrease in sediment delivery.
- No measurable detrimental change in channel stability (MBTSG 1998).
- No measurable loss of pocket water and pools.

Caution Zone

Because coarse and fine substrate may come from any part of the watershed, and its delivery is influenced by basin hydrology, the entire watershed is the caution zone.

ROADS

Problem Assessment

Roads are a prevalent feature on managed forested and rangeland landscapes, and can have numerous negative impacts to bull trout. The aquatic assessment portion of the Interior Columbia Basin Ecosystem Management Project (ICBEMP) provides a detailed analysis of the relationship between road densities and bull trout status and distribution (Quigley et al. 1997). The following problem assessment draws on information contained in that report. Bull trout are less likely to use streams in highly roaded areas.for spawning and rearing, and where found in highly roaded areas are less likely to be at strong population levels. Bull trout strongholds in the Interior Columbia River Basin showed a very strong (P=0.0001) negative correlation with road densities. The average road density in bull trout strongholds was 0.45 miles/square mile, which is considerably less than the standard of 2 - 3 miles/square mile reported as adequate for populations of other, anadromous salmonids. Bull trout populations classified as "depressed" had an average watershed road density of 1.4 miles/square mile and bull trout typically were absent at an average road density of 1.7 miles/square mile. Although some variability in these patterns was apparent (correlation coefficients were not reported) the association was strong, suggesting that bull trout are exceptionally sensitive to the direct, indirect or cumulative effects of roads.

Quigley et al. (1997) state that,

> "the effects associated with roads reach beyond their direct contribution to disruption of hydrologic function and increased sediment delivery to streams. Roads provide access, and the activities which accompany access magnify the negative effects on aquatic systems beyond those due solely to roads themselves. Activities associated with roads include, but are not limited to, fishing, recreation, timber harvest, livestock grazing, and agriculture. Roads also provide avenues for stocking non-native fishes. Unfortunately, we do not have adequate broad-scale information on many of these attendant effects to identify their component contributions accurately. Thus we are forced to use roads as a catch-all indicator of human disturbance."

Biological Needs

Bull trout need streams and lakes that are cold, clean, complex and connected (MBTSG 1998). Roads have the potential to adversely affect all of the habitat components discussed in this Guidance : water temperature, substrate composition and stability, habitat complexity, and connectivity. Roads may also isolate streams from riparian areas, causing a loss in floodplain and riparian function. Furniss et al. (1991) state that:

> "Roads may have unavoidable harmful effects on streams, no matter how well they are located, designed or maintained...Roads modify natural hillslope networks and accelerate erosion processes. These changes can alter physical processes in streams, leading to changes in stream flow regimes, sediment transport and storage, channel bank and bed configurations, substrate composition, and stability of slopes adjacent to streams. These changes can have significant biological consequences that affect virtually all components

of stream ecosystems."

Increased sediment transport to streams is one of the most frequently cited effects of roads (Gibbons and Salo 1973; Reid and Dunne 1984; Everest et al. 1987; Swanston 1991). Increased levels of sedimentation often have adverse effects on fish habitats and riparian ecosystems, and fine sediment deposited in spawning gravels of bull trout can reduce survival of eggs and developing alevins (Weaver and White, 1985; Weaver and Fraley 1991; Cross and Everest 1995). Important habitat components for juvenile bull trout such as benthic invertebrate abundance, food availability, interstitial spaces in the substrate, and pools may be reduced or lost due to increased levels of sediment (Megahan et al. 1980; Shepard et al. 1984; Everest et al. 1987; USDA and USDI 1993).

Various effects of roads may combine to alter the hydrologic response to characteristics of streams. Roads and roadside ditches may substantially increase the stream drainage network. Roads also intercept groundwater and significantly compact forest soils, resulting in increased surface runoff. Any of these changes may contribute to increased stream peak flows. During normal high flow events, the added stream power may help mobilize coarse bedload (boulders, cobble, gravel). Depending on magnitude and timing, this has the potential to cause physical displacement and direct morality of bull trout eggs and juveniles.

Bull trout are highly vulnerable to extinction when they exist as small, isolated subpopulations above man-made barriers. Widespread degradation of bull trout habitats resulting from direct and indirect effects of roads provide barriers to bull trout movement. Barriers to movement can result in fragmentation and isolation, resulting in subpopulations being more vulnerable to all other stressors. Other stressors include hybridization with brook trout, angling and poaching, as well as degradation of spawning and rearing habitats (MBTSG 1998).

Objectives

- Manage or reduce negative road effects to habitat in bull trout watersheds by repairing and relocating roads and by decreasing current road densities.

- Restore floodplain and habitat connectivity by removing physical barriers to migration caused by roads, culverts, fords and crossings, and maintain or restore hydrologic processes and floodplain functions. However, in specific cases where barriers block non-native species access to bull trout habitat, retaining the barrier may be more desirable than removing it.

- Implement integrated road management strategies across public and private lands for bull trout.

- Control road access, avoid road placement, and prioritize road removal to eliminate access for non-native species introductions in areas of high native species integrity.

- Control road access, avoid road placement, and prioritize road removal to eliminate access for poaching in bull trout staging and spawning areas.

- Avoid road placement and prioritize road removal to eliminate impacts that increase peak flows and physical disturbance causing mortality of eggs that may be in the gravel or displacement of juveniles using the substrate for cover.

Caution Zone

Because impacts from roads in both upland and riparian forests potentially affect bull trout habitat, the entire watershed is the caution zone. Although findings from ICBEMP have not been analyzed for watersheds west of the Cascades (i.e. where the Northwest Forest Plan applies), it is very likely that these patterns will apply equally to those steeper, wetter coastal forests.

FLOODPLAIN AND RIPARIAN PROTECTION

Problem Assessment

Both east and west of the Cascades, current riparian vegetation patterns are fragmented and early seral vegetation has frequently replaced mature riparian forests. For example, basinwide analysis of the Interior Columbia Basin indicates that riparian tree composition and age and size class have changed largely as a result of land management activities, while riparian stand density has increased (USDA and USDI 1997). In many areas, including eastern Washington, fire control in addition to other land management practices has contributed to shifts in species composition away from native, shade intolerant species (e.g., ponderosa pine) towards higher stand densities of native and non-native shade tolerant species (Bolsinger et al. 1997).

Similarly, riparian habitat conditions on federal lands within the range of the northern spotted owl have been degraded by road construction and land management activities (USDA and USDI 1993). This has resulted in many riparian areas being currently dominated by red alder or bigleaf maple and containing fewer conifers than the historic condition (USDA et al. 1993). These changes in species composition and size of riparian conifers can affect the amount of shading provided to streams and the potential large woody debris component needed to maintain channel complexity, as well as other riparian and floodplain functions.

Biological Needs

Floodplain and riparian forest functions important to bull trout include: storing and slowing floodwaters; absorbing pollutants from runoff; reducing sediment delivery to streams; providing a forage base to fish and habitat to some aquatic invertebrates; maintaining habitat and channel complexity; supplying shade, nutrients, and large woody debris; providing hydrologic connectivity for seeps, springs, and groundwater upwellings; and providing connectivity to off-channel habitats.

Caution Zone

Each specific riparian function primarily operates within an area of variable size relative to the stream channel. For example, the USDA et al. (1993) and Montana Bull Trout Scientific Group (1998) identified the following functions of riparian zones and widths of riparian area associated with maintaining each function:

- Root strength and bank stability: Root systems are important in providing slope stability, maintaining bank integrity, reducing erosion and sediment delivery rates, providing cover (undercut banks and deep pools). Caution zone for root strength is approximately 30 feet or ½ crown diameter beyond the 100-year floodplain.

- Large wood delivery to streams: Large woody debris helps form pools, regulate sediments, disperse stream energy, create channel complexity, stabilizes channels, and provides a major component of instream organic matter (Bisson et al. 1987; Bilby and

Ward 1989; Pearsons et al. 1992). Caution zone for this function is the 100-year floodplain plus one site-potential tree height distance.

- Stream shade and temperature: Canopy cover provided by riparian vegetation is an important factor influencing stream water temperatures. Buffer widths of approximately one site potential tree height correlate well with shade provided for maintenance of water temperatures. The caution zone is the 100-year floodplain plus one site potential tree height. If there are springs, seeps, or wetlands present immediately outside of this caution zone, the width of the caution zone would be expanded to include these features, which provide important sources of cool water to streams.

- Microclimate: Brosofske et al. (1997) and USDA et al. (1993) indicate that stream buffers may need to be wider for maintaining microclimate than for other riparian functions. The appropriate zone of concern for small streams (1st - 4th order) that are temperature sensitive, have discontinuous or inadequate riparian vegetation along much of their length, and are already listed under section 303 (d) of the Clean Water Act due to thermal impairment, may be the 100-year floodplain plus two site potential tree height distances (apprx 300'). However, the contribution of microclimate to stream temperature is an area needing further research.

- Nutrients: Leaf and organic litter inputs may originate from varying distances from streams, depending on numerous site-specific conditions. However, most litter inputs to streams decline at distances greater than approximately one-half of a site potential tree height (USDA et al. 1993; Erman et al. 1977)

Objectives

- Conduct activities that allow for and enhance the various functions of riparian areas and that consider the various caution zones above.

- Modify or avoid land management activities that do not promote the full array and expression of riparian functions over time (e.g., shade, LWD, litter inputs, root strength and bank stability, microclimate, etc.).

- Avoid concentrating known or potentially harmful activities (e.g., livestock grazing, timber harvest and salvage, gravel mining, motorized travel, recreational development) in riparian areas.

- Use appropriate measurements, and common sense, when describing and delineating riparian areas and their functional zones of influence.

Appendix 6.

Interagency memorandum (dated June 19, 1998) to amend the biological assessment for the PACFISH/INFISH LRMP Section 7 consultation on bull trout.

United States Department of Agriculture | Forest Service | R-1, 4, 6 | OR/WA/ID/MT | Bureau of Land Management | United States Department of Interior

Reply Refer to: 2670 (FS)/6840 (BLM)

Date: June 19, 1998

Subject: Additional Information for the PACFISH/INFISH LRMP Section 7 Consultation

To: Mr. Michael Spear, Regional Director
USDI Fish and Wildlife Service
911 N.E. 11th Ave.
Portland, Oregon 97232-4181

The USDA Forest Service (FS) and USDI Bureau of Land Management (BLM) cooperatively developed and adopted interim aquatic conservation strategies (PACFISH and INFISH) to ensure our actions conserve aquatic resources and to avoid federal listing of fish species under the Endangered Species Act. These strategies provide interim protection of fish habitat and riparian areas until a long-term management strategy is adopted as part of the Interior Columbia Basin Ecosystem Management Project. In the decisions to adopt the interim strategies, the FS and BLM stated the short-term duration (approximately 18 months) of the strategies would likely affect the implementation of several components of the strategies. It was anticipated that some provisions would be initiated but would be unlikely to be completed during the interim period. Due to the extended duration of the interim strategies, the FS, BLM, and FWS representatives discussed and agreed to measures to fully implement all components of the strategies.

On June 16, 1998, representatives from the USDI Fish and Wildlife Service (FWS), BLM and FS met to discuss the biological assessment of the continued implementation of FS Land and Resource Management Plans (LRMPs) and BLM Resource Management Plans (RMPs) in the Columbia River, Klamath River, Lost River, and Warner Lakes basins on listed fish species and critical habitat proposed for listing under the Endangered Species Act. The biological assessment of the LRMPs and RMPs within these river basins was split into 2 assessment areas, the Northwest Forest Plan and PACFISH/INFISH. The meeting discussions and this letter focus only on the management plans within the PACFISH/INFISH area.

By way of this letter, we are adopting the enclosed commitments in implementing the PACFISH and INFISH aquatic habitat conservation strategies to ensure the FS and BLM management plans and associated actions conserve the federally listed bull trout and sucker species addressed in the INFISH/PACFISH LRMP biological assessment. Please amend the description of the INFISH and PACFISH LRMP ongoing actions in the biological assessment to include these agreed upon commitments. To implement these commitments, the FS, BLM and FWS, as well as the NMFS if they concur will work collaboratively and combine management direction within PACFISH and INFISH and the biological opinions for INFISH and PACFISH as needed to add efficiency and reduce duplication in the management of resident and anadromous habitat resources covered by those management strategies and biological opinions. The FS is willing to take the lead in coordinating a meeting to start this collaborative process.

ROBERT W. WILLIAMS
Regional Forester
(for Regions 1, 4 and 6)

ELAINE Y. ZIELINSKI
State Director
(for Montana, Idaho and Oregon/Washington)

Enclosure

The following are the commitments that the Forest Service and Bureau of Land Management will apply to INFISH/PACFISH LRMPs within the range of listed bull trout and suckers:

1. Restoration and improvement: The FS and the BLM, in cooperation with the NMFS and the FWS, will develop and implement strategies that will integrate and coordinate restoration, protection and evaluation measures (construction/maintenance, flood repair, watershed, and fish habitat improvements, etc.) to expeditiously achieve restoration objectives at multiple scales (DPS , metapopulation watershed). Restoration opportunities will be identified through an agreed upon approach using existing funding, information and programs, and incorporating new information as it becomes available. Initial strategy development will be completed by March 1, 1999.

2. Standard and guidelines: The FS and BLM will complete prior commitments in the PACFISH and INFISH decisions, and use the conclusions in the PACFISH/INFISH reviews and the land management plan Biological Assessment for bull trout and suckers.

Prior commitments to be emphasized are:

a. Road evaluation and Planning (PACFISH and INFISH standards RF-2 and RF-3). Implementation of these existing standards in PACFISH/INFISH is necessary to understand and begin reducing impacts from roads on streams with habitat for ESA listed and proposed fish. Achievement of PACFISH/ INFISH RF-2 and RF-3 will be a priority.

i) Using existing information and road definitions, the FWS will be provided with road inventories on the management units in the three bull trout DPSs within 120 days of BO signature.. This information should include a description of road definitions and survey methodology used. Information gaps will be identified and a schedule will be developed to provide information to the FWS within 2 years.

ii) As part of watershed analyses, road inventories, and other appropriate information will be used to collaborate with NMFS and FWS in developing restoration strategies. Restoration strategies will be used to identify key processes needing attention, prioritize key locations and project types, address implementation and scheduling issues and provide a preliminary estimate of costs. These strategies will serve as the primary framework for implementation of integrated restoration activities.

iii) Continue updating the road inventories. Incorporate new information consistent with 2.a.i. (above).

b. To complete the commitments made in the aquatic strategies for culvert replacement, fish passage, grazing facilities in RHCAs, recreation facilities, and minerals management the implementation of these existing standards in PACFISH/INFISH are necessary to understand and begin reducing impacts from these management activities on streams with habitat for ESA listed and proposed fish. Achievement of PACFISH/ INFISH RF-4 and RF-5, GM-2, RM-1, and MM-2 will be a priority.

3. Key and priority watershed networks: reexamine the structure and function of INFISH priority and PACFISH key watershed networks to ensure the protection and recovery of bull trout and listed sucker metapopulations.

a. Identify and clarify the primary functions of key, priority, and special emphasis watershed.

b. Identify special emphasis watersheds (within 60 days of BO signing) to ensure a comprehensive refugia network for the protection and recovery of bull trout and listed suckers.

c. Completing watershed analysis in existing INFISH priority watersheds, and special emphasis watersheds as identified in 3b above, is a priority (required in PACFISH and INFISH standards, TM-1, RF-2, RM-1). Project decisions will be guided by the results of watershed analysis.

d. Priorities and schedules for watershed analysis will be developed concurrently with #1 (above) and updated annually.

4. Watershed analysis: Watershed analysis will be conducted according to "Ecosystem Analysis at the Watershed Scale", Field Guide for Watershed Analysis, 1995, as updated. In general watershed analysis will not be project-driven but undertaken to generate an information base and recommendations for use in project planning.

5. Monitoring: To improve monitoring efforts, to make the level of monitoring commensurate with the level of on-the-ground activities, and to provide feedback on the effects of activities, the FS and BLM will develop a mechanism for improved monitoring accountability and oversight. Interagency collaboration in the development of this mechanism is necessary to ensure a common understanding of expectations.

a. Consider NMFS' expectations for monitoring in the 1995 LRMP Opinion (section IX.I. and Appendix A-10), when updating the PACFISH monitoring strategy.

b. Activate the PACFISH interagency effectiveness monitoring subgroup including areas covered by INFISH, (within 120 days of signature) to develop a monitoring strategy including a range of monitoring alternatives commensurate with anticipated land management activity levels, funding, and staffing levels.

c. Incorporate INFISH areas into PACFISH implementation monitoring efforts.

d. Improve the current implementation monitoring process by expanding regional/state level USFS/BLM line officer involvement in PACFISH/INFISH implementation oversight and review.

6. Long-term Conservation and Recovery: FS and BLM will use their authorities in carrying out programs for the conservation of endangered and threatened species as consistent with Section 7.a(1) of ESA.

a. Using PACFISH, INFISH, watershed analysis and other information, develop a conservation approach to protect and restore existing high quality habitats and the connectivity between them. The FS and BLM will review existing roadless and low density areas (as defined in ICBEMP science assessment team) to assess their importance to listed species habitat.

b. As a foundation for the development of a long-term conservation and recovery strategy, the FS and BLM will develop a mechanism for improved accountability and oversight to ensure PACFISH and INFISH direction is fully implemented. Interagency collaboration in the development of this mechanism is necessary to ensure a common understanding of expectations.

1. Provide a mechanism, (within 120 days of signature), that ensures full implementation of programmatic aquatic conservation measures at all organizational levels for the bull trout and sucker species addressed in the BA "Effects to Bull Trout, short nose sucker, Lost River sucker, and Warner sucker of Land and Resource Management plans, and associated federal actions on National Forests and Bureau of Land Management Resource Areas in the Columbia River, Klamath River, and Jarbidge River Basins. June 15, 1998".

2. Provide a strategy which will be used if funding or priorities prevent full implementation of the aquatic conservation measures. Annually, upon receipt of the initial budget, review the fiscal year priorities and program of work for attainment of fish conservation measures. Identify highest priority work for available funds and identify and document significant shortfalls in funding or staffing.

7. The FS and BLM, in coordination with the FWS, will complete section 7 consultation at the watershed level by May 1999. The watershed consultation will follow the approach agreed to in the January 27, 1998 letter of direction on bull trout conferencing, with modifications as agreed to by the agencies. After the effective date of the bull trout listing, and until the watershed consultations are completed, all ongoing and proposed actions must conform to INFISH and PACFISH guidelines and these seven commitments.